学生手册 2026–2028

CIE IGCSE Physics 全基础题型

0625 · Core & Extended · 电学与磁学

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[4] 专题 4 电学与磁学

4.1 磁学基本现象

题型 1：按材料性质辨磁体（考频★★★★☆）

知识点 能被磁体吸引并可被磁化的材料称为_____材料；不被磁体吸引的材料称为非磁性材料。未磁化的铁或钢靠近磁体时，会产生_____磁性并受到吸引；移开磁体后，软铁较易失去磁性。软铁易磁化也易退磁，适合制成临时磁体，电磁铁属于临时磁体；钢较难退磁，适合制成_____磁体。需要持久磁性的装置使用永久磁体，指南针、电动机、扬声器和防盗报警器均属其用途。

答案：磁性；感应；永久

怎么认 题目出现材料能否被吸引、磁化后的保持性或装置用途时，先判定磁性材料，再对应临时磁体或永久磁体。

一. 先筛磁性材料与用途

例题 1

(c) State **one** use of a permanent magnet.

（2024 春季 0625/32 第8题(c)）

解：永久磁体能长期保留磁性，电动机可利用其磁场工作。

答：用于电动机。

针对练习

1. Which metal can be attracted by a magnet?

A zinc

B lead

C iron

D copper

（2023 冬季 0625/13 第24题）

2. Fig. 6.1 shows a person using a magnetic window cleaner. The part on the outside of the window is attracted to the inside part through the glass window.

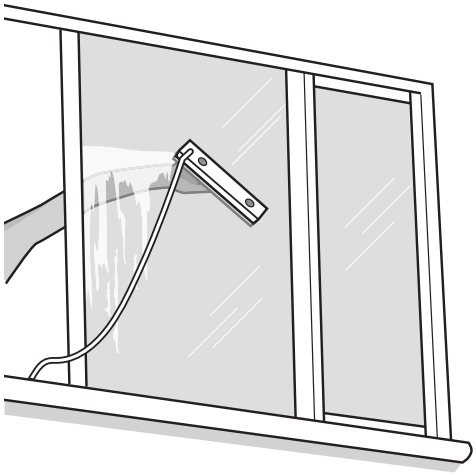


Fig. 6.1

Each part of the window cleaner contains two magnets. Fig. 6.2 shows the magnetic field between the parts of the window cleaner.

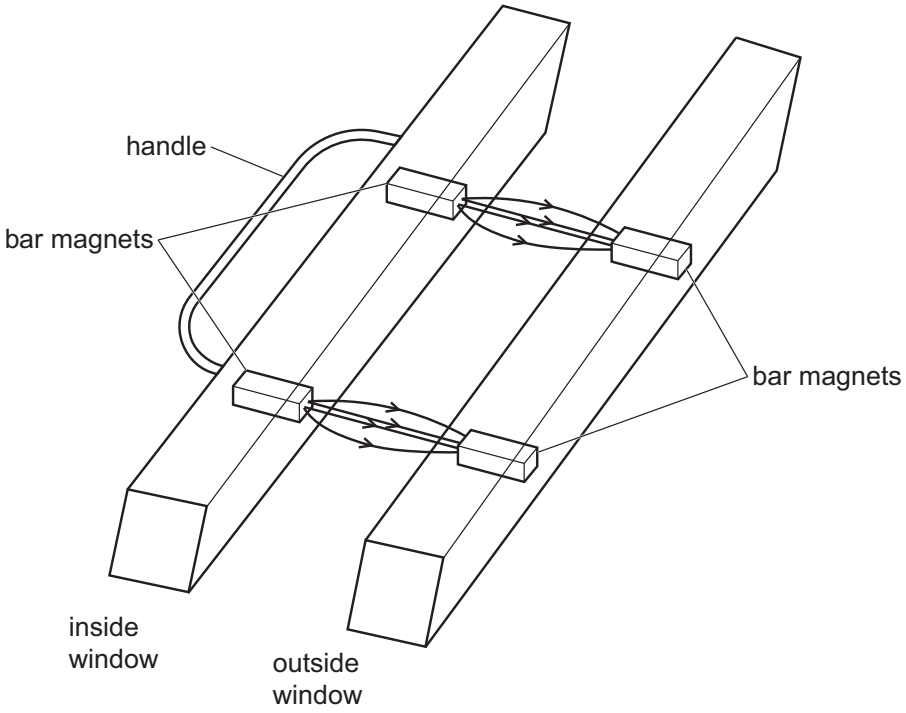


Fig. 6.2

(a) Glass is **not** a magnetic material.

State the difference between magnetic and non-magnetic materials.

（2025 夏季 0625/41 第6題(a)）

3. Which statements about magnets are correct?

1 Permanent magnets are made of steel.

2 Electromagnets are temporary magnets.

3 A magnet can be used to induce magnetism in an iron bar.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2025 冬季 0625/22 第24题）

4. Which statement is **always** true?

A A magnetic material attracts a non-magnetic material.

B A magnetic material repels another magnetic material.

C A magnetic material attracts another magnetic material if one of them is magnetised.

D A non-magnetic material repels another non-magnetic material.

（2024 春季 0625/12 第23题）

二. 软铁做暂时磁体，钢做永久磁体

知识点 软磁性材料容易磁化，也容易退磁，适合制成暂时磁体，常用材料是_____。
硬磁性材料磁化后不容易退磁，能长期保留磁性，适合制成永久磁体，常用材料是_____。
判断材料时，以磁化后是否需要长期保留磁性为条件；这种材料性质不涉及物理量单位。

答案：软铁；钢

怎么认 题目出现永久磁体、暂时磁体或电磁铁铁芯时，先按是否需长期保留磁性选择钢或软铁。

例题 2 **(b)** State the name of a material that is suitable for a permanent magnet.

（2024 春季 0625/32 第8题(b)）

解：永久磁体需要在磁化后长期保留磁性，钢不容易退磁，适合制成永久磁体。
答：钢。

针对练习

5. A hard magnetic material can be used to make a permanent magnet.

A soft magnetic material can be used to make a temporary magnet.

Which row shows whether iron and steel are hard or soft magnetic materials?

	iron	steel
A	hard	hard
B	hard	soft
C	soft	hard
D	soft	soft

（2023 冬季 0625/12 第24题）

6. Fig. 6.1 shows a person using a magnetic window cleaner. The part on the outside of the window is attracted to the inside part through the glass window.

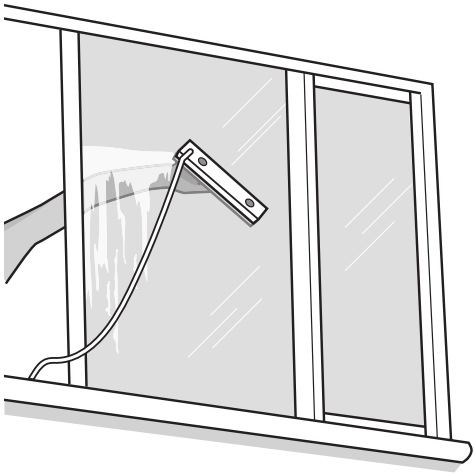


Fig. 6.1

Each part of the window cleaner contains two magnets. Fig. 6.2 shows the magnetic field between the parts of the window cleaner.

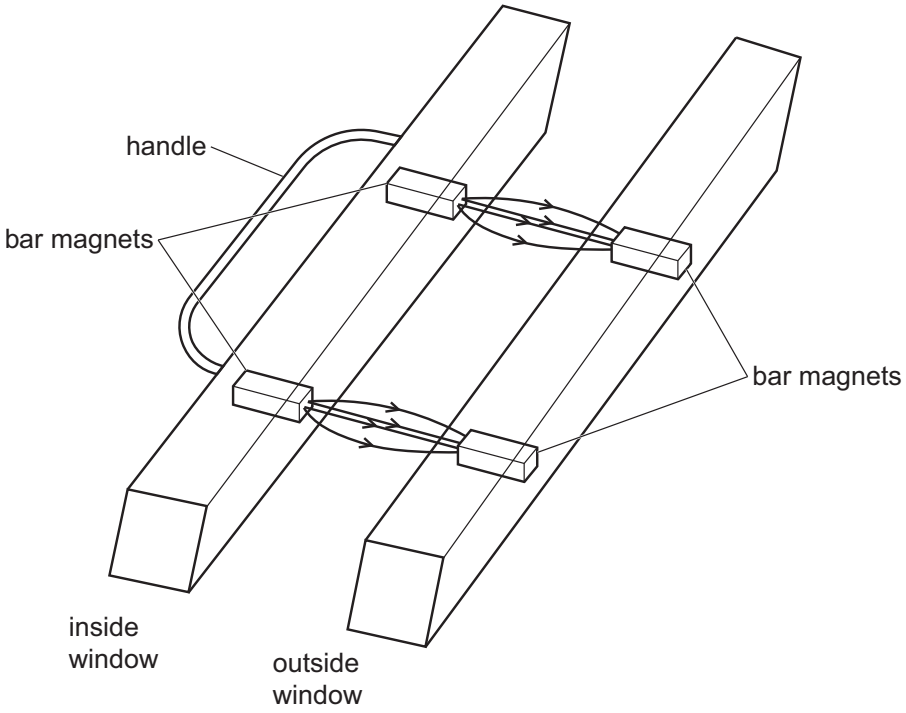


Fig. 6.2

(b) Suggest a suitable material for the magnets in the window cleaner. Explain your answer.

（2025 夏季 0625/41 第6题(b)）

7. Which metal could be used for a permanent magnet and which metal could be used for the core of an electromagnet?

	permanent magnet	core of electromagnet
A	iron	copper
B	iron	steel
C	steel	copper
D	steel	iron

（2023 冬季 0625/11 第24题）

8. **(a)** Fig. 9.1 shows three devices: a compass, a transformer and an electromagnet. The main parts of the devices are labelled.

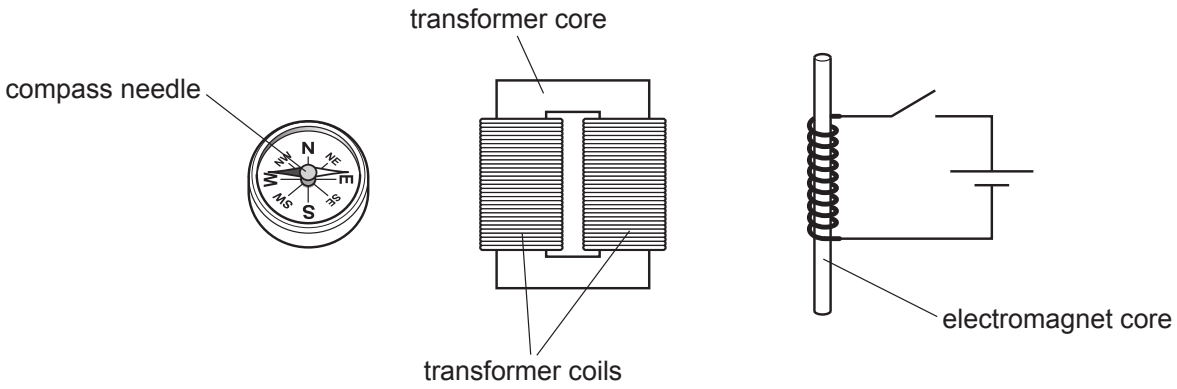


Fig. 9.1

Complete Table 9.1 by adding a suitable metal for each part. Choose from the metals in the list.

Each metal can be used once, more than once or not at all.

aluminium **copper** **soft iron** **silver** **steel**

Table 9.1

part	metal
compass needle	
transformer core	
transformer coils	
electromagnet core	

（2024 夏季 0625/33 第9题(a)）

三. 先把近端标成异名极

知识点 未磁化的磁性材料靠近磁体或与磁体接触时，会获得磁性，这种现象称为_____。

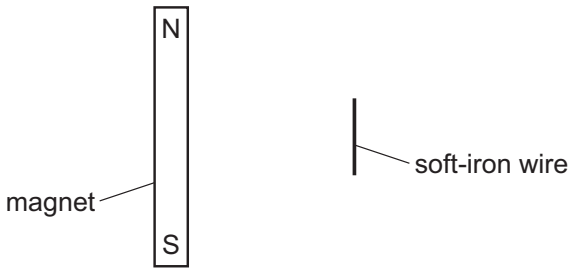
靠近磁体某磁极的一端会感应出_____磁极，异名磁极相互吸引。

软铁容易被磁化，也容易失去磁性；钢被磁化后能_____磁性。

答案：感应磁化；异名；保留

怎么认 题目出现未磁化软铁靠近磁体时，先把近端标成与来极相反的感应磁极。

例题 3 The diagram shows a bar magnet at rest on a smooth horizontal surface. A length of soft-iron wire is held parallel to the magnet.



The wire is released.

What happens?

A The wire moves away from the magnet.

B The wire moves towards the magnet.

C The wire's centre stays in its present position and the wire rotates through 90° in a clockwise direction.

D The wire's centre stays in its present position and the wire rotates through 90° in an anticlockwise direction.

（2023 春季 0625/12 第24题）

解：软铁丝在磁场中发生感应磁化。
磁体 N 极旁的软铁丝上端感应为 S 极，磁体 S 极旁的软铁丝下端感应为 N 极。
软铁丝两端均与磁体相吸，因而向磁体移动。
故选 B。

针对练习

9. A student uses a permanent magnet to lift some unmagnetised nails. Some of the nails are made of iron and some are made of steel. Fig. 7.1 shows the magnet lifting the nails.

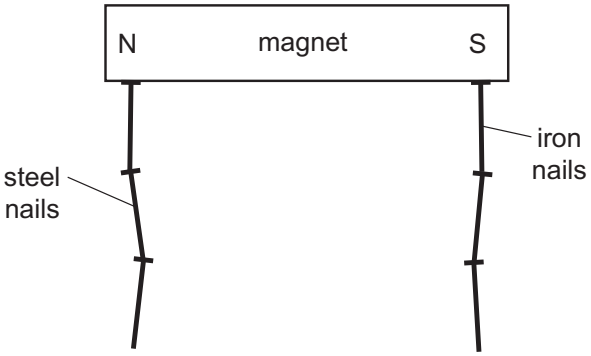


Fig. 7.1

(a) (i) Each nail lifts the nail below it by induced magnetism.

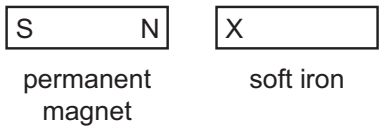
Describe what is meant by induced magnetism.

(ii) The student leaves the nails attached to the magnet for several hours, then removes the magnet.

State a difference between a magnetic property of the iron nails and of the steel nails.

（2023 夏季 0625/32 第7题(a)）

10. An unmagnetised piece of soft iron is placed close to a strong permanent magnet, as shown.



What is the induced polarity of end X of the soft iron and in which direction does the magnetic force act on the soft iron?

	polarity of end X	direction of force on the soft iron
A	N	to the left
B	N	to the right
C	S	to the left
D	S	to the right

（2023 夏季 0625/21 第23题）

题型 2：由吸斥现象判磁极（考频★★☆☆☆）

知识点 条形磁体两端为磁极，分别称 N 极和 S 极；同名磁极相互_____，异名磁极相互_____。

未磁化的铁、钢等磁性材料靠近磁体时会感应磁化，因而受到吸引；吸引不能证明它原来是磁体。

铜等非磁性材料不受磁体吸引；两个物体发生_____时，二者必定都是磁体。

磁力属于力，单位是牛顿，符号为 N。

答案：相斥；相吸；相斥

怎么认 题目出现物体靠近后的吸引或排斥现象时，先找是否相斥，再判定物体是否为磁体及其磁极。

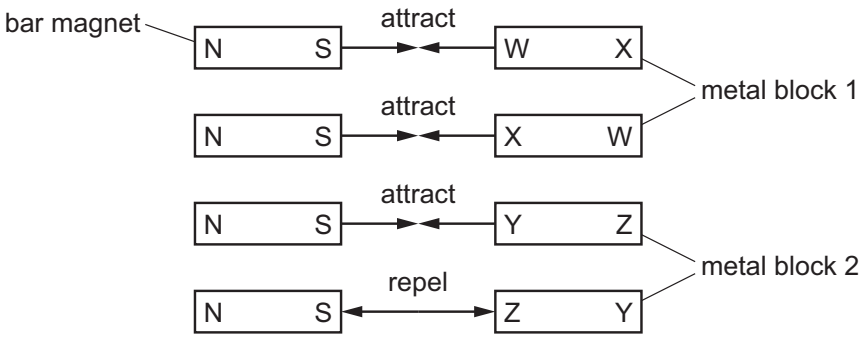
例题 1

A student has a bar magnet and two metal blocks.

The student places the bar magnet next to end W and end X of metal block 1.

The student then places the bar magnet next to end Y and end Z of metal block 2.

The diagram shows which ends of the metal blocks are attracted or repelled by the bar magnet.



Which metal blocks are bar magnets?

A both metal block 1 and metal block 2

B metal block 1 only

C metal block 2 only

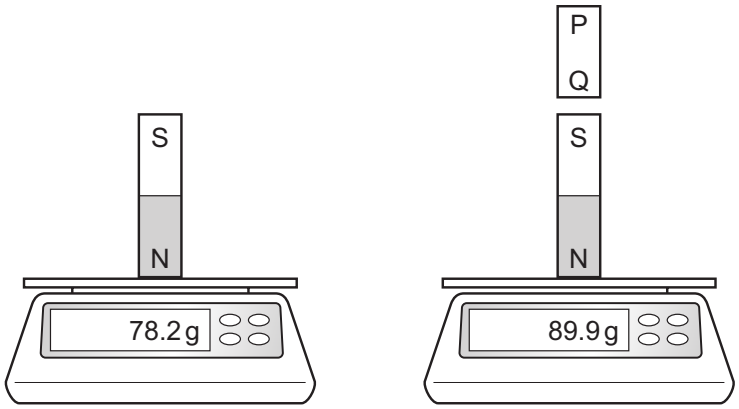
D neither metal block 1 nor metal block 2

（2025 夏季 0625/12 第24题）

解：若金属块 1 为条形磁体，W、X 两端应为异名磁极；已知磁体的 S 极靠近两端时不可能均相吸，故金属块 1 不是条形磁体。
已知磁体的 S 极与金属块 2 的 Z 端相斥，故 Z 端为 S 极，金属块 2 是条形磁体。
所以只有金属块 2 是条形磁体。故选 C。

针对练习

1. The diagram shows what happens when a bar PQ is brought near to a permanent magnet which is standing on a balance.



What could bar PQ be?

A an iron bar or a permanent magnet with P a N pole

B an iron bar or a permanent magnet with Q a N pole

C an iron bar only

D a permanent magnet only

（2024 冬季 0625/12 第24题）

2. **(a)** A student has six metal bars. The bars are all the same size. Four of the bars are magnets, one is a bar of unmagnetised steel and the other is a bar of copper metal.

The student arranges the bars in pairs with a small gap between them as shown in Fig. 7.1.

For each pair of bars in Fig. 7.1, state whether a force acts between the bars.
Choose from these phrases:

attractive force **no force** **repulsive force**

Each phrase may be used once, more than once or not at all.

For each pair of bars, write your answer on the dotted line.

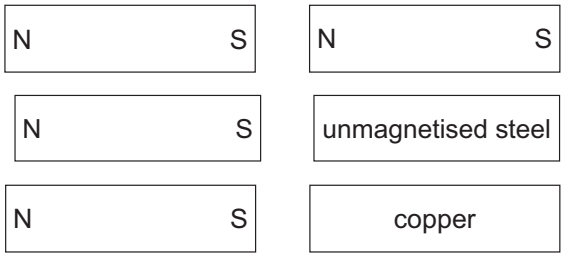


Fig. 7.1

（2025 冬季 0625/31 第7题(a)）

3. **(a)** Fig. 7.1 shows three bars of steel, A, B and C.

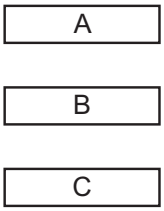


Fig. 7.1

A student is given the three pieces of steel. Two of the pieces are magnetised and one piece is unmagnetised.

Describe and explain how the student determines which piece is unmagnetised using only the three pieces of steel.

（2024 夏季 0625/42 第7题(a)）

4. Diagrams 1, 2 and 3 show an experiment to compare two magnets 1 and 2.

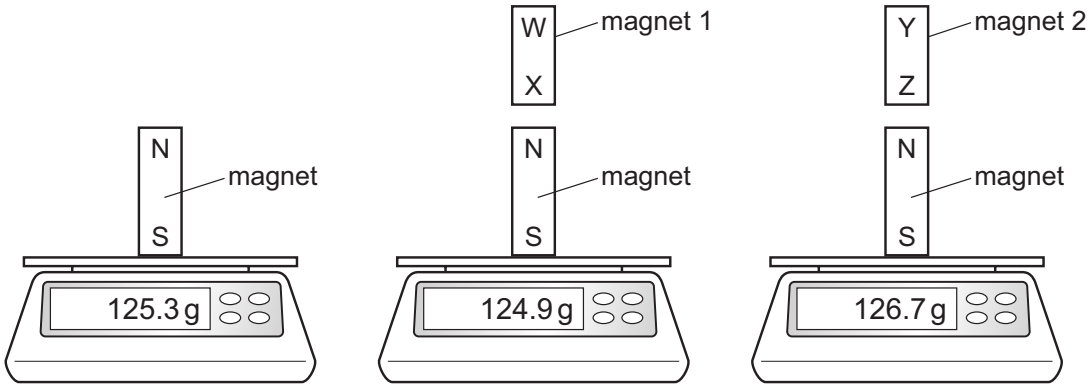


diagram 1　　diagram 2　　diagram 3

Which row explains the readings on the balances?

	polarity of magnet 1	polarity of magnet 2
A	X is an N pole	Z is an N pole
B	X is an N pole	Z is an S pole
C	X is an S pole	Z is an N pole
D	X is an S pole	Z is an S pole

（2024 夏季 0625/13 第25题）

题型 3：用磁场线判方向强弱（考频★★★★☆）

知识点　磁场是磁极会受到力的_____。

某点的磁场方向规定为放在该点的_____极所受力的方向。

磁场线越密，磁场越_____；磁场线越疏，磁场越弱。

答案：区域；N；强

怎么认 题目出现磁场定义、某点场向或场线疏密时，先用 N 极受力判方向，再由疏密判强弱。

一. 用 N 极受力定义场向

例题 1

(a) (i) State what is meant by a magnetic field.

(ii) Define the direction of a magnetic field.

（2023 夏季 0625/42 第8题(a)）

解： 由磁场的定义，磁场是磁极会受到力的区域。
某点的场向按 N 极受力规定，故为放在该点的 N 极所受力的方向。
答：(i) 磁极会受到力的区域；(ii) 放在该点的 N 极所受力的方向。

针对练习

1. **(b)** Describe what is meant by a magnetic field.

（2025 冬季 0625/31 第7题(b)）

2. Which statement about the direction of a magnetic field at a point is correct?

A It is the direction of the force on an N pole placed at that point.

B It is the direction of the force on an S pole placed at that point.

C It is the direction of the force on a positive charge placed at that point.

D It is the direction of the force on a negative charge placed at that point.

（2024 夏季 0625/22 第25题）

3. Which statement describes a magnetic field?

A It is a region where all objects experience a force.

B It is a region where all electric charges experience a force.

C It is a region where all magnetic poles experience a force.

D It is a region where all metals experience a force.

（2025 夏季 0625/11 第29题）

4. Students are asked for a statement about magnetic fields.

Three statements are listed.

1 A magnetic field is described as a region in which a stationary electric charge experiences a force.

2 The direction of a magnetic field at a point is the direction of the force on an S pole at that point.

3 The relative strength of a magnetic field is shown by the spacing of the magnetic field lines.

Which statements are correct for magnetic fields?

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 3 only

（2024 夏季 0625/23 第26题）

二. 沿磁体外部 N 到 S 判方向

知识点 磁场是磁极受到力作用的区域；磁场线表示磁场的方向和分布。

在磁体外部，磁场线由_____极指向_____极，指南针的 N 端沿该点的磁场方向。

磁场线越密处磁场越强，任意两条磁场线不能相交；磁场线本身无单位。

答案：N；S

怎么认 题目出现磁场线箭头、指南针 N 端或磁极判断时，先沿磁体外部 N 极到 S 极定向。

例题 2 Fig. 8.1 shows the magnetic field pattern around two permanent magnets. The magnets are repelling each other.

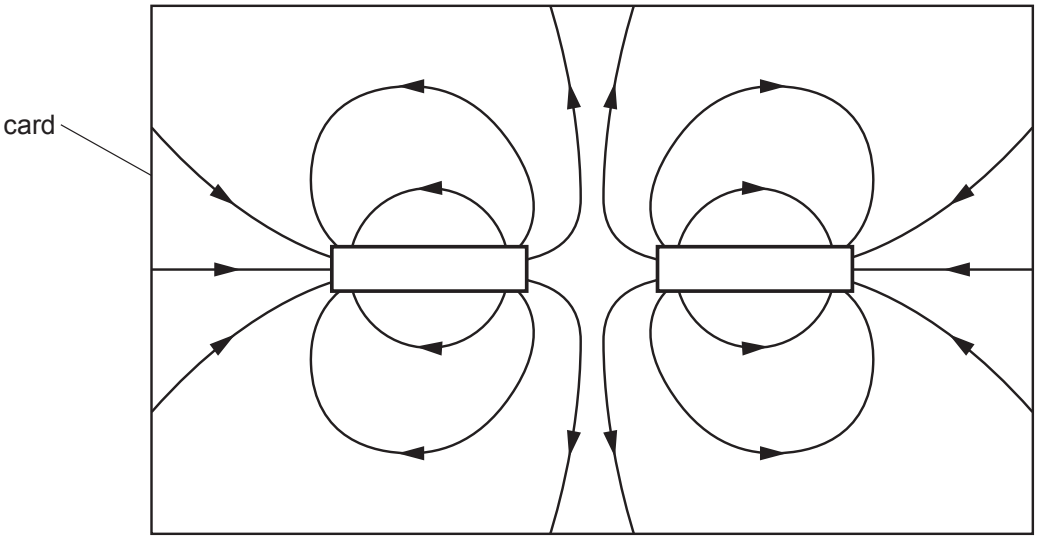


Fig. 8.1

(a) On Fig. 8.1, label both the poles on **each** magnet.

（2023 夏季 0625/31 第8题(a)）

解：磁体外部的磁场线由 N 极指向 S 极。
图中两磁体间的磁场线均从相对端向外延伸，故两相对端均为 N 极，每根磁体的另一端均为 S 极。
答：左磁体从左到右为 S、N；右磁体从左到右为 N、S。

针对练习

5. The magnetic field of a bar magnet can be represented by magnetic field lines.

Which diagram shows two magnetic field lines correctly?

A



B



C

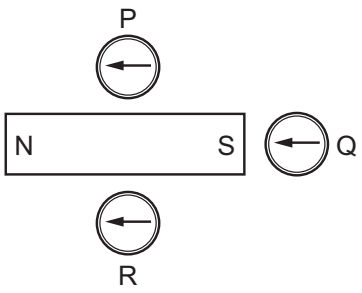


D



（2023 夏季 0625/22 第23题）

6. The diagram shows three small compasses near to a bar magnet.



Which compasses show the direction of the magnetic field due to the bar magnet?

A P and Q **B** P only **C** Q and R **D** Q only

（2024 冬季 0625/13 第24题）

7. **(a)** Fig. 8.1 shows a permanent bar magnet.

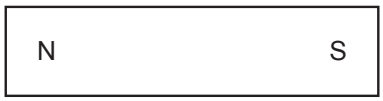


Fig. 8.1

Describe an experiment to identify the **pattern** and **directions** of the magnetic field lines around the bar magnet.
You may draw on Fig. 8.1 as part of your answer.

（2024 春季 0625/32 第8题(a)）

8. A plotting compass is placed close to the pole of a magnet with poles marked X and Y. The N pole of the plotting compass points to pole X, as shown.



Pole Y of the magnet is then placed close to another magnet with poles marked P and Q, as shown. The magnets repel each other.



magnets repel

Which row is correct?

	pole X	pole P
A	N	N
B	N	S
C	S	N
D	S	S

（2025 春季 0625/12 第28题）

三. 先比场线疏密再看叠加

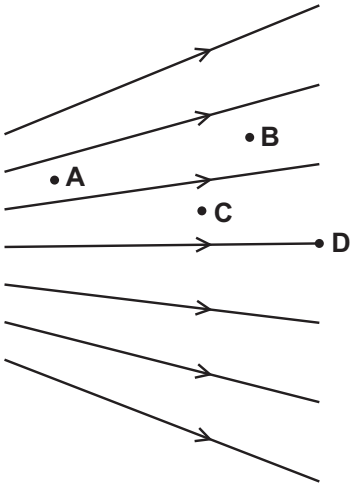
知识点 磁场是磁极受到磁力作用的区域；磁体外部的磁场线由_____极指向_____极。
在同一幅按相同规则绘制的图中，磁场线越密，磁场越强；磁场线越疏，磁场越弱。
同一点的两个磁场方向相同时相互增强，方向相反时相互抵消；大小相等、方向相反时合磁场为零。
磁场强弱可用磁通密度 B 表示，其单位为特斯拉，符号为 _____。

答案：北（N）；南（S）；T

怎么认 题目出现磁场线疏密、箭头或多个磁体叠加时，先比较场线间距，再判断各磁场方向。

例题 3 A magnetic field is represented in the diagram by magnetic field lines.

At which point is the magnetic field strongest?



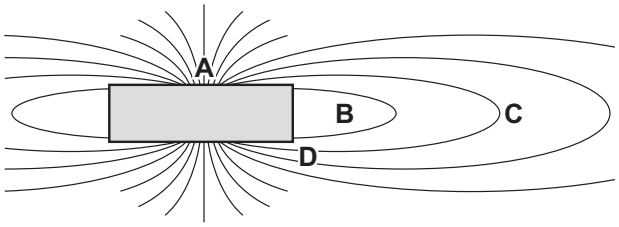
（2024 夏季 0625/21 第25题）

解： 磁场线越密，磁场越强。
图中 A 点附近相邻磁场线的间距最小，故 A 点的磁场最强。
故选 A。

针对练习

9. The diagram shows part of the magnetic field around a strong magnet.

In which position does a magnetic pole experience the strongest force?



（2024 冬季 0625/21 第24题）

10. Fig. 6.1 shows a person using a magnetic window cleaner. The part on the outside of the window is attracted to the inside part through the glass window.

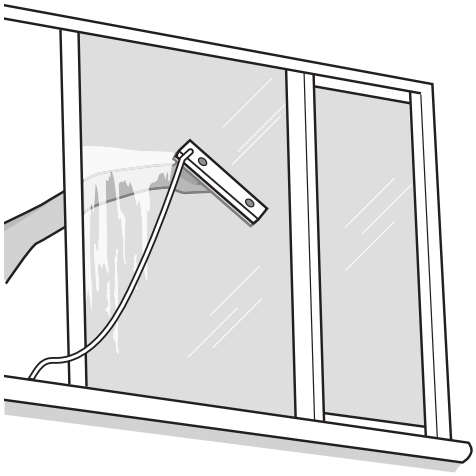


Fig. 6.1

Each part of the window cleaner contains two magnets. Fig. 6.2 shows the magnetic field between the parts of the window cleaner.

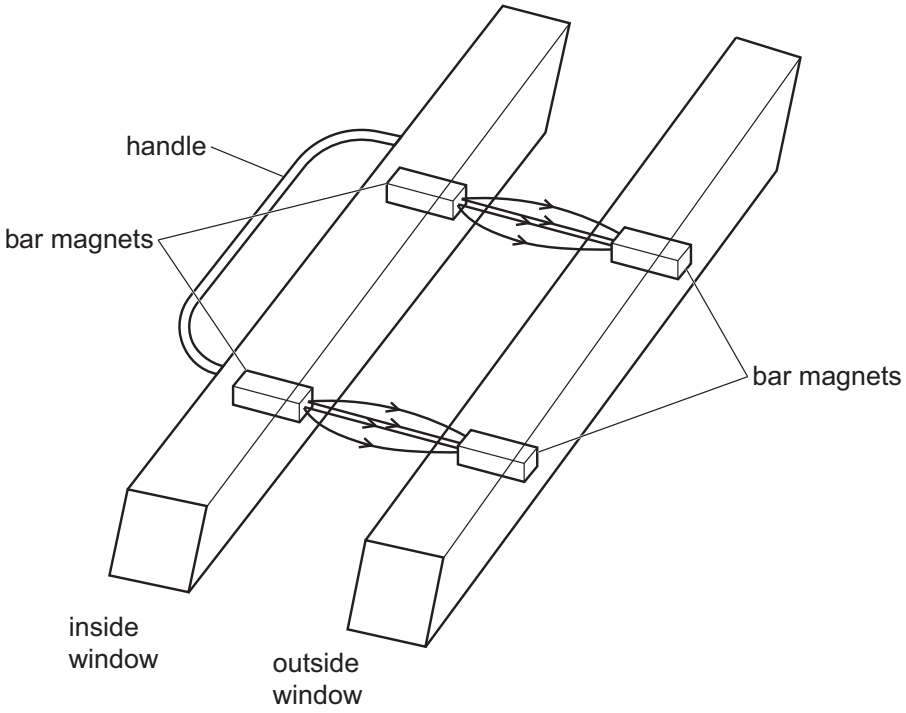


Fig. 6.2

(d) State how the field lines in Fig. 6.2 show different strengths of the magnetic field between the magnets.

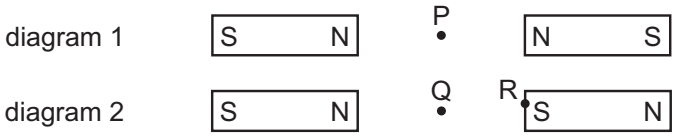
（2025 夏季 0625/41 第6题(d)）

11. Which row describes the magnetic field around a weak magnet?

	direction of field	spacing of field lines
A	north pole to south pole	close together
B	north pole to south pole	far apart
C	south pole to north pole	close together
D	south pole to north pole	far apart

（2025 夏季 0625/23 第24题）

12. The diagrams show two arrangements of a pair of identical bar magnets.



Three points, P, Q and R, are shown.

At which point is the magnetic field due to the magnets weakest and at which point is it strongest?

	weakest magnetic field	strongest magnetic field
A	P	Q
B	P	R
C	Q	P
D	Q	R

（2024 春季 0625/22 第26题）

4.2.1 电荷

题型 1：由摩擦后的电性追电子（考频★★★☆☆）

知识点 固体摩擦起电时，发生转移的是带_____电的电子，正电荷不发生转移。
物体得到电子时带_____电，物体失去电子时带_____电。
电子从失去电子的物体转移到得到电子的物体；同种电荷相斥，异种电荷相吸。

答案：负；负；正

怎么认 题目出现摩擦后物体带正、负电或给出电子转移方向时，先由电性判断电子得失。

一. 由正负电判电子得失

例题 1 **(a)** A student uses a dry cloth to rub a plastic rod.

State how the plastic rod gains a positive charge from friction between the cloth and the rod.

（2023 春季 0625/32 第8题(a)）

解：摩擦起电时，发生转移的是电子。
塑料棒带正电，说明塑料棒失去电子。
答：电子从塑料棒转移到干布。

针对练习

1. **(b)** A piece of plastic is charged positively by friction.

State what charge transfers occur during this process.

（2023 冬季 0625/43 第7题(b)）

2. A student rubs a plastic rod with a cloth.

Electrons move from the cloth to the rod.

Which statement about the rod is correct?

A It is negatively charged and is attracted by a negatively charged object.

B It is negatively charged and is attracted by a positively charged object.

C It is positively charged and is attracted by a negatively charged object.

D It is positively charged and is attracted by a positively charged object.

（2025 冬季 0625/11 第25题）

3. A student rubs a plastic rod with a cloth.

The rod becomes electrically charged and is attracted by a negatively charged object.

Which statement about the rod is correct?

A It is negatively charged because it has gained electrons.

B It is negatively charged because it has lost electrons.

C It is positively charged because it has gained electrons.

D It is positively charged because it has lost electrons.

（2024 夏季 0625/23 第27题）

4. **(b)** A plastic rod is rubbed with a cloth. The plastic rod becomes negatively charged and the cloth becomes positively charged.

(i) Explain why.

(ii) The negatively charged plastic rod is suspended by an insulating thread. Another negatively charged plastic rod is brought close to the suspended rod.

State what happens to the suspended plastic rod.

（2025 夏季 0625/42 第7题(b)）

二. 手持摩擦棒先排除导体

知识点 导体中有能在材料内移动的_____，绝缘体中没有能自由移动的电子。

固体因摩擦而带电时，发生转移的是_____；得到电子的物体带负电，失去电子的物体带正电。

手持材料摩擦时，导体中的电子可经人体移动，绝缘体上的电荷则能保留下来。

答案：自由电子；电子

怎么认 题目出现手持并摩擦不同材料的棒时，先选绝缘材料，再判断电子转移。

例题 2 **(c)** Explain how the structure of an electrical conductor differs from the structure of an electrical insulator.

（2023 冬季 0625/43 第7题(c)）

解：导体中存在自由电子，这些电子能在材料内移动；绝缘体中的电子受到束缚，不能在材料内自由移动。

答：导体有自由电子，绝缘体没有自由电子。

针对练习

5. A teacher wishes to show the production of electrostatic charges.

She holds a rod and rubs it with a cotton cloth. A copper rod, a glass rod, a plastic rod and a steel rod are available.

Which two rods would both be suitable to use?

A a copper rod and a glass rod

B a glass rod and a plastic rod

C a plastic rod and a copper rod

D a plastic rod and a steel rod

（2023 冬季 0625/13 第28题）

题型 2：用吸斥与电子移动判静电（考频★★★☆☆）

知识点 电荷有_____和_____两种，电荷量的单位是库仑（C）。

同种电荷相互排斥，异种电荷相互吸引；此规律适用于两个带电体之间的作用。

悬挂物体远离已知带电体表示排斥；另一带电体位于秤上带电体上方时，秤示数增大表示两者_____。

答案：正电荷；负电荷；相互排斥

怎么认 题目出现带电体的偏转方向或秤示数变化时，先判断吸引还是排斥，再判电性。

一. 先把偏转或示数化成吸斥

例题 1 Two charged rods, X and Y, are brought, in turn, near to a negatively charged rod.

X is attracted by the negatively charged rod, and Y is repelled.

What are the charges on X and Y?

	charge on X	charge on Y
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

（2025 夏季 0625/11 第26题）

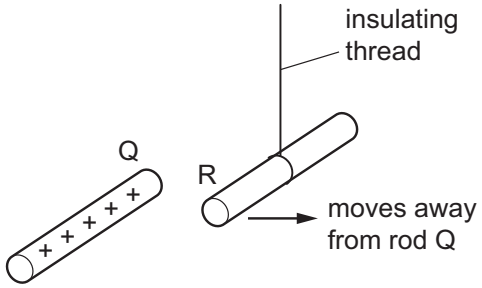
解：X 与带负电的棒相互吸引，由异种电荷相互吸引，得 X 带正电。

Y 与带负电的棒相互排斥，由同种电荷相互排斥，得 Y 带负电。

故选 C。

针对练习

1. In the diagram, rod R is suspended from an insulating thread.



When the positively charged rod Q is brought close to rod R, rod R moves away from rod Q.

Which conclusion can be made from this observation?

A Rod R is charged, but it is not possible to identify the sign of the charge.

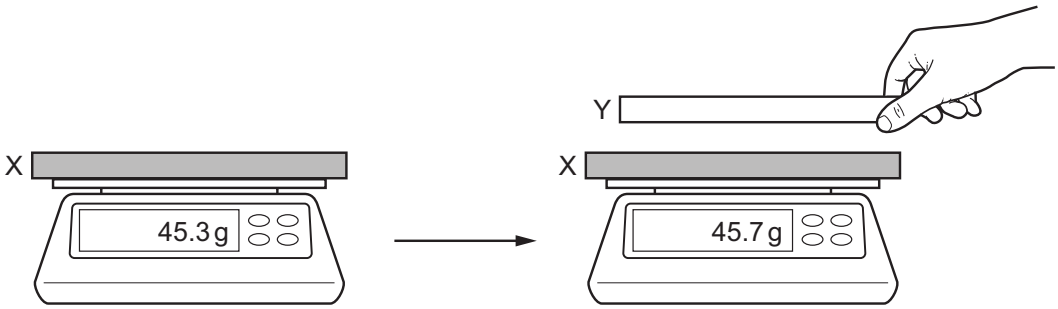
B Rod R must be positively charged.

C Rod R must be negatively charged.

D Rod R is uncharged.

（2023 冬季 0625/12 第28题）

2. A charged rod X is placed on a balance and another rod Y is brought close to it, as shown.



Which combination of charges would cause the change in the balance reading shown?

	X	Y
A	negative charge	negative charge
B	negative charge	positive charge
C	negative charge	no charge
D	positive charge	no charge

（2024 春季 0625/22 第23题）

3. **(b)** Three balls, P, Q and R, are electrically charged. The balls are suspended by threads of insulating material. Fig. 8.1 shows the arrangement.

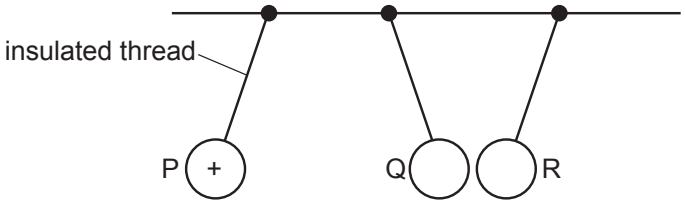


Fig. 8.1

The charge on ball P is positive.

State the charge on ball Q and the charge on ball R.

（2023 春季 0625/32 第8題(b)）

4. Fig. 5.1 shows a metal sphere S. The sphere has been charged with a negative charge.

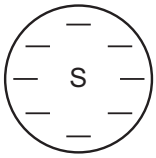


Fig. 5.1

(b) Fig. 5.3 shows sphere S being spray painted. Sphere S is negatively charged. As the paint particles exit the wide nozzle of the paint sprayer, they become charged with a positive charge.

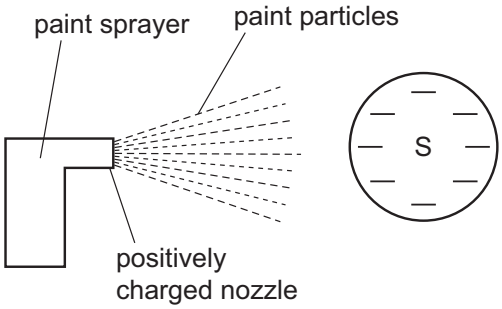


Fig. 5.3

(i) Explain why the paint particles spread out when they leave the nozzle.

(ii) The sphere can be painted by hand using a paintbrush.

Suggest and explain **one** advantage to using charged paint from a spray gun to paint sphere S.

（2024 冬季 0625/43 第5題(b)）

二. 先判断自由电子被吸引还是排斥

知识点 电荷分为正、负两种，同种电荷相互_____，异种电荷相互_____；电荷量的单位是库仑（C）。

固体摩擦起电时，只有带负电的_____发生转移；物体得到电子带负电，失去电子带正电。

金属中的正离子固定不动，能在金属内移动的是自由电子。

带电体靠近未带电金属时，自由电子因吸引或排斥而重新分布，使金属两端分别显出异种电荷。

金属接地时，电子可在金属与大地之间移动，多余电子流入大地，电子不足时由大地补入。

答案：排斥；吸引；电子

怎么认 题目出现带电体靠近金属、墙面或接地物体时，先判断自由电子被吸引还是排斥，再判断电子流向。

例题 2 A man walks across a carpet. He becomes negatively charged by friction with the carpet.

What happens as he touches a metal object connected to the Earth?

A The man gains electrons.

B The man loses electrons.

C The man gains protons.

D The man loses protons.

（2023 春季 0625/12 第25题）

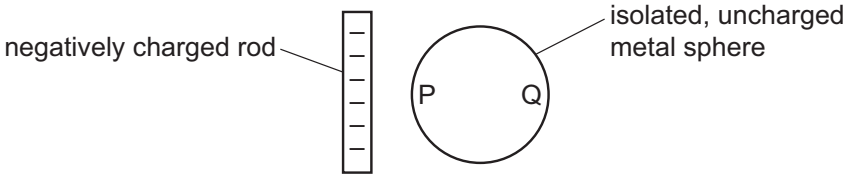
解：人因摩擦带负电，说明人体有多余电子。

触摸接地金属时，多余电子由人体经金属流入大地，人体失去电子。

故选 B。

针对练习

5. A negatively charged rod is brought close to an isolated, uncharged metal sphere.



What are the charges on sides P and Q of the sphere?

A P and Q are both negatively charged.

B P and Q are both positively charged.

C P is negatively charged and Q is positively charged.

D P is positively charged and Q is negatively charged.

（2024 冬季 0625/13 第25题）

6. A negatively charged rod is brought near to a metal sphere. A positive charge develops on the surface of the metal sphere closest to the negatively charged rod.

Why is this?

A Electrons in the sphere are attracted by the negatively charged rod.

B Electrons in the sphere are repelled by the negatively charged rod.

C Positive charges in the sphere are attracted by the negatively charged rod.

D Positive charges in the sphere are repelled by the negatively charged rod.

（2025 春季 0625/22 第24题）

7. A positively charged balloon is placed against a wall. The charge makes the balloon stick to the wall.

Which statement explains this?

A Positive charges on the balloon attract electrons in the wall.

B Positive charges on the balloon attract protons in the wall.

C Positive charges on the balloon repel electrons in the wall.

D Positive charges on the balloon repel protons in the wall.

（2025 夏季 0625/22 第26题）

8. A negatively charged plastic rod is brought near to an isolated, uncharged metal sphere and held there.

What happens when the metal sphere is earthed?

A Electrons flow from the metal sphere to earth.

B Electrons flow from earth to the metal sphere.

C Positive charge flows from the metal sphere to earth.

D Positive charge flows from earth to the metal sphere.

（2025 冬季 0625/12 第27题）

题型 3：用电场线判方向与受力（考频★★★☆☆）

知识点 电场是电荷在其中会受到_____的区域。

在不改变原电场的条件下，某点的电场方向规定为放在该点的_____所受电力的方向。

正电荷受力方向与电场方向相同，负电荷受力方向与电场方向_____。

电场线的箭头表示电场方向；孤立负电荷周围的电场线沿径向指向负电荷。方向本身没有单位。

答案：电力；正试探电荷；相反

怎么认 题目出现电场定义、电场线箭头或询问某点场向时，先按正试探电荷的受力方向判定。

一. 用正电荷受力定义场向

例题 1 Fig. 6.1 shows an isolated metal sphere suspended by an insulating thread from the ceiling.

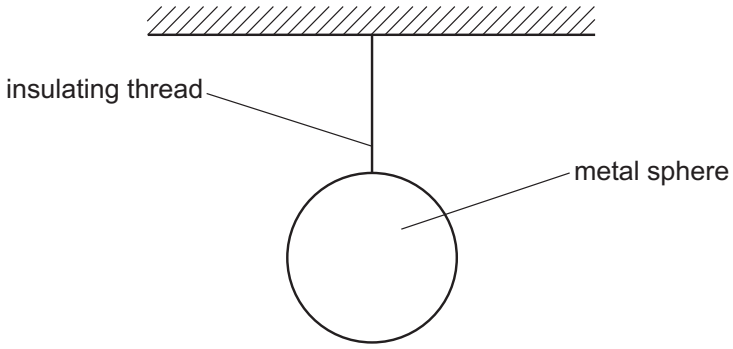


Fig. 6.1

The sphere is negatively charged.

(a) The charge on the sphere produces an electric field in the surroundings.

(i) State what is meant by ‘electric field’.

（2024 夏季 0625/41 第6题(a)）

解：答：电场是电荷在其中会受到电力的区域。

针对练习

1. **(b)** Fig. 7.1 shows a negatively charged metal sphere S.

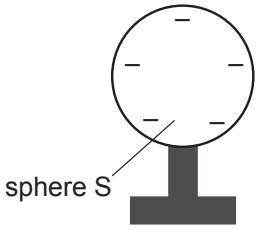


Fig. 7.1

There is an electric field surrounding S.

(i) State what is meant by an electric field.

（2023 冬季 0625/41 第7题(b)）

2. **(a)** State what is meant by an electric field.

（2025 夏季 0625/42 第7题(a)）

3. Which statement describes the direction of an electric field at a point?

A the direction of the force on a negative charge

B the direction of the force on an N pole

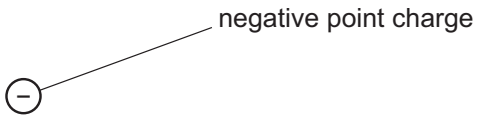
C the direction of the force on a positive charge

D the direction of the force on an S pole

（2023 冬季 0625/21 第25题）

4. **(a)** **(i)** State what is meant by an electric field.

(ii) Fig. 8.1 shows a negative point charge.



（2025 夏季 0625/43 第8题(a)）

二. 先定场线箭头再判粒子受力

知识点 电场方向规定为正试验电荷在该点所受力的方向，电场强度的单位为 N/C。

正点电荷周围的场线沿半径_____，负点电荷周围的场线沿半径指向电荷。

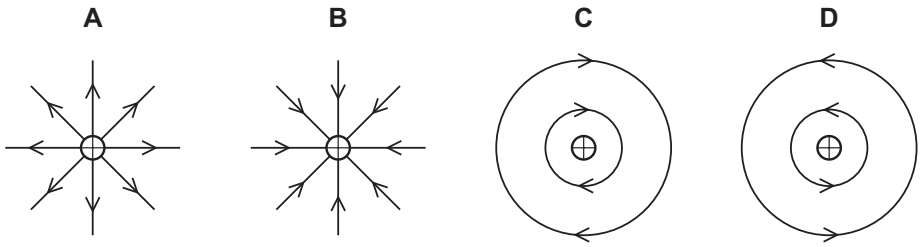
两块足够大且平行的异号带电板之间，远离边缘处的场线平行且均匀，由_____板指向_____板。

正电荷所受电场力与电场方向相同，负电荷所受电场力与电场方向相反。

答案：向外；正；负

怎么认 题目出现带电球、场线箭头、平行带电板或负粒子受力时，先定电场方向，再按电荷正负判受力方向。

例题 2 Which diagram shows the electric field pattern and direction around a positive point charge?



（2023 春季 0625/22 第25题）

解：正点电荷周围的场线沿半径均匀分布，方向由电荷向外。

图 A 中的场线为向外的径向直线，符合正点电荷的电场。

故选 A。

针对练习

5. **(b)** Fig. 8.1 shows a negatively charged metal sphere.

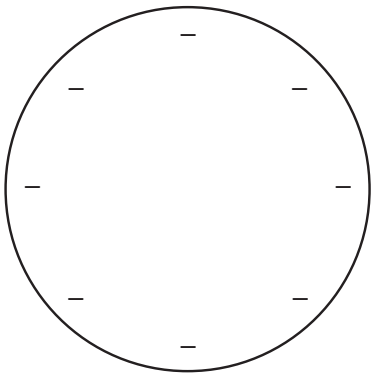


Fig. 8.1

On Fig. 8.1, draw **four** lines to show the electric field and its direction.

（2023 夏季 0625/42 第8题(b)）

6. **(ii)** On Fig. 7.1, draw the pattern of the electric field surrounding sphere S and indicate direction.

(c) Fig. 7.2 shows a small negative charge Z placed near to sphere S.

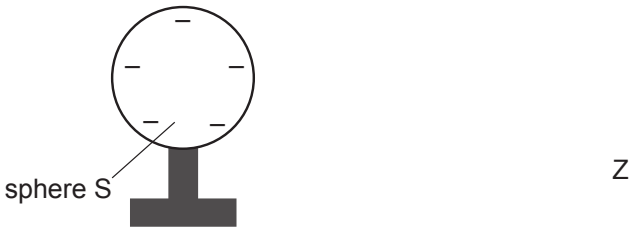


Fig. 7.2

Charge Z experiences a force due to the electric field surrounding S.

On Fig. 7.2, draw an arrow to show the direction of this force on Z.

（2023 冬季 0625/41 第7题(c)）

7. Fig. 7.1 shows two charged metal plates. X marks the position of the centre of the space between the plates.

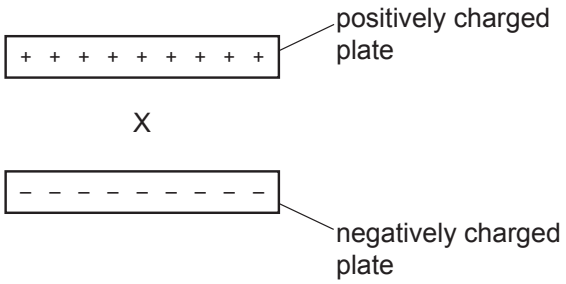


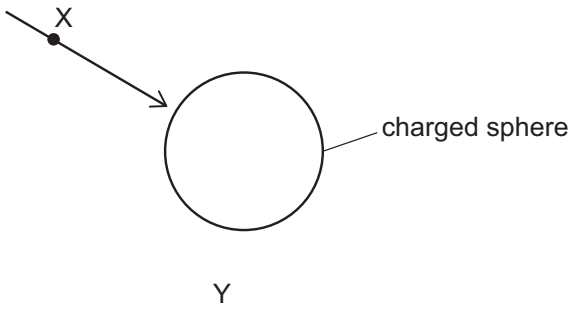
Fig. 7.1

(a) **(i)** On Fig. 7.1, draw at least **four** field lines to show the pattern and the direction of electric field between the two charged plates.

(ii) Describe the effect on a negatively charged particle placed at X.

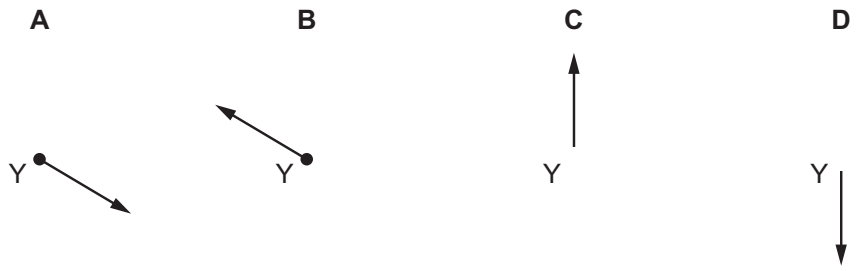
（2024 夏季 0625/43 第7题(a)）

8. The diagram shows a charged sphere and the direction of the electric field at point X due to the sphere.



An electron is placed at point Y.

Which diagram shows the direction of the force acting on the electron due to the charged sphere?



（2024 冬季 0625/23 第25题）

4.2.2 电流

题型 1：用自由电子解释金属电流（考频★★★☆☆）

知识点 金属内部含有位置固定的正离子和能够在金属中移动的自由电子。

金属导电时，_____不发生定向移动，_____定向移动并形成电流。

自由电子带负电，其移动方向与约定的电流方向相反。

答案：正离子；自由电子

怎么认 题目出现导线中移动的带电粒子或判断导体时，先找能自由移动的电子。

一. 先找能自由移动的电子

例题 1

(c) The student connects ball P to earth with a copper wire. Charges from the earth flow in the copper wire to ball P.

State the name of the electrically charged particles moving in the copper wire.

（2023 春季 0625/32 第8题(c)）

解：铜是金属，铜线中能自由移动的带电粒子是自由电子。

答：自由电子。

针对练习

1. Which material is a good electrical conductor?

A glass

B copper

C rubber

D wood

（2024 夏季 0625/11 第25题）

2. Which substances both contain large concentrations of free electrons?

A aluminium and glass

B copper and water

C copper and nylon

D silver and gold

（2023 冬季 0625/13 第26题）

3. A student tests the electrical conduction of four materials.

- aluminium
- iron
- plastic
- silver

Which materials are good conductors of electricity?

A aluminium, iron and silver

B aluminium and silver only

C iron, silver and plastic

D plastic only

（2024 夏季 0625/12 第27题）

4. **(c)** In another experiment, the student compares different electrically conducting and electrically insulating materials.

(i) State the name of **one** electrically conducting material and the name of **one** electrically insulating material.

(ii) Explain how electrical conducting materials allow a current to pass.

（2025 冬季 0625/31 第7题(c)）

二. 电流从正到负，电子反向

知识点 电流表示电荷通过电路中某点的快慢，$I = \frac{Q}{t}$，其中 Q 的单位为库仑（C），t 的单位为秒（s），I 的单位为安培（A）。

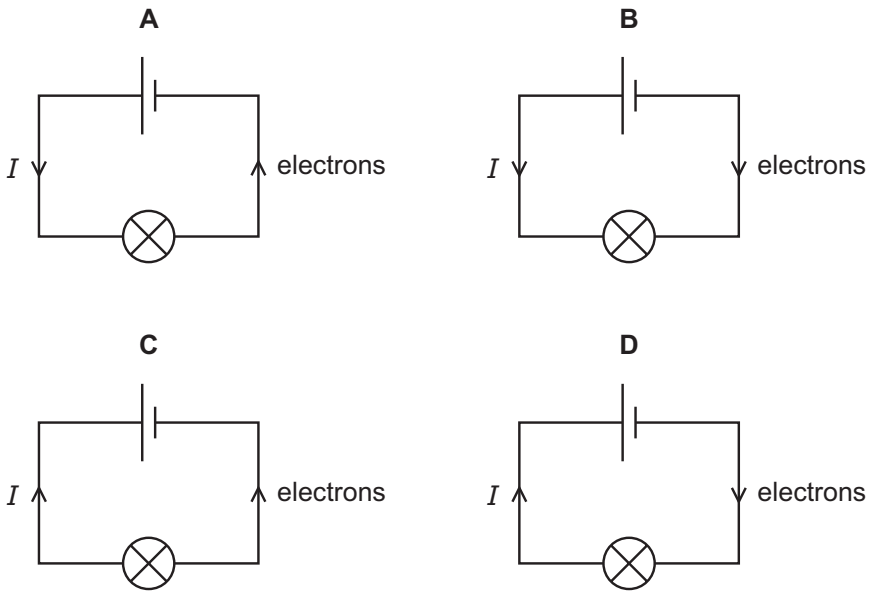
在金属导体中，电流由自由电子的定向移动形成；电源外电路的传统电流从_____极流向_____极。

自由电子从负极流向正极，其移动方向与传统电流方向_____；电流表测量电流。

答案：正；负；相反

怎么认 题目出现电池正负极及电流方向时，先沿外电路从正极到负极标传统电流，再反向标电子流。

例题 2 Which circuit shows the directions of the conventional current I and the flow of electrons?



（2024 夏季 0625/23 第28题）

解：电池符号的长线为正极，短线为负极。
沿外电路，传统电流从正极流向负极，故左侧导线中的 I 向下。
自由电子的移动方向与传统电流相反，故右侧导线中的电子向下。
故选 B。

针对练习

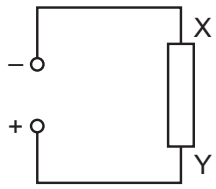
5. There is an electric current in a circuit with a battery. This question refers to the positive and negative terminals of the battery.

Which row correctly describes the directions of the conventional current and the electron flow in the circuit?

	direction of conventional current	direction of electron flow
A	from the negative to the positive terminal	from the negative to the positive terminal
B	from the negative to the positive terminal	from the positive to the negative terminal
C	from the positive to the negative terminal	from the negative to the positive terminal
D	from the positive to the negative terminal	from the positive to the negative terminal

（2025 冬季 0625/23 第26题）

6. A power source is connected to a resistor XY.

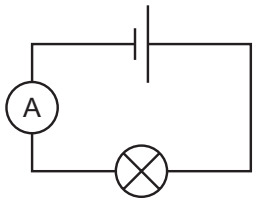


In which directions are the conventional current and the flow of free electrons through the resistor?

	conventional current	free electron flow
A	X to Y	X to Y
B	X to Y	Y to X
C	Y to X	X to Y
D	Y to X	Y to X

（2023 冬季 0625/22 第25题）

7. The diagram shows an electric circuit.



In which direction do free electrons flow around this circuit and what quantity does the ammeter measure?

	direction of electron flow	quantity measured by the ammeter
A	anticlockwise	charge passing each point in the circuit per unit time
B	anticlockwise	total charge passing through the ammeter
C	clockwise	charge passing each point in the circuit per unit time
D	clockwise	total charge passing through the ammeter

（2023 冬季 0625/23 第25题）

题型 2：看方向是否变化辨交直流（考频★★☆☆☆）

知识点 电流是电荷的定向流动，规定正电荷移动的方向为电流方向，单位是_____，符号为 A。

在金属导体中，电流由自由电子的定向移动形成，其方向与自由电子的定向移动方向相反。

方向始终不变的电流称为_____（d.c.）；方向反复改变的电流称为_____（a.c.）。

在电流或电压随时间变化的图像中，交流图线交替位于零线两侧，直流图线不跨越零线。

答案：安培；直流电；交流电

怎么认 题目出现电流方向描述或随时间变化的图像时，先判断方向是否反复改变。

例题 1 Which statement about electric current in a conductor is correct?

A In a d.c. circuit, the electric current gradually decreases along the conductor.

B In a d.c. circuit, the free electrons flow back and forth.

C In an a.c. circuit, the electric current remains exactly the same all the time.

D In an a.c. circuit, the flow of charge changes direction continually.

（2023 夏季 0625/12 第25题）

解： 直流电的方向始终不变；交流电中电荷流动的方向反复改变。
A 错，同一支路中的电流不沿导体逐渐减小；B 错，直流电中自由电子不往复移动；C 错，交流电不始终保持相同；D 对。
故选 D。

针对练习

1. **(a)** Describe what is meant by alternating current (a.c.).

（2023 冬季 0625/33 第9题(a)）

2. Fig. 3.1 shows black solar panels installed on the roof of a house and a large rechargeable battery.

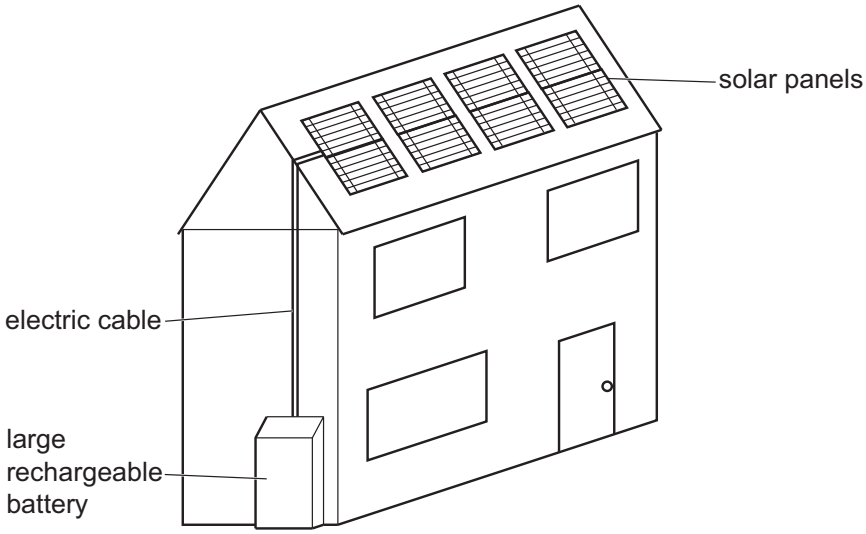


Fig. 3.1 (not to scale)

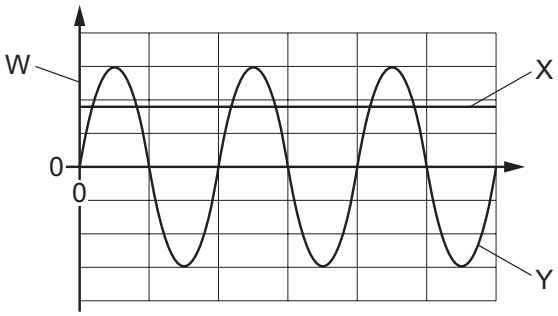
The solar panels produce electricity and give a maximum power output of 3.5 kW. The efficiency of the solar panels is 16%.

(c) The solar panels produce direct current (d.c.) and household appliances use alternating current (a.c.).

State the difference between alternating current and direct current.

（2025 冬季 0625/42 第3题(c)）

3. A student draws graphs of an a.c. supply and a d.c. supply.



Which row shows the correct labels for W, X and Y?

	label of W	a.c. supply	d.c. supply
A	time	X	Y
B	time	Y	X
C	voltage	X	Y
D	voltage	Y	X

（2024 夏季 0625/22 第26题）

4. A student writes three statements about electric current.

1 Electric current is a flow of charge.

2 Electric current in a circuit is measured using a voltmeter.

3 The direction of an alternating current (a.c.) continually changes.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2025 冬季 0625/13 第27题）

题型 3：用电流表和 I=Q/t（考频★★★☆☆）

知识点 电流由电荷的定向流动形成，电流大小等于_____内通过某点的电荷量，即 $I = \frac{Q}{t}$。

I 的单位是安培（A），Q 的单位是库仑（C），t 的单位是 s。

测量某电阻中的电流时，电流表必须与该电阻_____，使通过二者的电流相同。

判断材料是否导电时，将材料接入电路并闭合开关；电流表有_____示数，说明材料中有电流。

答案：单位时间；串联；非零

怎么认 题目出现测量某元件电流或用电流表判断导体时，先把电流表串入待测支路。

一. 把电流表串入待测支路

例题 1 What is an electric current and how is an ammeter positioned in a circuit to measure the current in a resistor?

	what is an electric current?	positioning of an ammeter
A	a flow of charge	in parallel with the resistor
B	a flow of charge	in series with the resistor
C	a flow of voltage	in parallel with the resistor
D	a flow of voltage	in series with the resistor

（2024 夏季 0625/11 第26题）

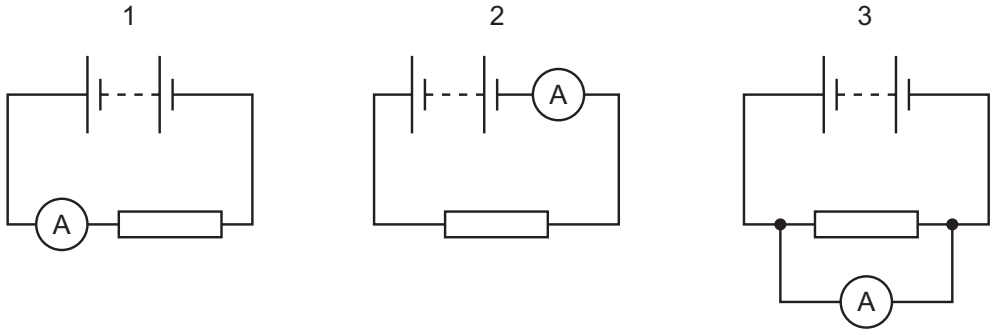
解： 电流是电荷的流动。

测量电阻中的电流时，电流表应与电阻串联，使通过二者的电流相同。

故选 B。

针对练习

1. A student uses an ammeter to measure the current in a resistor. He considers three different circuits, as shown.



In which of the circuits does the ammeter measure the current in the resistor?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 3 only

（2023 冬季 0625/13 第25题）

2. A student tests various materials to determine whether they are electrical conductors or insulators. The student uses the circuit shown in Fig. 9.1.

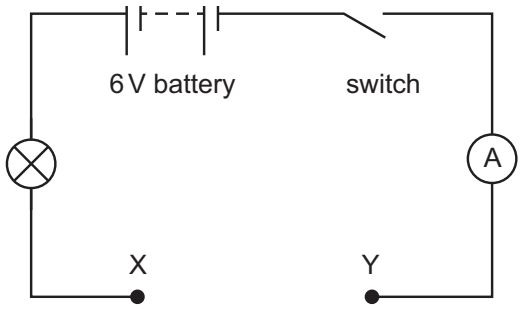


Fig. 9.1

(a) The student connects a piece of tin metal between X and Y.

Describe how the student can determine whether tin is an electrical conductor.

（2024 冬季 0625/31 第9题(a)）

二. 先统一时间与电流单位

知识点 电流是单位时间内通过某点的电荷量，关系为 $I=\frac{Q}{t}$，其中 I 的单位是 A，Q 的单位是 C，t 的单位是 s。

使用关系式前，时间应化为_____，电流应化为_____；求电荷量时，$Q=It$。

$1\ \text{min}=60\ \text{s}$，$1\ \text{ms}=10^{-3}\ \text{s}$，$1\ \text{ns}=10^{-9}\ \text{s}$，$1\ \text{mA}=10^{-3}\ \text{A}$。

答案：s；A

怎么认 题目出现电流、通电时间和所求电荷量时，先统一为 A 和 s，再由 $Q=It$ 计算。

例题 2 **(c)** The current in a lamp is 2.0A. The lamp is switched on for a time of 120s.

Calculate the charge that flows.

（2025 夏季 0625/43 第8题(c)）

解： 由 $I=\frac{Q}{t}$ 得

$Q=It$

$Q=2.0\times120=240\ \text{C}$

答：流过的电荷量为 240 C。

针对练习

3. Fig. 6.1 shows the circuit diagram for a flashlight (torch).

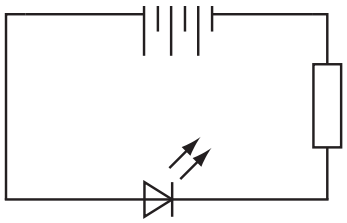


Fig. 6.1

The electromotive force (e.m.f.) of the battery is 4.5V. The circuit contains a 60Ω fixed resistor. The current in the light-emitting diode (LED) is 0.020A.

(d) Calculate the total charge that flows through the LED in 3600s.

（2023 冬季 0625/42 第6题(d)）

4. **(d)** In a lightning strike, there is a current of 3.0×10^4 A for 48 ms.

Calculate the charge that flows.

（2023 春季 0625/42 第6题(d)）

5. There is a current of 0.60 A in a closed circuit.

How much charge passes a point in the circuit in 2.5 min?

A 0.24 C **B** 1.5 C **C** 90 C **D** 5400 C

（2024 冬季 0625/21 第25题）

6. Fig. 6.1 shows an isolated metal sphere suspended by an insulating thread from the ceiling.

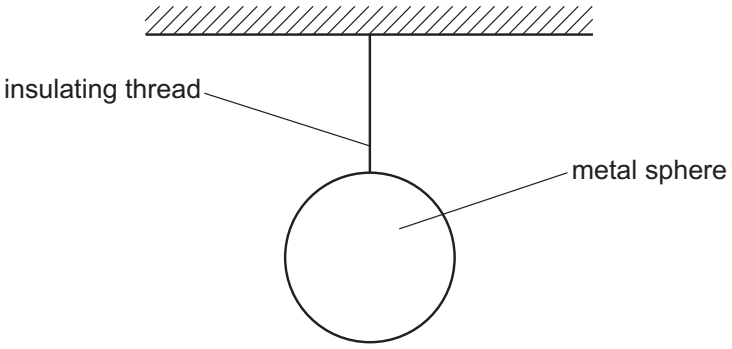


Fig. 6.1

The sphere is negatively charged.

(ii) Draw on Fig. 6.1 to show the pattern and direction of the electric field produced by charge on the sphere. Draw at least **four** lines.

(b) The magnitude of the charge on the sphere is 3.5×10^{-10} C.

An earthed metal wire is touched against the surface of the sphere and the sphere is discharged.

(i) State what happens in the wire as the sphere is discharged.

(ii) It takes a time of 0.14 ns for the sphere to discharge completely.

Calculate the average current in the earthed wire as the sphere discharges.

（2024 夏季 0625/41 第6题(b)）

4.2.3 电动势与电势差

题型 1：区分电动势与电势差（考频★★☆☆☆）

知识点 电动势 E 是电源推动单位电荷绕完整电路一周所做的功；电势差 V 是单位电荷通过元件时所做的功。

当电功 W 以焦耳计、电荷量 Q 以库仑计时，$E = \frac{W}{Q}$，$V = \frac{W}{Q}$。

电动势与电势差的单位都是_____，单位符号为_____；前者对应电源和完整电路，后者对应元件或两点。

答案：伏特；V

怎么认 题目出现电源推动电荷绕完整电路时，先判为电动势；出现电荷通过元件或两点间时，先判为电势差。

例题 1 **(a)** Define potential difference (p.d.).

（2023 春季 0625/42 第7题(a)）

解：电荷通过元件时所做的功为 W，通过元件的电荷量为 Q，则 $V=\frac{W}{Q}$。

答：电势差是单位电荷通过元件时所做的功。

针对练习

1. Which unit is used for the potential difference (p.d.) between two points in an electrical circuit?

A ampere (A)

B joule (J)

C ohm (Ω)

D volt (V)

（2024 夏季 0625/11 第27题）

2. Electromotive force (e.m.f.) is defined in terms of the energy supplied in driving which physical quantity around a complete circuit?

A charge

B resistance

C potential difference (p.d.)

D power

（2025 冬季 0625/13 第28题）

3. The electromotive force (e.m.f.) of a battery is 7.5 V.

(a) Define the term electromotive force.

（2024 夏季 0625/41 第7题(a)）

4. Which electrical quantity is defined in terms of the energy supplied by a source in driving charge round a complete circuit?

A current

B electromotive force

C potential difference

D power

（2025 冬季 0625/23 第27题）

题型 2：把电压表并联在两点间（考频★★☆☆☆）

知识点 电势差是单位电荷通过元件时所做的功，$V=\frac{W}{Q}$；单位为伏特（V）。

电压表测量两点间的_____，应与被测元件或两点_____。

选定量程后，根据刻度的_____读数。

答案：电势差；并联；最小分度

怎么认 题目出现测量元件两端或两点间电势差时，先找两个端点并将电压表并联跨接。

例题 1

A student investigates a circuit containing different combinations of three resistors.

She first uses Circuit A, shown in Fig. 2.1.

Circuit A

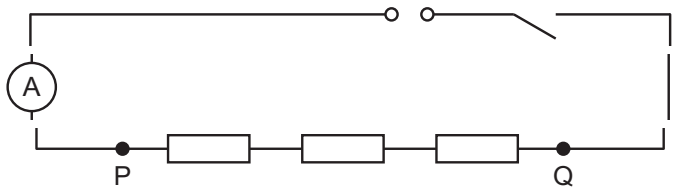


Fig. 2.1

(a) On Fig. 2.1, draw a voltmeter connected to measure the potential difference (p.d.) V terminals P and Q.

（2024 春季 0625/62 第2题(a)）

解：P、Q 是被测电势差的两个端点，电压表应并联在两点之间。

答：在 P、Q 间跨接一个圆圈内标 V 的电压表。

针对练习

1. Which statement about a voltmeter is correct?

A It has a scale which is marked in amperes (A).

B It must be connected in series in a circuit.

C It measures potential difference (p.d.).

D It must have three terminals.

（2023 冬季 0625/11 第26题）

2. A student investigates a light-dependent resistor (LDR).

The student assembles a series circuit consisting of a power supply, a switch, a 470 Ω resistor and an LDR.

(b) (i) The student:

- closes the switch
- connects a voltmeter across the 470 Ω resistor
- records the reading on the voltmeter
- opens the switch.

On Fig. 2.1, draw a voltmeter connected to measure the potential difference (p.d.) across the 470 Ω resistor.

(ii) The voltmeter reading is shown in Fig. 2.3.

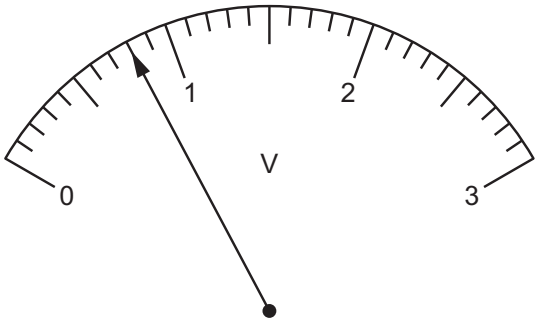


Fig. 2.3

Record the voltmeter reading V_{XY}.

（2025 夏季 0625/62 第2题(b)）

3. A student determines the resistance of a resistor.

She uses the apparatus shown in Fig. 2.1.

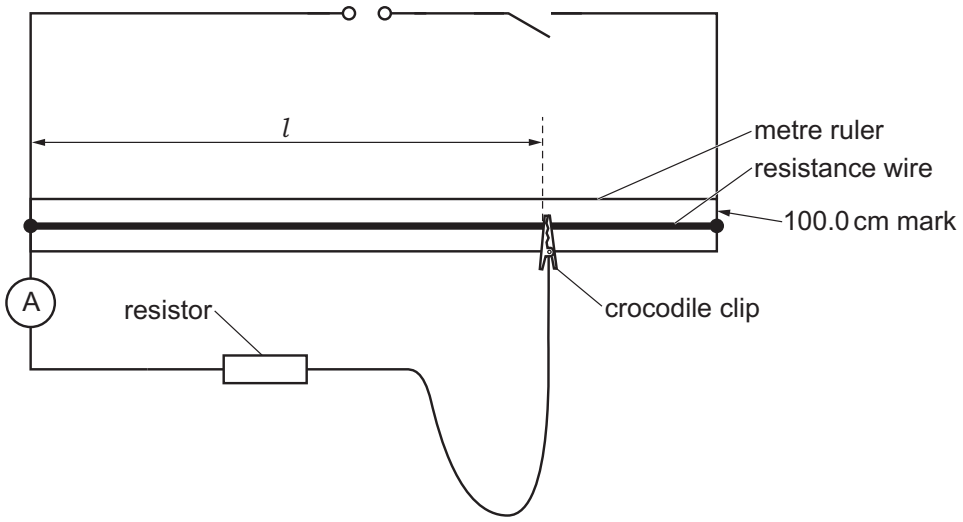


Fig. 2.1

(a) On Fig. 2.1, draw a voltmeter connected to measure the potential difference (p.d.) across the resistor.

（2024 冬季 0625/63 第2题(a)）

题型 3：用每库仑能量算电压（考频★★★☆☆）

知识点 电动势 E 等于电源使单位电荷绕完整电路一周所做的电功，即 $E=$ _____；电势差 V 等于单位电荷通过元件时所转移的能量，即 $V=$ _____。
式中，W 表示电功或转移的能量，Q 表示电荷量；W 用焦耳，Q 用库仑。
求功或能量时，移项得 $W=VQ$，电动势情形写成 $W=EQ$；求电荷时，移项得 $Q=\frac{W}{V}$ 或 $Q=\frac{W}{E}$。
电动势和电势差的单位都是伏特（V），且 $1\ \mathrm{V}=$ _____。

答案：$\frac{W}{Q}$；$\frac{W}{Q}$；$1\frac{\mathrm{J}}{\mathrm{C}}$

怎么认 题目出现电动势或电势差、能量和电荷中的两个量时，先写 $E=\frac{W}{Q}$ 或 $V=\frac{W}{Q}$。

一. 先写 V=W/Q 再移项

例题 1

(b) (i) State the equation which defines electromotive force (e.m.f.) *E*.

(ii) The e.m.f. of a battery is 9.0 V. The battery is in a circuit.

Calculate the work done by the battery when it moves a charge of 30 C around a complete circuit.

（2023 春季 0625/42 第7题(b)）

解：电动势表示电源使单位电荷绕完整电路一周所做的电功，故
$E=\frac{W}{Q}$
由 $E=\frac{W}{Q}$ 得
$W=EQ$
$W=9.0\times 30$
$W=270\ \mathrm{J}$
答：(i) $E=\frac{W}{Q}$；(ii) $270\ \mathrm{J}$。

针对练习

1. A cell has an electromotive force (e.m.f.) of 1.5 V.

How much energy is transferred by the cell when it drives 6.0 C of charge round a complete circuit?

A 4.0 J **B** 4.0 W **C** 9.0 J **D** 9.0 W

（2024 夏季 0625/23 第29题）

2. Which two physical quantities have the unit J / C?

A charge and energy

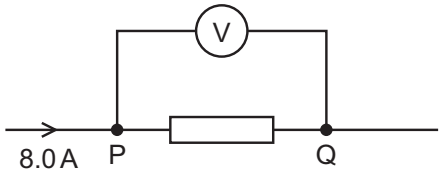
B charge and potential difference (p.d.)

C electromotive force (e.m.f.) and p.d.

D e.m.f. and charge

（2024 冬季 0625/21 第26题）

3. The diagram shows part of an electric circuit. The reading on the voltmeter is 16 V. The current in the resistor is 8.0 A.



One coulomb of charge flows from P to Q through the resistor.

How much energy is transferred in the resistor?

A 2.0 J **B** 8.0 J **C** 16 J **D** 128 J

（2025 冬季 0625/11 第27题）

4. **Fig. 8.1**

On Fig. 8.1, draw **four** field lines to show the pattern and the direction of the electric field due to the negative point charge.

(b) The potential difference (p.d.) of a lightning strike is 2.9×10^8 V. The energy transferred by the lightning strike is 4.5×10^5 MJ.

Calculate the charge that flows.

（2025 夏季 0625/43 第8题(b)）

二. 先用 Q=It 求电荷

知识点 电动势是电源使单位电荷绕完整电路一周所做的功，关系为 $E = \frac{W}{Q}$；电势差是单位电荷通过元件时所做的功，关系为 $V = \frac{W}{Q}$。

电动势和电势差均以_____为单位，1 V = 1 J/C；上述关系适用于相应过程中转移能量为 W、通过电荷量为 Q。

电流在时间 t 内通过的电荷量为 $Q = It$，其中 I 的单位为 A，t 的单位为 s，Q 的单位为_____。

题目未给出 Q 时，先由 $Q = It$ 求电荷量，再代入_____。

答案：伏特（V）；库仑（C）；$E = \frac{W}{Q}$ 或 $V = \frac{W}{Q}$

怎么认 题目出现电流、通电时间和转移能量，且求电动势或电势差时，先由 $Q = It$ 求电荷量。

例题 2 A battery is connected to a circuit. It is switched on for 1.0 minute. During that time, there is a current of 0.40 A in the circuit and the battery supplies a total of 48 J of energy.

Which row gives the charge that passes and the electromotive force (e.m.f.) of the battery?

	charge that passes in 1.0 minute / C	e.m.f. of the battery / V
A	0.40	2.0
B	0.40	120
C	24	2.0
D	24	120

（2023 夏季 0625/21 第27题）

解： $t = 1.0 \text{ min} = 60 \text{ s}$。

由 $Q = It$ 得

$Q = 0.40 \times 60 = 24 \text{ C}$。

由 $E = \frac{W}{Q}$ 得
$E = \frac{48}{24} = 2.0$ V。
故选 C。

针对练习

5. A cell passes a current of 2.0 A in a circuit for 30 s. In this time, the cell transfers 120 J of energy.

What is the electromotive force (e.m.f.) of the cell?

A 0.50 V **B** 1.5 V **C** 2.0 V **D** 8.0 V

（2025 冬季 0625/21 第27题）

6. In a circuit, two identical lamps are in parallel. The parallel pair of lamps is in series with a resistor and a battery.

The battery does 120 J of work moving 50 C of charge around the circuit in time *t*.

In each lamp, 40 J of work is done by the charge that passes through it in time *t*.

The electromotive force (e.m.f.) of the battery is *E* and the potential difference (p.d.) across one lamp is *V*.

Which statement about *E* and *V* is correct?

A *E* is 2.4 V and *V* is 0.80 V.

B *E* is 2.4 V and *V* is 1.6 V.

C *E* is 4.8 V and *V* is 2.4 V.

D *E* is 4.8 V and *V* is 4.8 V.

（2025 冬季 0625/22 第25题）

7. Fig. 7.1 shows two charged metal plates. X marks the position of the centre of the space between the plates.

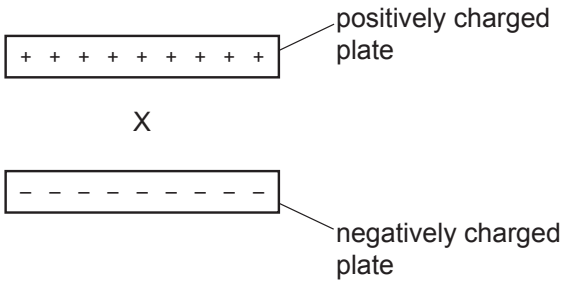


Fig. 7.1

(b) During a thunderstorm, an electric field is set up between a cloud and the ground. Charges on the cloud and on the ground are shown in Fig. 7.2.

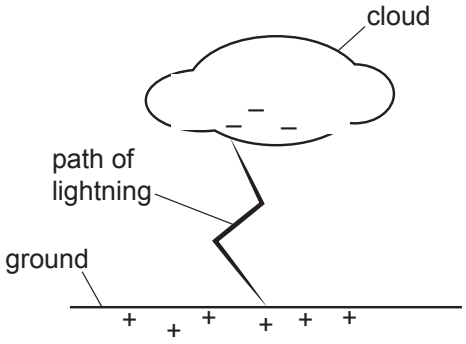


Fig. 7.2

The lightning shown in Fig. 7.2 discharges a current of 28 000 A for 0.0012 s.

(i) Calculate the charge that flows from the cloud to the ground.

(ii) The lightning transfers 1.2×10^8 J of energy.

Calculate the potential difference between the base of the cloud and the ground.

（2024 夏季 0625/43 第7题(b)）

4.2.4 电阻

题型 1：用 R=V/I 处理数值（考频★★★☆☆）

知识点 导体两端的电势差 V 与通过导体的电流 I 之比为电阻 R，即 $R = \frac{V}{I}$，使用时 I 不能为零。

V 的单位为伏特，I 的单位为_____，R 的单位为_____（Ω）。

电流以毫安给出时，先按 $1\ \text{mA} = 10^{-3}\ \text{A}$ 换算为安培，再计算电阻。

答案：安培；欧姆

怎么认 题目出现电势差、电流并求电阻时，先把电流换成安培，再写 $R=\frac{V}{I}$。

一. 直接代入 R=V/I

例题 1 Which expression is used to calculate electrical resistance?

A charge ÷ potential difference

B current ÷ potential difference

C potential difference ÷ charge

D potential difference ÷ current

（2025 冬季 0625/11 第26题）

解：由 $R=\frac{V}{I}$ 得，电阻的计算式为电势差除以电流。
故选 D。

针对练习

1. A resistor with a potential difference (p.d.) of 100 V across it carries a current of 5.0 mA.

What is the resistance of the resistor?

A 0.50 Ω **B** 20 Ω **C** 500 Ω **D** 20 000 Ω

（2024 冬季 0625/12 第26题）

2. A cylinder is made of modelling clay. The modelling clay is an electrical conductor.

Fig. 8.1 shows the cylinder.

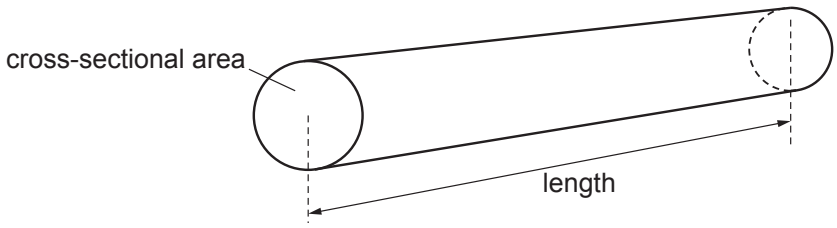


Fig. 8.1

The cylinder is connected into a circuit.

Fig. 8.2 shows that the circuit also includes a battery of electromotive force (e.m.f.) 9.0 V and a resistor P.

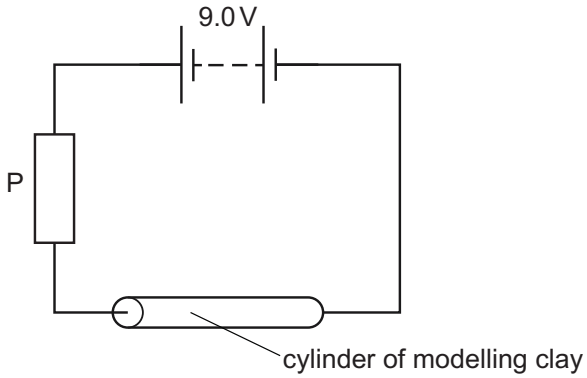


Fig. 8.2

The resistance of P is 4.0 Ω. The current in P is 1.5 A.

(a) Calculate:

(i) the magnitude *X* of the charge that flows through P in 600 s

(ii) the resistance of the cylinder of modelling clay.

（2023 冬季 0625/41 第8题(a)）

二. 先锁定同一元件的 V、I、R

知识点 电阻表示导体对电流的阻碍作用，某元件的电阻满足 $R = \frac{V}{I}$。

变形得 $V = IR$ 或 $I = \frac{V}{R}$；式中的三个量必须属于_____元件，并对应同一工作状态。

V、I、R 的单位分别是伏特（V）、安培（A）和_____（Ω），且 $1\ \Omega = 1\frac{\text{V}}{\text{A}}$。

串联电路的总电阻等于各电阻之和，各电阻中的电流相同；求某个电阻的电势差时，应把该电流与该电阻配对。

答案：同一；欧姆

怎么认 题目出现某元件的 V、I、R 中两项并求第三项时，先确认三者属于同一元件，再变形 $R=\frac{V}{I}$。

例题 2 Fig. 8.1 shows an arrangement for making an electromagnet. The electromagnet consists of a solenoid and a core.

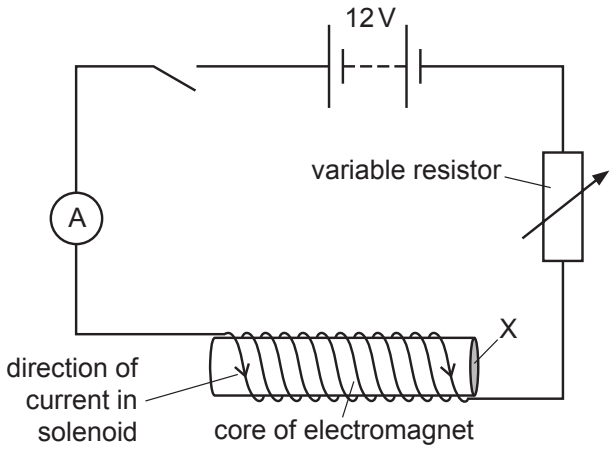


Fig. 8.1

(c) The resistance of the solenoid is 8.0 Ω.
The current in the solenoid is 1.2 A.

Calculate the potential difference (p.d.) across the solenoid.

（2024 夏季 0625/31 第8题(c)）

解： 由 $R=\frac{V}{I}$ 得

$V=IR$

$V=1.2\times 8.0=9.6\ \text{V}$

答：螺线管两端的电势差为 $9.6\ \text{V}$。

针对练习

3. There is a current of 2.0 A in a resistor of resistance 8.0 Ω.

What is the potential difference (p.d.) across the resistor?

A 0.25 V **B** 4.0 V **C** 8.0 V **D** 16 V

（2025 冬季 0625/13 第30题）

4. A student sets up the circuit shown in Fig. 7.1.

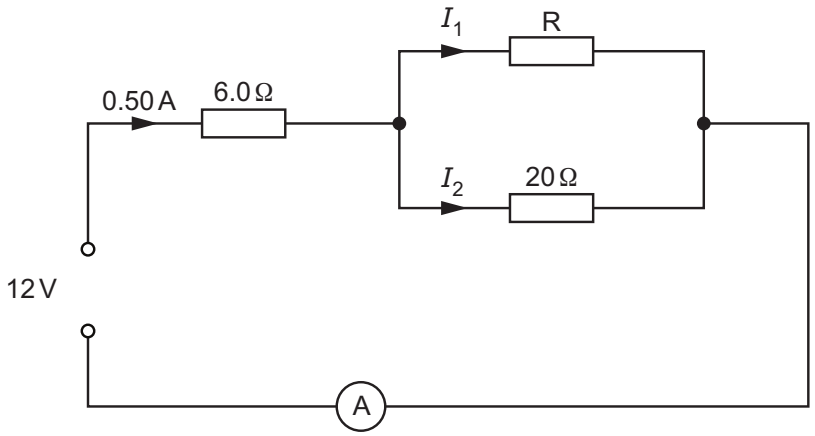


Fig. 7.1

(b) Calculate the potential difference (p.d.) across the 6.0 Ω resistor.

（2025 夏季 0625/43 第7题(b)）

5. Two identical resistors, R_1 and R_2, are connected to a 24 V battery, as shown in Fig. 7.1.

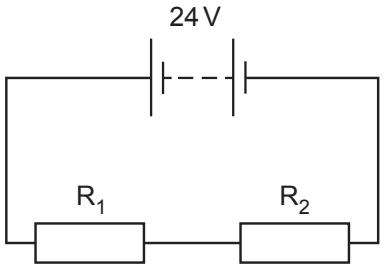


Fig. 7.1

The value of each resistor is 50 Ω.

(c) Determine the potential difference (p.d.) across R_1.

（2023 冬季 0625/33 第7题(c)）

6. A student investigates the resistance *R* of a diode using the circuit shown in Fig. 2.1.

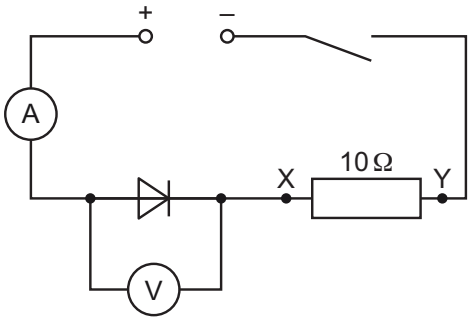


Fig. 2.1

(a) The student:

- closes the switch
- records the voltmeter reading V
- records the ammeter reading I
- opens the switch.

Fig. 2.2 shows the readings on the voltmeter and the ammeter.

Record the readings on the voltmeter and the ammeter in the first row of Table 2.1.

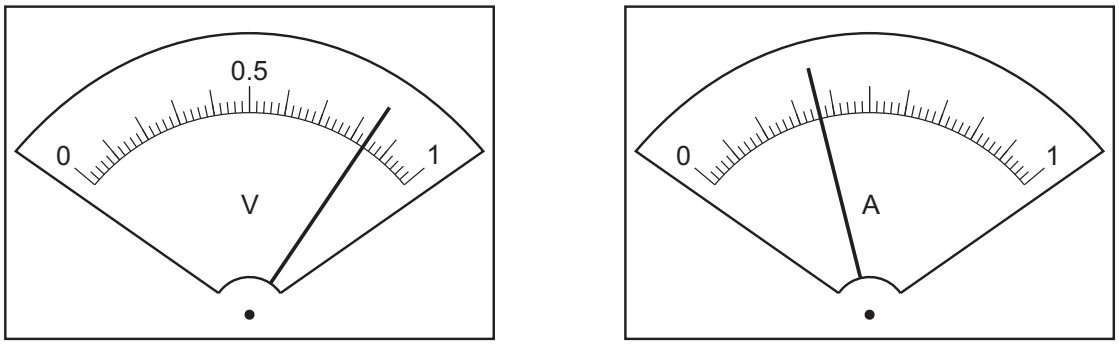


Fig. 2.2

Table 2.1

resistance between X and Y / Ω	V / V	I / A	R / Ω
10			
13	0.83	0.27	
20	0.81		4.5

(c) The student:

- connects a 3 Ω resistor in series with the 10 Ω resistor between terminals X and Y, as shown in Fig. 2.3, and repeats the procedure in **(a)**

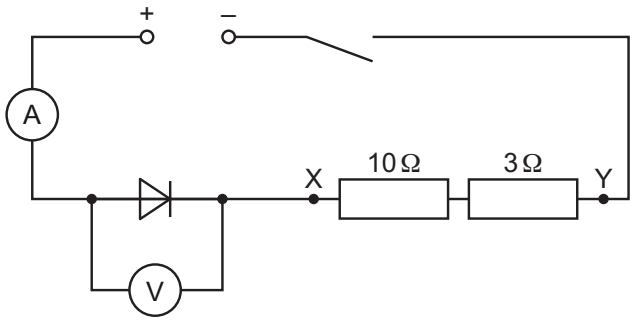


Fig. 2.3

- connects the 7 Ω, 10 Ω and 3 Ω resistors in series between X and Y, as shown in Fig. 2.4, and repeats the procedure in **(a)**.

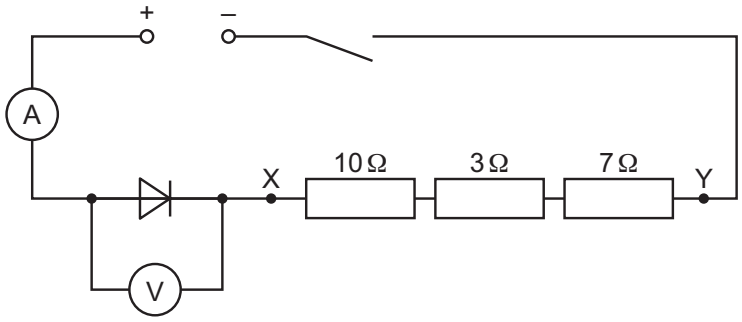


Fig. 2.4

Table 2.1 is incomplete.

Complete Table 2.1 by adding the missing values of R and I.

（2024 夏季 0625/62 第2题(c)）

题型 2：用伏安法测电阻（考频★★☆☆☆）

知识点 导体的电阻等于其两端的电势差与通过它的电流之比，即 $R =$ _____；电势差、电流和电阻的单位分别为伏特（V）、安培（A）和欧姆（Ω）。

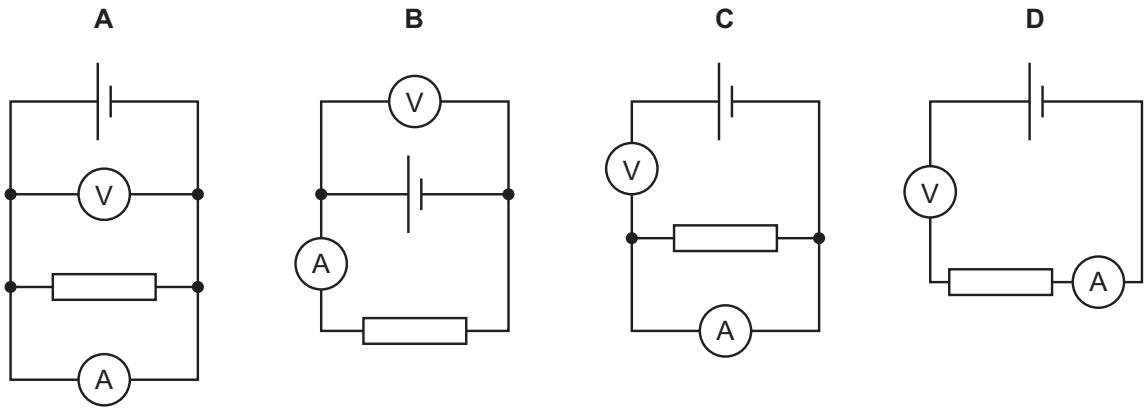
伏安法测量时，电流表应与被测电阻_____，电压表应并联在被测电阻两端。

电路闭合且电流不为零时，应成对读取 V 和 I，每组数据按 $R = \frac{V}{I}$ 计算。

答案：$\frac{V}{I}$；串联

怎么认 题目出现测量电阻、伏特表与安培表电路图时，先找电流表串联、电压表并联的电路。

例题 1 Which circuit can be used to measure the resistance of a resistor?



（2023 夏季 0625/12 第26题）

解：B 中电流表与被测电阻串联，测得通过电阻的电流 I。
电压表并联在该支路两端；电流表的电阻可忽略，故电压表测得电阻两端的电势差 V。
$R = \frac{V}{I}$
故选 B。

针对练习

1. A student measures the resistance of a wire.

Which two measurements must the student make?

A length and current

B potential difference (p.d.) and current

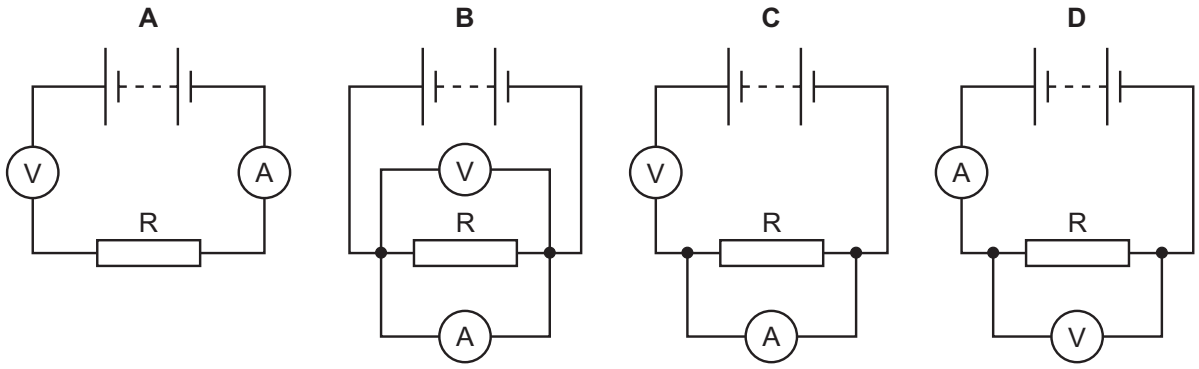
C cross-sectional area and power

D potential difference (p.d.) and diameter

（2025 冬季 0625/13 第29题）

2. A student determines the resistance of resistor R. She uses a circuit including a voltmeter and an ammeter.

Which circuit does she use?



（2024 夏季 0625/21 第26题）

题型 3：按长度截面判断导线电阻（考频★★★☆☆）

知识点 同种材料且温度相同时，均匀导线的电阻 R 与长度 L 成_____比，与横截面积 A 成_____比。

比较两根导线时，$\frac{R_2}{R_1}=\left(\frac{L_2}{L_1}\right)\left(\frac{A_1}{A_2}\right)$。

圆形截面的面积为 $A=\pi\frac{d^2}{4}$；电阻的单位为欧姆，符号为 Ω。

电源电压不变时，由 $I=\frac{V}{R}$，总电阻减小，电流增大。

答案：正；反

怎么认 题目出现同材料导线的长度、横截面积或直径变化时，先比较 $\frac{L}{A}$。

一. 先看更长还是更细

例题 1

A wire has a uniform circular cross-sectional area.

Which statement is correct?

A The resistance of the wire is directly proportional to its cross-sectional area and inversely proportional to its diameter.

B The resistance of the wire is directly proportional to its cross-sectional area and inversely proportional to its length.

C The resistance of the wire is directly proportional to its length and inversely proportional to its cross-sectional area.

D The resistance of the wire is directly proportional to its length and inversely proportional to its diameter.

（2023 夏季 0625/21 第25题）

解：同种材料且温度相同时，导线电阻满足

$R\propto\frac{L}{A}$

故电阻与长度成正比，与横截面积成反比。故选 C。

针对练习

1. A nichrome wire, P, has a length of 1.0 m and a diameter of 1.0 mm.

A second nichrome wire, Q, has a length of 2.0 m and a diameter of 2.0 mm.

Which statement correctly compares the resistance of Q with that of P?

A The resistance of Q is one-quarter the resistance of P.

B The resistance of Q is one-half the resistance of P.

C The resistance of Q is the same as the resistance of P.

D The resistance of Q is four times the resistance of P.

（2024 春季 0625/22 第27题）

2. A student set up the electrical circuit that is shown in Fig. 9.1.

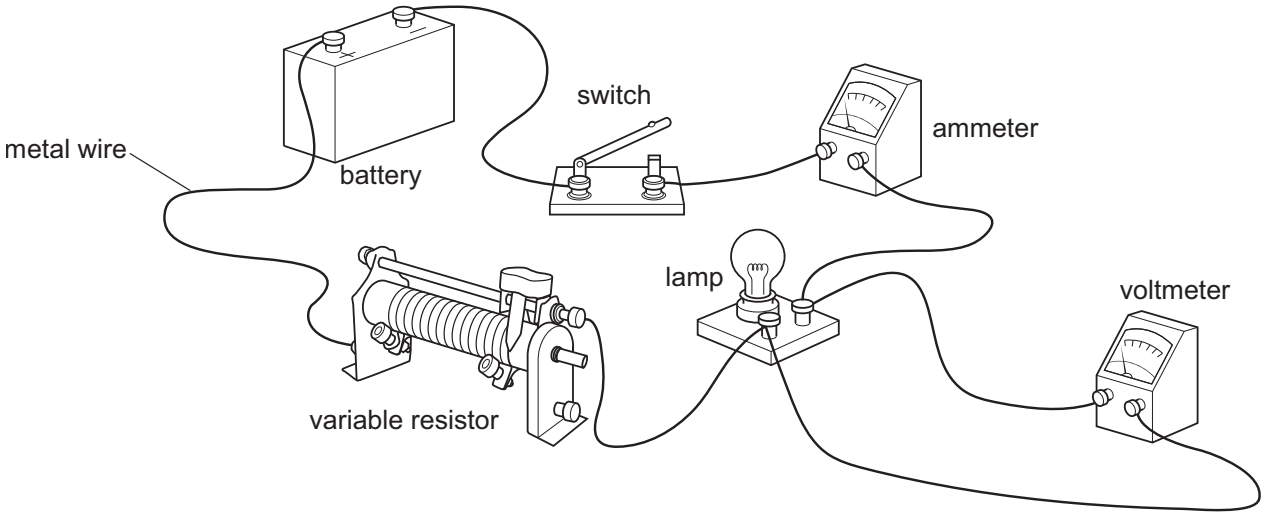


Fig. 9.1

(c) The student moves the sliding contact from position A to position B, as shown in Fig. 9.3.

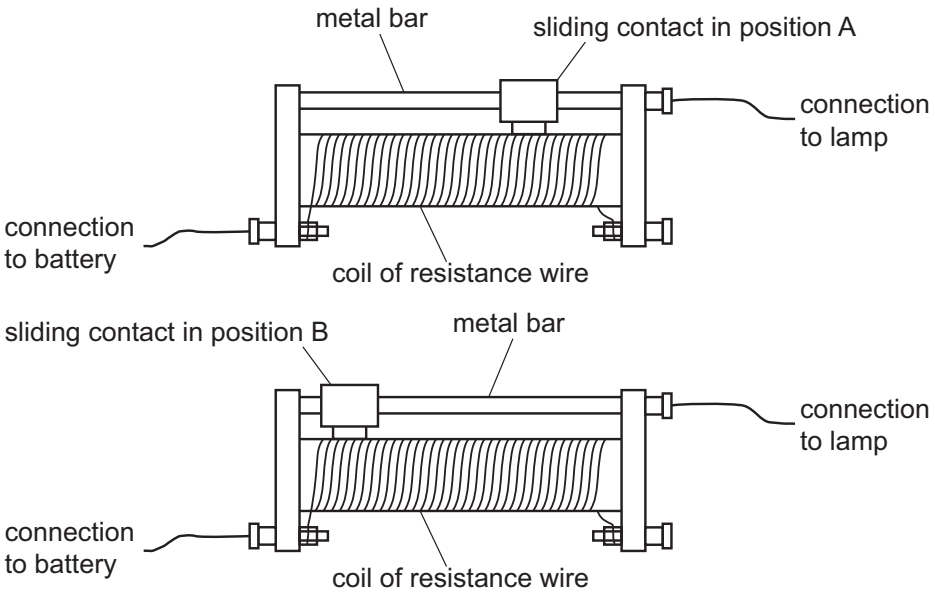


Fig. 9.3

State and explain any effect on the current in the circuit when the sliding contact is moved from position A to position B.

（2025 春季 0625/32 第9题(c)）

二. 先把直径变化平方成面积比

知识点 同种材料、温度不变时，导线的电阻 $R=\rho\frac{L}{A}$，其中 ρ 为电阻率，L 为长度，A 为横截面积。

电阻与导线的_____成正比，与导线的_____成反比。

圆形导线的横截面积与直径的_____成正比。

比较两根导线时，$\frac{R_2}{R_1}=\left(\frac{L_2}{L_1}\right)\left(\frac{A_1}{A_2}\right)$；电阻单位为 Ω。

答案：长度；横截面积；平方

怎么认 题目出现同材料导线的长度、横截面积或直径变化时，先写电阻比关系。

例题 2 A copper wire of length 80 cm and cross-sectional area 0.20 mm^2 has resistance *R*.

Which length of copper wire of cross-sectional area 0.40 mm^2 has resistance *R*?

A 10 cm **B** 20 cm **C** 40 cm **D** 160 cm

（2025 春季 0625/22 第27题）

解：设第二根导线的长度为 L_2，由 $R \propto \frac{L}{A}$ 得

$\frac{R_2}{R_1} = \left(\frac{L_2}{80\ \text{cm}}\right)\left(\frac{0.20\text{mm}^2}{0.40\text{mm}^2}\right)$

因 $R_2 = R_1$，故

$1 = \left(\frac{L_2}{80\ \text{cm}}\right) \times \frac{1}{2}$

$L_2 = 160\ \text{cm}$

故选 D。

针对练习

3. A wire has a resistance of 8.0 Ω.

A second wire of the same material has twice the length and twice the cross-sectional area.

What is the resistance of the second wire?

A 4.0 Ω **B** 8.0 Ω **C** 16 Ω **D** 32 Ω

（2023 冬季 0625/21 第27题）

4. An electric heater uses a resistance wire of resistance 26 Ω. The power dissipated in the resistance wire is 2500 W.

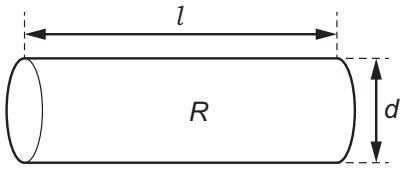
(b) The resistance wire of the heater has a length of 1.2 m and a cross-sectional area of $7.9 \times 10^{-7}\ m^2$.

A new heater is designed using wire of the same material with length 1.8 m and cross-sectional area $5.8 \times 10^{-7}\ m^2$.

Calculate the resistance of this wire.

（2023 夏季 0625/43 第6题(b)）

5. A cylinder of conducting putty has length *l*, diameter *d* and resistance *R*. The putty is now moulded into a cylinder of diameter 2*d* that has the same volume.

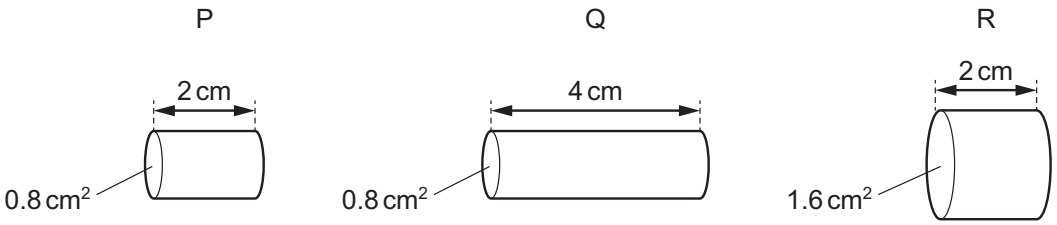


By which factor does the resistance of the putty cylinder decrease?

A 2 **B** 4 **C** 8 **D** 16

（2024 冬季 0625/23 第27题）

6. The diagram shows three wires, P, Q and R. They are all made from the same metal.



Which list gives the wires in order of resistance, from lowest to highest?

A P → Q → R

B Q → R → P

C R → P → Q

D R → Q → P

（2024 冬季 0625/11 第26题）

题型 4：看电流—电压图判电阻特性（考频★★★☆☆）

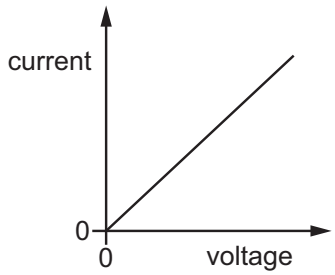
知识点 导体两端的电压 V 与通过导体的电流 I 的比值定义为电阻 R，即 $R=\frac{V}{I}$，单位为欧姆（Ω）。
金属导体在温度等物理条件不变时，电流与电压成正比。
电流—电压图为过原点的直线时，各点的 $\frac{V}{I}$ _____，故电阻_____。

答案：相等；保持不变

怎么认 题目出现电流—电压图为过原点的直线时，先由 $R=\frac{V}{I}$ 判断比值是否不变。

一. 过原点直线先判电阻不变

例题 1 The diagram shows the current–voltage graph for a metal wire.



What can be deduced from the graph?

A As voltage increases, the temperature of the wire increases.

B As voltage increases, the temperature of the wire decreases.

C As voltage increases, the resistance of the wire increases.

D As voltage increases, the resistance of the wire remains constant.

（2023 夏季 0625/21 第26题）

解：图线为过原点的直线，故 I 与 V 成正比。
由 $R=\frac{V}{I}$ 得，$\frac{V}{I}$ 保持不变，电阻保持不变。
故选 D。

针对练习

1. In this experiment, you will investigate circuits containing different combinations of resistors. Fig. 2.1 shows **circuit A** which has been set up for you.

Carry out the following instructions, referring to Fig. 2.1.

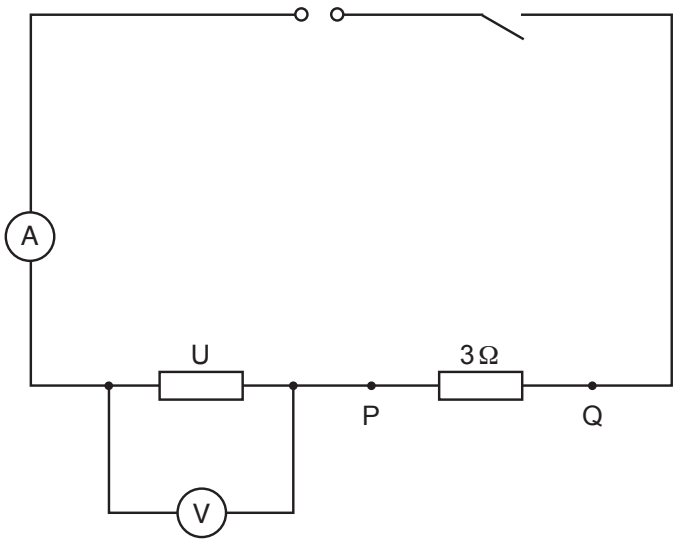


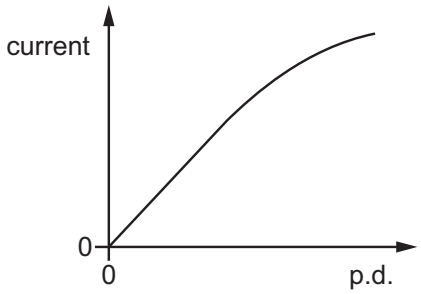
Fig. 2.1

(f) Another student suggests that potential difference and current for resistor U are proportional.

State how a graph of potential difference against current for resistor U can confirm this suggestion.

（2023 夏季 0625/53 第2题(f)）

2. The graph shows the relationship between the current in a circuit component and the potential difference (p.d.) across it. The graph has a straight section and a curved section.



What happens to the resistance of the component in these two sections as the current increases?

	straight section	curved section
A	resistance increases	resistance decreases
B	resistance increases	resistance increases
C	no change in resistance	resistance decreases
D	no change in resistance	resistance increases

（2023 春季 0625/22 第27题）

二. 先看对称弯曲还是单向导通

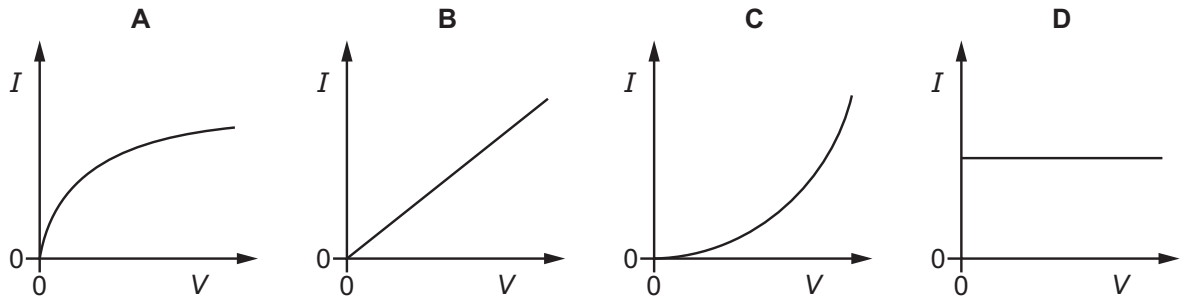
知识点 电流–电压图表示元件中电流 I 随电压 V 的变化；某工作点的电阻为 $R=\frac{V}{I}$，单位为_____。灯丝灯的图线经过原点，在正、负电压两侧呈_____；电流增大时灯丝温度升高，电阻增大，图线逐渐变平。

二极管具有_____导电性；反向电压下电流近似为零，正向电压达到一定值后电流迅速增大。

答案：欧姆；关于原点对称的弯曲形状；单向

怎么认 题目出现电流–电压图并要求判断灯丝灯或二极管时，先看是否对称弯曲，再看是否单向导通。

例题 2 Which diagram shows the current–voltage (I–V) graph for a filament lamp?



（2024 冬季 0625/22 第27题）

解：灯丝中电流增大时，温度升高，电阻增大。

$R=\frac{V}{I}$

故电压增大时，电流的增幅逐渐减小，图线从原点出发并逐渐变平。故选 A。

针对练习

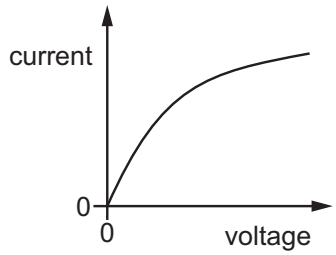
3. **(a)** On Fig. 6.1, sketch the current–voltage graph of a filament lamp and explain its shape.



Fig. 6.1

（2023 冬季 0625/43 第6题(a)）

4. The graph shows the current–voltage characteristic for a filament lamp.



Which statement describes how the resistance of the lamp changes as the voltage increases?

A The resistance decreases to zero.

B The resistance decreases, but not to zero.

C The resistance increases.

D The resistance remains constant.

（2023 冬季 0625/22 第27题）

5. **(a)** Fig. 7.1 shows a sketch of the current–voltage graph for an electrical component.

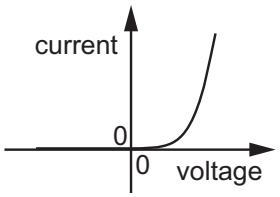


Fig. 7.1

(i) Name the electrical component.

Explain how you identified the component from the graph in Fig. 7.1.

(ii) Draw the circuit symbol for this component.

（2025 夏季 0625/41 第7题(a)）

6. **(b)** Fig. 6.2 shows two light-emitting diodes (LEDs) connected in parallel in a circuit. R is a red LED and G is a green LED.

The voltmeter across the LEDs shows a potential difference (p.d.) of 2.0 V.

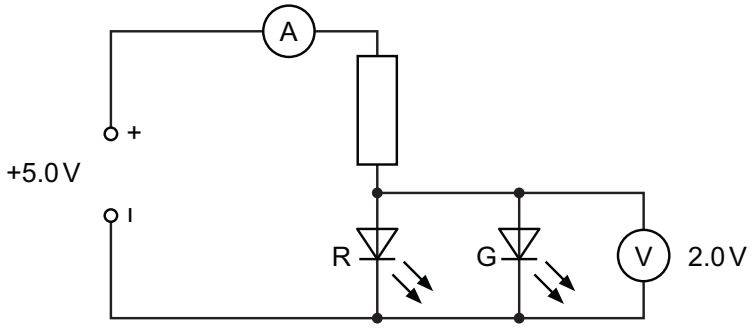


Fig. 6.2

(i) Fig. 6.3 shows a current-p.d. graph for the LEDs.

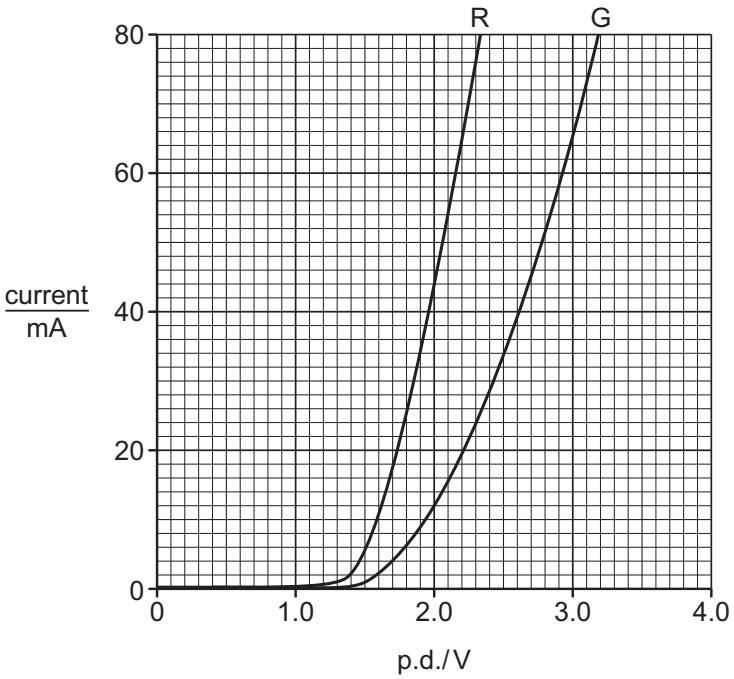


Fig. 6.3

Use Fig. 6.3 to determine the current in the ammeter.

(ii) The connections to the power supply are reversed. State the reading on the ammeter.

（2025 冬季 0625/43 第6题(b)）

4.2.5 电能与电功率

题型 1：追踪并计算电路能量（考频★★★☆☆）

知识点 电路工作时，能量从电源传递给_____，再由电路元件传递到_____。

用电器两端电压为 V、通过的电流为 I 时，电功率 $P = IV$，单位为 W。

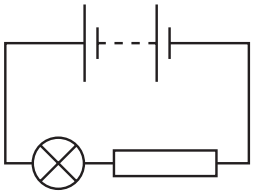
当电压和电流在时间 t 内保持不变时，$E = IVt$；I 用 A，V 用 V，t 用 s，则 E 的单位为_____。

答案：电路元件；周围环境；J

怎么认 题目出现电源、用电器、周围环境，或给出电流、电压、时间时，先判定能量方向，再把时间化为秒并写 $E = IVt$。

一. 先认能量源与去向，再用 E=IVt

例题 1 The diagram shows a circuit.



Which energy transfers occur?

A battery → lamp → surrounding air

B battery → surrounding air → battery

C lamp → surrounding air → battery

D surrounding air → lamp → battery

（2023 春季 0625/12 第27题）

解：电池是电能的来源，能量由电池传递给灯泡。
灯泡获得能量，并将能量传递到周围空气。
故选 A。

针对练习

1. There is a current of 2.0 A in a resistor for a time of 30 s. The potential difference (p.d.) across the resistor is 12 V.

How much energy is transferred in the resistor?

A 1.25 J **B** 5.0 J **C** 180 J **D** 720 J

（2025 冬季 0625/13 第31题）

2. In an experiment, a student uses an electrical heater connected to a power supply.

(a) The current in the electrical heater is 2.2 A. The voltage (p.d.) across the heater is 12 V.

Calculate the energy transferred to the heater in 90 s.

（2024 冬季 0625/31 第10题(a)）

3. **(a)** The battery in a laptop computer is connected to a battery charger for 20 minutes. The potential difference (p.d.) across the battery is 14 V. The current in the battery is 1.8 A.

Calculate the energy transferred to the battery in 20 minutes.

（2024 夏季 0625/32 第8题(a)）

4. Fig. 3.1 shows a mains electric heater used to heat a small room.

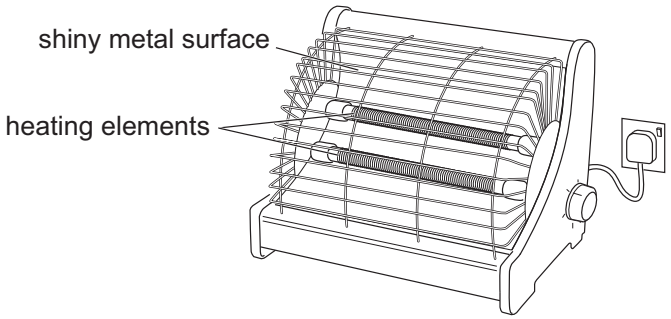


Fig. 3.1

(d) The mains voltage is 230 V. The two identical heating elements are connected in parallel. Each heating element has a resistance of 89 Ω.

(i) Calculate the current in **one** heating element.

(ii) Show that the electrical power of the heater is approximately 1200 W. State any equation you use in words or symbols.

(iii) The heater is 95% efficient at converting electrical work done to thermal energy.

Calculate the thermal energy emitted by the heater in **(d)(ii)** in 60 s. Give your answer to **two** significant figures.

（2025 春季 0625/42 第3题(d)）

二. 先由 P=IV 求每秒转移能量

知识点 电功率表示电路每秒转移的电能，$P = IV$，其中 P、I、V 的单位分别为 W、A、V。

电压和电流保持不变时，时间 t 内转移的电能为 _____，E 的单位为 J，t 的单位为 s。

电流是单位时间通过导体横截面的电荷量，$I = \frac{Q}{t}$，故 _____，Q 的单位为 C。

计算时，1 kW $= 10^3$ W，1 h $= 3600$ s。

答案：$E = Pt = IVt$；$Q = It$

怎么认 题目出现电压、功率、通电时间并求电荷时，先由 $P = IV$ 求电流。

例题 2 An electric fire is connected to a 240 V supply and transfers energy at a rate of 1.0 kW.

How much charge passes through the fire in 1.0 h?

A 42 C **B** 250 C **C** 1.5 10^4 C **D** 2.4 10^5 C

（2023 夏季 0625/22 第27题）

解： $P = 1.0$ kW $= 1.0 \times 10^3$ W，$t = 1.0$ h $= 3.6 \times 10^3$ s。

由 $P = IV$ 得

$I = \frac{P}{V} = \frac{1.0 \times 10^3}{240} = \frac{25}{6}$ A。

由 $Q = It$ 得

$Q = \frac{25}{6} \times 3.6 \times 10^3 = 1.5 \times 10^4$ C。故选 C。

针对练习

5. Fig. 6.1 shows the circuit diagram for a flashlight (torch).

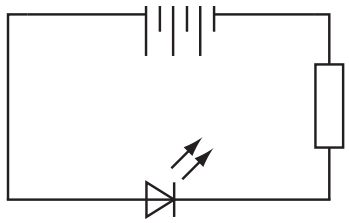


Fig. 6.1

The electromotive force (e.m.f.) of the battery is 4.5 V. The circuit contains a 60 Ω fixed resistor. The current in the light-emitting diode (LED) is 0.020 A.

(c) The chemical energy stored in the battery is 1050 J.

Show that the flashlight operates for approximately 3 h.

（2023 冬季 0625/42 第6题(c)）

6. Fig. 9.1 shows a wireless charging plate used to charge the battery in a mobile phone (cell phone). The coil of wire is part of an electric circuit.

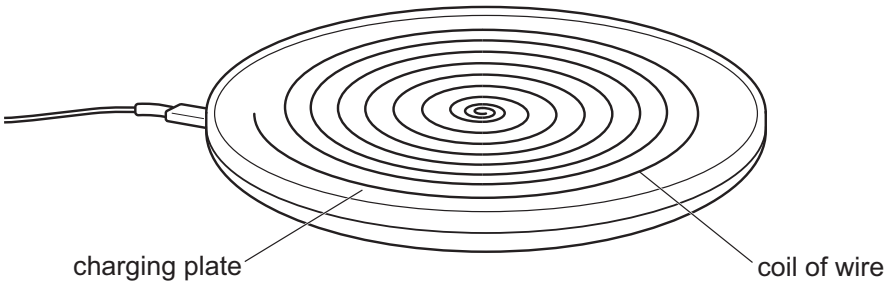


Fig. 9.1

The charging plate is connected to an a.c. power supply. The power supply is turned on.

(c) The mobile phone battery can be recharged using this charging plate and stores 4.5×10^4 J of energy when fully recharged. The current in the secondary coil is 0.63 A when the output voltage is 12 V.

(i) Calculate the time taken to fully recharge a completely uncharged battery.

(ii) Calculate the charge passing through the battery in 60 s.

（2024 冬季 0625/42 第9题(c)）

题型 2：用 P=IV 算电功率（考频★★☆☆☆）

知识点 电功率表示电路元件单位时间内转移的电能，$P = \frac{E}{t}$。

同一元件两端电压为 V、通过的电流为 I 时，$P =$ _____；对满足欧姆定律的电阻，还有 $P = I^2R$。电压用伏特、电流用安培时，功率单位为_____（W）；计算前各物理量的单位应保持一致。

答案：IV；瓦特

怎么认 题目出现电压、电流或电阻并求功率时，先统一单位，再用 $P = IV$ 或等价式。

例题 1 There is a current I in a resistor. The potential difference (p.d.) across the resistor is V.

What does the product IV represent?

A the charge flowing through the resistor

B the energy transferred by the resistor

C the power dissipated by the resistor

D the resistance of the resistor

（2025 春季 0625/12 第30题）

解： 由电功率关系得

$P = IV$。

故 IV 表示电阻耗散的电功率。故选 C。

针对练习

1. An electric heater uses a resistance wire of resistance 26 Ω. The power dissipated in the resistance wire is 2500 W.

(a) Calculate the current in the resistance wire.

（2023 夏季 0625/43 第6题(a)）

2. Fig. 9.1 shows an electric water heater. The heater is connected to the mains electrical supply.

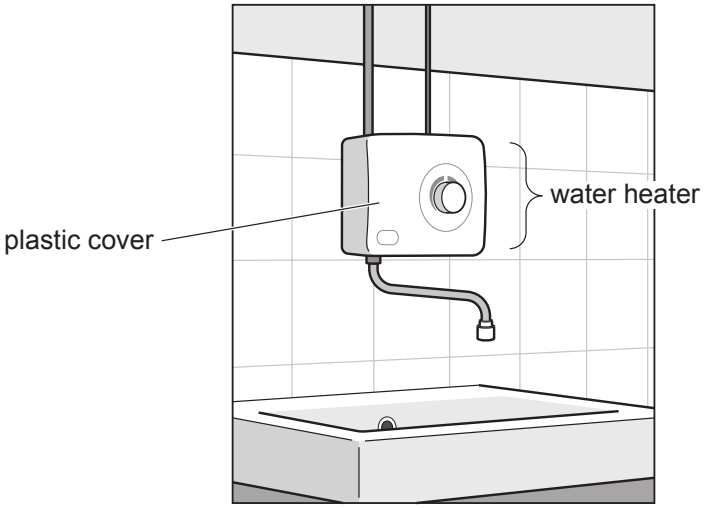


Fig. 9.1

Fig. 9.2 shows the electrical safety label for the heater.

Water Heater Model xxxxxx1
230 V (volts)
720 W (watts)
Disconnect from the mains supply before removing the plastic cover.

Fig. 9.2

(a) (i) Explain why the safety label states, 'Disconnect from the mains supply before removing the plastic cover.'

(ii) The heater is switched on.

Calculate the current in the heater. Use the information in Fig. 9.2.

（2023 冬季 0625/32 第9题(a)）

3. The table gives data for four different electrical devices.

Which device develops the greatest power?

	device	voltage	current
A	car headlight	12 V	3.0 A
B	cooling fan	110 V	0.40 A
C	electric spark generator	400 kV	0.10 mA
D	mains lamp	240 V	0.20 A

（2025 夏季 0625/11 第27题）

题型 3：用千瓦时算耗电费（考频★★☆☆☆）

知识点 电功率 P 表示电路转移能量的快慢，关系式为 $P = IV$，P、I、V 的单位分别为 W、A、V。用电器在时间 t 内转移的电能为 $E = Pt$；以千瓦时计算时，功率用_____作单位，时间用_____作单位。

1 kW h 是功率为 1 kW 的用电器工作 1 h 所转移的能量；电费等于_____乘每千瓦时电价。

答案：千瓦（kW）；小时（h）；用电量（kW h）

怎么认 题目出现电器功率、使用时间和每 1 kW h 电价时，先用 $E = Pt$ 算用电量。

例题 1 Fig. 9.1 shows an electric kettle.

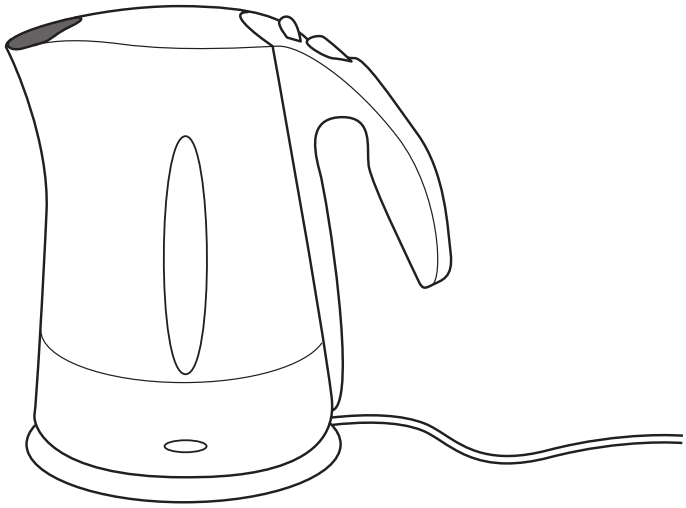


Fig. 9.1

(a) (i) The power input of the kettle is 1.5 kW. The potential difference of the mains electrical supply for the kettle is 220 V.

Calculate the current in the kettle when it is switched on.

(ii) The 1.5 kW kettle is used for a total of 4.0 hours. The cost of 1.0 kW h of electrical energy is 14 pennies (p).

Calculate the cost of the energy used by the kettle in 4.0 hours.

（2023 春季 0625/32 第9题(a)）

解：1.5 kW = 1500 W，由 $P = IV$ 得

$I = \frac{P}{V} = \frac{1500}{220} \approx 6.8$ A

由 $E = Pt$ 得 $E = 1.5 \times 4.0 = 6.0$ kW h

费用 $= 6.0 \times 14 = 84$ p

答：电流为 6.8 A，使用 4.0 h 的电费为 84 p。

针对练习

1. The cost of electrical energy is $0.25 for each unit of 1 kW h. A 2200 W heater is switched on for 48 minutes.

What is the cost of this use?

A $0.44 **B** $0.55 **C** $26 **D** $440

（2023 夏季 0625/23 第26题）

2. A television uses many electrical components.

(d) The energy used by the television in one hour is 0.14 kWh. The cost of one kWh of energy is 36 cents.

Calculate the cost of using the television for 6.0 hours.

（2025 冬季 0625/31 第8题(d)）

3. **(c)** **(i)** Define the kilowatt-hour (kW h) in words.

(ii) A small lamp illuminates an electric oven. The lamp has an output power of 25 W and operates for 220 hours in one year. The p.d. across the lamp is 230 V.

1. Calculate the energy transferred by the lamp in one year. Give your answer in kW h.

2. Calculate the current in the lamp.

（2025 夏季 0625/42 第7题(c)）

4.3.1 电路图与电路元件

题型 1：辨符号并按连接画电路（考频★★★★☆）

知识点 电路图用标准符号表示元件；识别时先按符号外形确定元件，再核对题目要求的功能。

圆圈内标有 M 的是_____，圆圈内有交叉线的是灯泡，分段矩形是_____。

矩形内有贯穿直线的是熔断器；斜箭头穿过矩形电阻的是可变电阻。

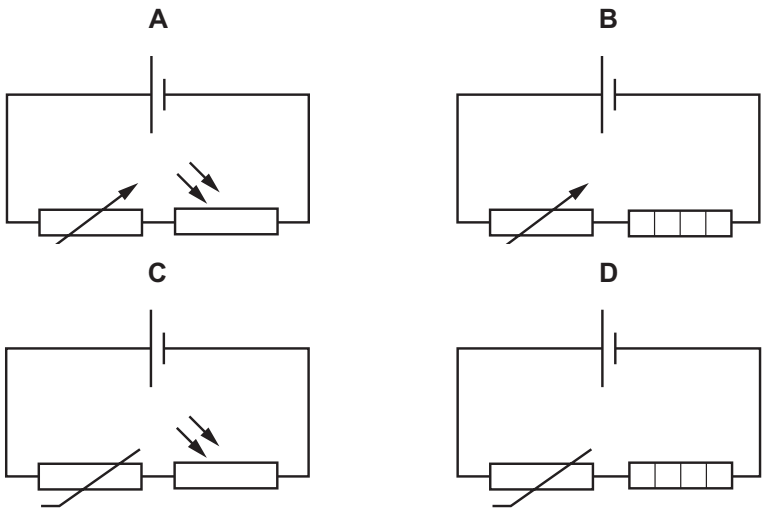
斜线带短折线的是热敏电阻；两支箭头指向矩形电阻的是_____。

答案：电动机；加热器；光敏电阻

怎么认 题目出现元件名称和若干电路符号时，先按外形逐个认出符号，再核对所需元件。

一. 先逐个认标准符号

例题 1 Which circuit contains a thermistor and a heater?



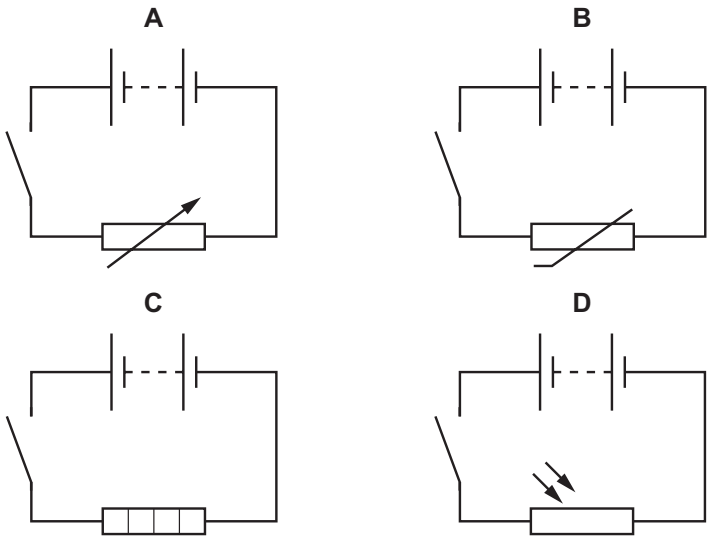
（2025 春季 0625/12 第31题）

解：斜线带短折线的矩形电阻为热敏电阻，分段矩形为加热器。

图 D 同时含有热敏电阻和加热器。故选 D。

针对练习

1. Which circuit contains a light-dependent resistor (LDR)?



（2025 冬季 0625/22 第27题）

2. Fig. 9.1 shows a series circuit. Two of the components in the circuit are labelled.

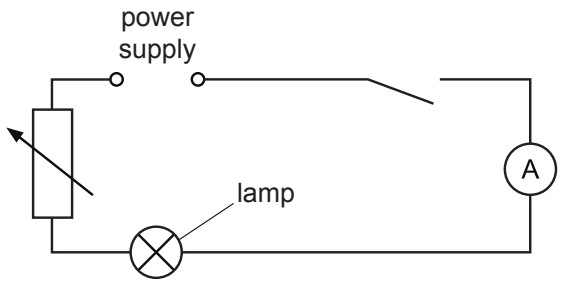


Fig. 9.1

(a) State the name of **two** other components in the circuit.

（2023 夏季 0625/31 第9题(a)）

3. **(a)** Fig. 8.1 shows the electrical symbols for some circuit components.

Draw a line from each electrical symbol to the name of the circuit component it represents.

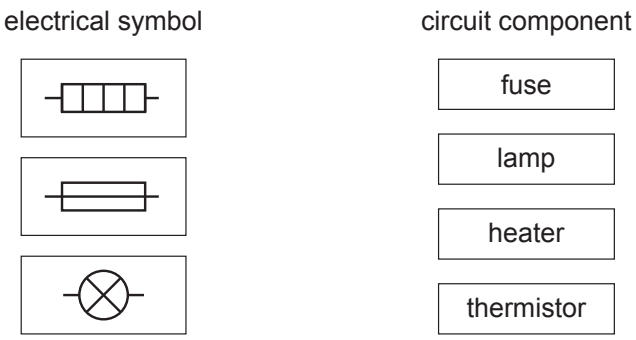
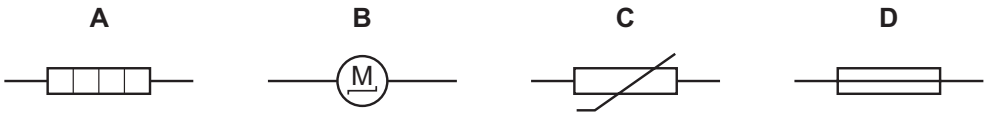


Fig. 8.1

（2023 夏季 0625/33 第8题(a)）

4. Which symbol represents a device that contains a current-carrying coil in a magnetic field?



（2024 冬季 0625/13 第29题）

二. 先沿导线定串并联再换符号

知识点 电路图用标准符号表示元件，并保留实物电路中的每个接点、分支及元件间的_____；导线形状与元件位置可以改变，但接法必须保持不变。

电流表测量通过元件的电流，必须与被测元件_____；电流单位为安培，符号为 A。

电压表测量元件两端的电势差，必须跨接在元件两端，与被测元件_____；电势差单位为伏特，符号为 V。

答案：连接关系；串联；并联

怎么认 题目出现实物电路图并要求补画电路图时，先沿导线确定接点和分支，再换成标准符号。

例题 2 Fig. 8.1 shows part of a circuit for measuring the resistance of a lamp.

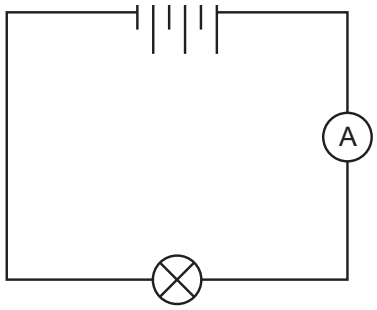


Fig. 8.1

(a) Draw on Fig. 8.1 to show how to connect a voltmeter to measure the potential difference across the lamp. Use the electrical symbol for a voltmeter.

（2024 夏季 0625/33 第8题(a)）

解： 灯泡左、右两端是被测电势差的两个端点，电压表应跨接在这两个端点之间。

在图 8.1 中，从灯泡两端各引出一条导线，在两线之间画圆圈内标有 V 的电压表符号。

答：电压表与灯泡并联。

5. A student investigates circuits containing different combinations of resistors.

Circuit A is shown in Fig. 3.1. Circuit A is **not** complete.

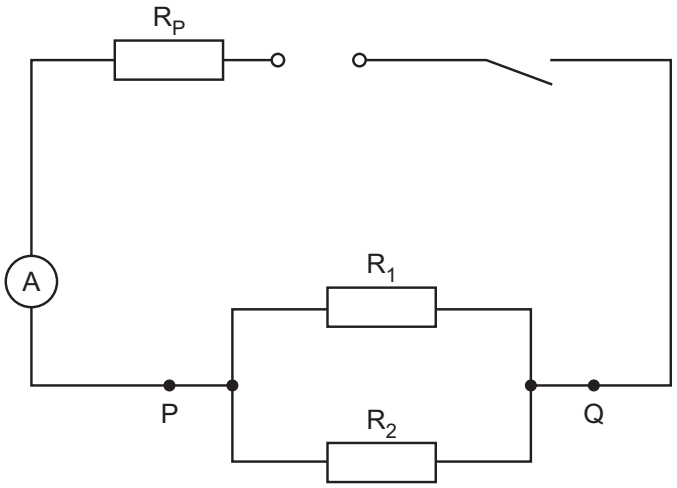
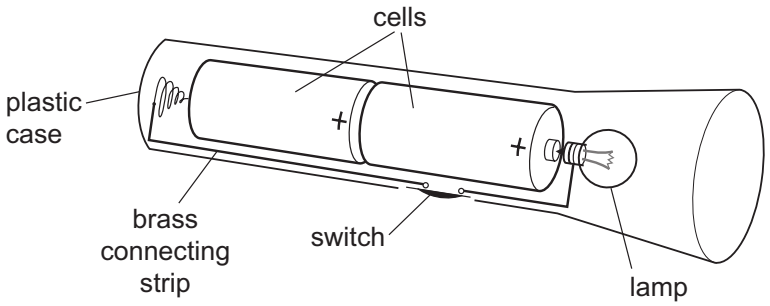


Fig. 3.1

(a) On Fig. 3.1, complete the circuit to show a voltmeter connected to measure the potential difference (p.d.) across the terminals P and Q.

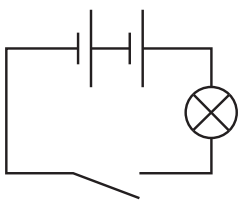
（2025 夏季 0625/63 第3题(a)）

6. The diagram shows a torch containing two cells, a switch and a lamp.

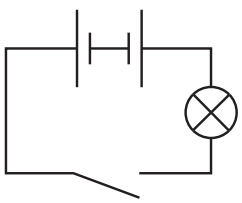


Which circuit diagram is correct for the torch?

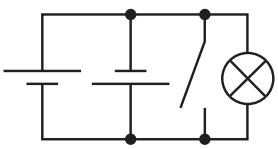
A



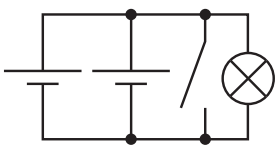
B



C



D



（2024 冬季 0625/13 第28题）

7. A teacher connects the circuit shown in Fig. 9.1.

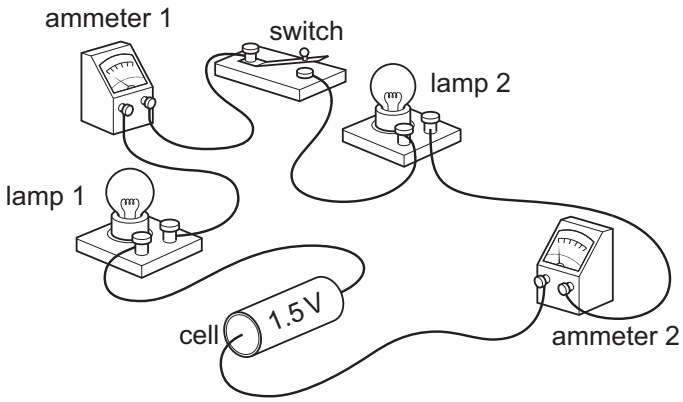


Fig. 9.1

(c) The teacher draws a circuit diagram for the circuit in Fig. 9.1. The circuit diagram is not completed.
Fig. 9.2 shows the teacher's incomplete circuit diagram.

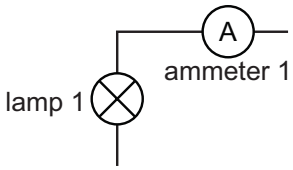


Fig. 9.2

Complete the circuit diagram by adding the symbols correctly connected.

（2025 冬季 0625/31 第9题(c)）

8. **(c)** A circuit consists of a d.c. power supply, a lamp and a thermistor.

(i) Draw a circuit diagram of these components connected in series.

(ii) Explain what happens in the circuit you have drawn in **(c)(i)** when the temperature of the thermistor is increased.

（2023 春季 0625/42 第7题(c)）

三. 先认斜箭头与串联限流位置

知识点 定值电阻用矩形表示；可变电阻在矩形上加一条_____电阻的斜箭头，改变接入电路的电阻可连续调节电流。
电势分压器有三个接线端，在矩形电阻上方加一条带箭头的支路，箭头_____电阻中部。
定值电阻与电路串联时可限制过大的电流；电阻的单位为欧姆，符号为 Ω。

答案：斜穿；垂直指向

怎么认 题目出现电阻矩形、箭头或串联电阻时，先看箭头方向和接线端数，再判断元件作用。

例题 3 **(a)** Draw the circuit symbol for a potential divider.

（2024 春季 0625/42 第7题(a)）

解：电势分压器有三个接线端，先画横向矩形电阻及左右接线端，再从上方画第三条接线，末端带箭头并垂直指向电阻中部。
答：图形为三端电势分压器符号。

9. In this experiment, you will investigate the resistance of a wire.

Refer to Fig. 2.1.

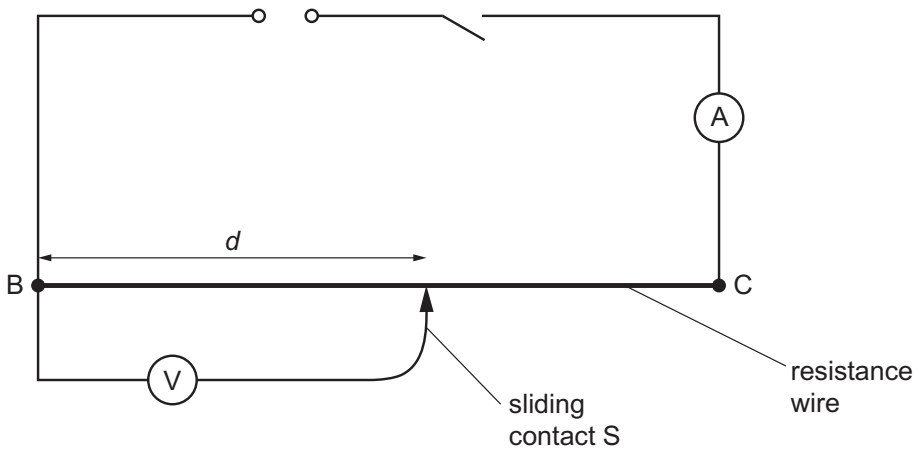


Fig. 2.1

(e) A variable resistor is a circuit component that can be made using a coil of resistance wire.

Draw the electrical symbol for a variable resistor.

（2024 夏季 0625/51 第2题(e)）

10. A student investigates a circuit containing different combinations of three resistors.

She first uses Circuit A, shown in Fig. 2.1.

Circuit A

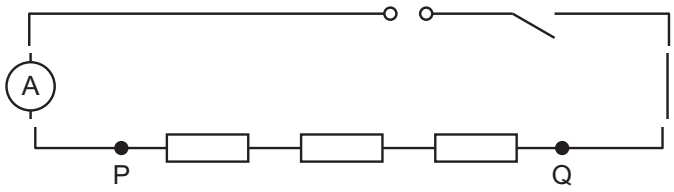


Fig. 2.1

(e) A student investigates the resistors in Circuit A using a variable resistor to change the current in the circuit.

(i) In the space below, draw the symbol for a variable resistor.

(ii) Suggest **one** advantage of using a variable resistor to change the current in the circuit.

（2024 春季 0625/62 第2题(e)）

11. In this experiment, you will investigate circuits containing different combinations of resistors. Fig. 2.1 shows **circuit A** which has been set up for you.

Carry out the following instructions, referring to Fig. 2.1.

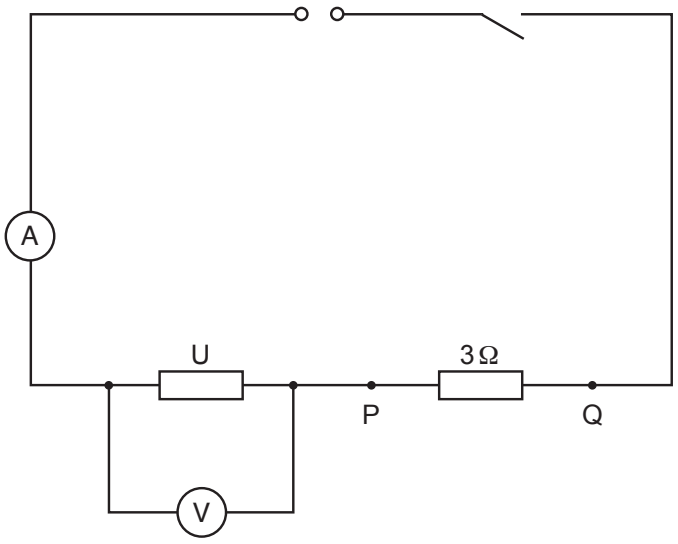


Fig. 2.1

(a) Circuit A

Close the switch.

Measure, and record in Table 2.1, the potential difference (p.d.) V across resistor U.

Measure, and record in Table 2.1, the current I in the circuit.

Open the switch.

Table 2.1

circuit	V/V	I/A	R/Ω
A			
B			
C			

(e) A student determines the resistance of resistor U using a variable resistor to control the current in the circuit.

(i) Briefly explain **one** advantage of using a variable resistor for this purpose rather than the procedure carried out in **(a)**, **(b)** and **(c)**.

(ii) Draw the circuit symbol for a variable resistor.

（2023 夏季 0625/53 第2题(e)）

12. A student investigates the resistances of identical wires connected in parallel.

She uses the circuit shown in Fig. 2.1.

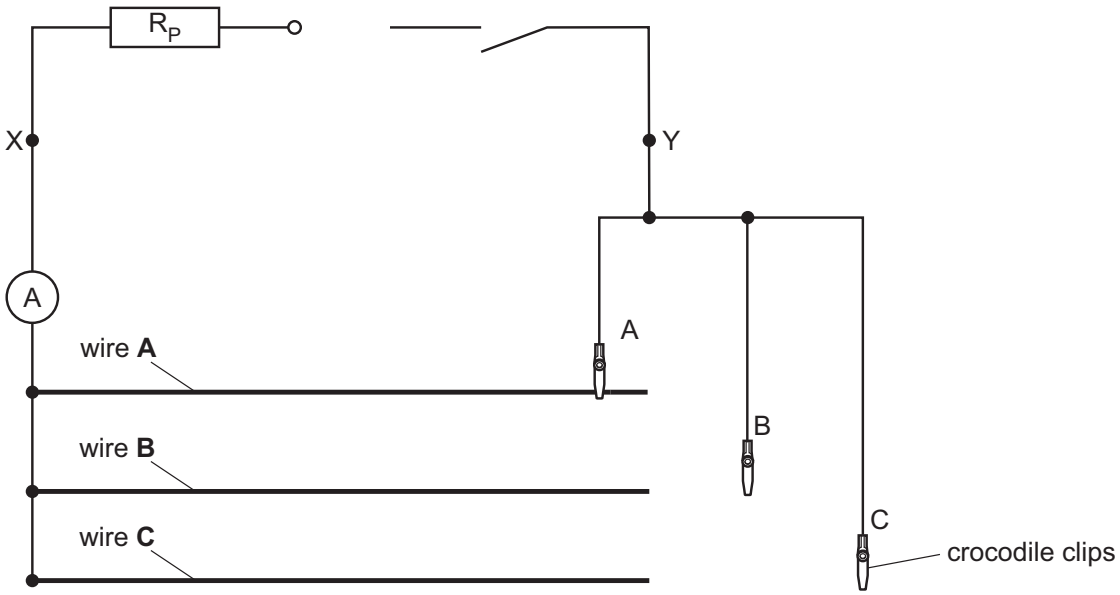


Fig. 2.1

(e) Briefly explain why resistor R_P, shown in Fig. 2.1, must remain in place throughout the experiment.

（2025 冬季 0625/63 第2题(e)）

题型 2：沿闭合回路判通断（考频★★☆☆☆）

知识点 元件中有持续电流，必须有电源在该路径中提供电势差，并形成_____；路径中的开关均应_____。

电路中有多个支路时，应分别沿每条支路检查；遇到断开的开关、断路或不能工作的元件，该路径中没有持续电流。

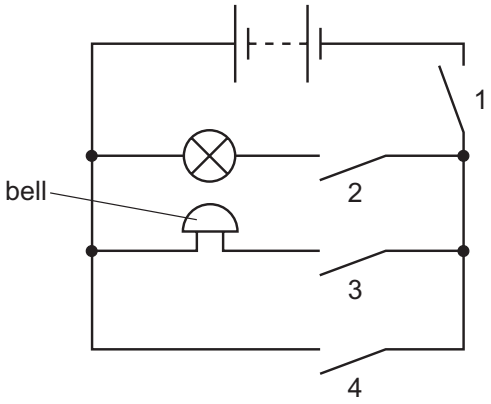
闭合开关可能接通支路，也可能使某元件被导线旁路；被旁路的元件两端无电势差。

变压器初级接直流电源时，次级线圈中没有持续的感应电流。

答案：完整闭合回路；闭合

怎么认 题目出现含多个开关或支路的电路图，且问哪些元件工作时，先逐条检查各支路能否连接电源两端。

例题 1 A student connects the circuit shown.



Which switches must be closed for the bell to ring without lighting the lamp?

A 1 and 2 only **B** 1 and 3 only **C** 1, 3 and 4 **D** 2, 3 and 4

（2023 夏季 0625/11 第29题）

解：电源接入电路，开关 1 必须闭合。
使电铃所在支路形成完整闭合回路，开关 3 必须闭合。
灯泡支路的开关 2 保持断开，灯泡不亮；开关 4 保持断开。
故选 B。

针对练习

1. **(a)** A student connects a circuit with two lamps and three switches, S_1, S_2 and S_3, as shown in Fig. 8.1.

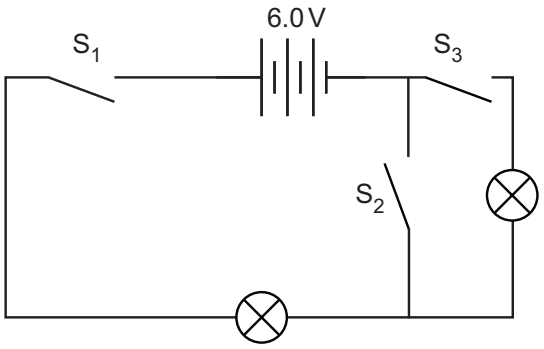


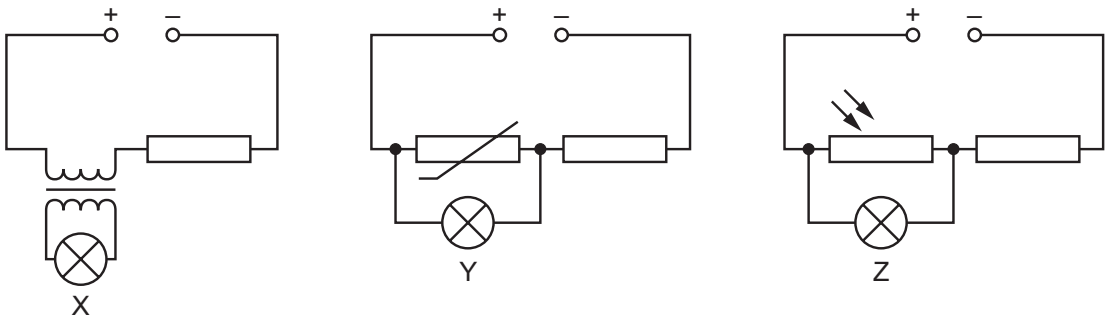
Fig. 8.1

(i) The student switches on **one** lamp.
State which switches the student closes to switch on only **one** lamp.

(ii) The student opens all the switches then switches on **two** lamps.
State which switches the student closes to switch on **two** lamps.

（2024 冬季 0625/33 第8题(a)）

2. X, Y and Z are lamps.



In which lamps is there a current?

	X	Y	Z
A	✓	✗	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

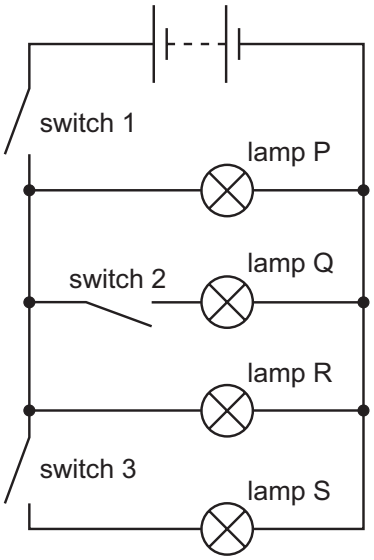
key

✓ = current in lamp

✗ = no current in lamp

（2023 春季 0625/12 第28题）

3. The circuit shown contains three switches and four lamps P, Q, R and S.



Which switches must be closed to light only lamps P and R?

A switch 1 only

B switch 1 and switch 2

C switch 1 and switch 3

D switch 2 and switch 3

（2023 夏季 0625/23 第28题）

题型 3：由温度和光强判传感器（考频★★★☆☆）

知识点 热敏电阻是电阻随温度变化的元件；NTC 热敏电阻的温度越高，电阻越_____。
光敏电阻（LDR）是电阻随光强变化的元件；光强越大，电阻越_____，电阻–光强图线向右下降。
在串联电路且电源电压不变时，传感器电阻减小，总电阻随之_____，电流增大。电阻的单位为 Ω；温度和光强按题目所给单位或标度表示。

答案：小；小；减小

怎么认 题目出现 NTC 热敏电阻或 LDR，要求画关系图或判断电流、亮度时，先判断温度或光强怎样改变电阻。

一. 先写升温或变亮使电阻减小

例题 1 A light-dependent resistor (LDR) has a low resistance in high light intensity and a high resistance in the dark.

(a) Sketch a graph of resistance (*y*-axis) against light intensity (*x*-axis) for an LDR.

（2025 春季 0625/42 第5题(a)）

解：横轴表示光强，纵轴表示电阻。
LDR 的光强越大，电阻越小，故图线随光强增大而下降。
答：两坐标轴分别标为光强和电阻，作负斜率直线或平滑曲线。

针对练习

1. What is a thermistor?

A a container to keep a hot liquid warm

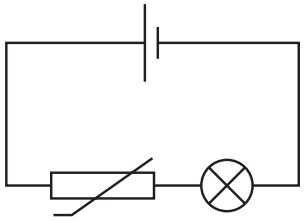
B a circuit to control room temperature

C a temperature-dependent resistor

D a heater for a room

（2024 冬季 0625/11 第28题）

2. The diagram shows a circuit.



Which change causes the bulb in the circuit to become brighter?

A a decrease in light intensity

B a decrease in temperature

C an increase in light intensity

D an increase in temperature

（2023 春季 0625/12 第29题）

3. A student connects the electrical circuit shown in Fig. 9.1.

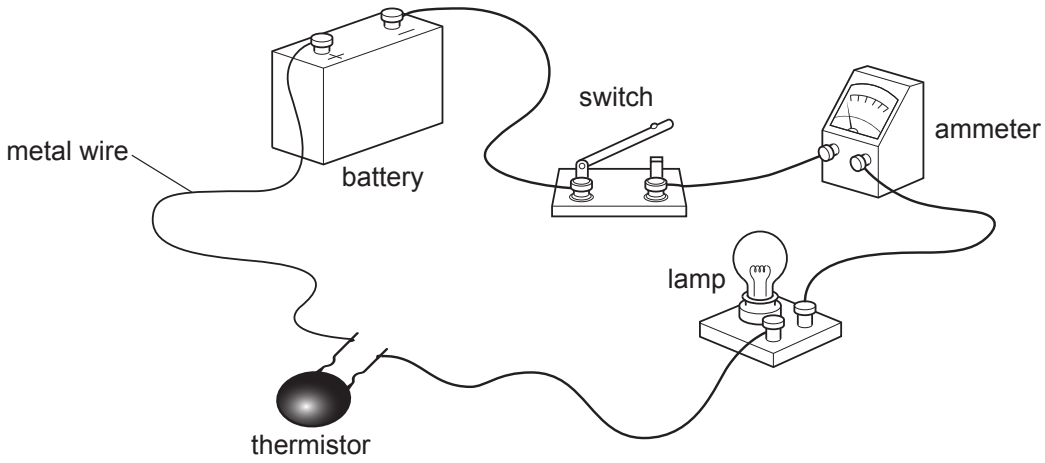


Fig. 9.1

(c) The student increases the temperature of the thermistor.

State and explain what happens to the current in the circuit.

（2024 春季 0625/32 第9题(c)）

二. 先判传感器阻值，再判线圈分压

知识点 负温度系数热敏电阻（NTC thermistor）的温度升高时，电阻_____；光敏电阻（LDR）的光强增大时，电阻_____。

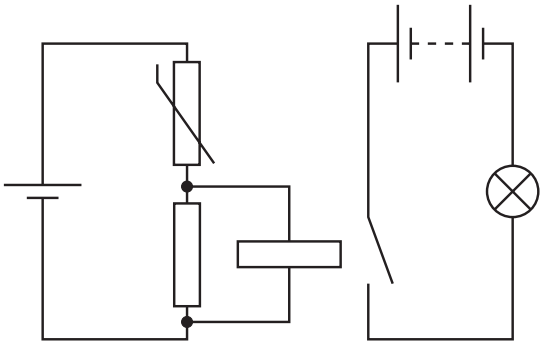
在电源电压不变时，串联分压器中电阻为 R_x 的部分分得的电压为 $V_x = V_s \frac{R_x}{R_1+R_2}$；电阻和电压的单位分别为 Ω 和 V。

继电器线圈两端的电压增大时，线圈电流增大；电流达到吸合值后，常开触点闭合，受控电路接通。

答案：减小；减小

怎么认 题目出现传感器、串联电阻和继电器线圈时，先判传感器阻值变化，再判线圈分压变化。

例题 2 The diagram shows a circuit that switches on a lamp when there is a change in the environment.



Which change in the environment causes the lamp to be switched on?

A a decrease in light intensity

B a decrease in temperature

C an increase in light intensity

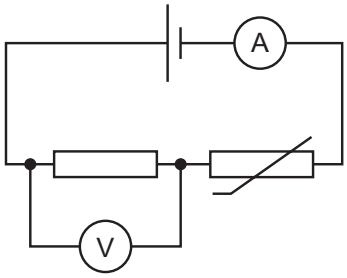
D an increase in temperature

（2023 夏季 0625/22 第29题）

解：图中上方元件为热敏电阻，温度升高时，其电阻 R_T 减小。
设下方定值电阻与继电器线圈组成部分的等效电阻为 R_p，则 R_p 不变。
$V_{\text{coil}} = V_s \frac{R_p}{R_T + R_p}$
R_T 减小时，V_{coil} 增大，线圈电流增大，常开触点闭合，灯泡发光。故选 D。

针对练习

4. A resistor and a thermistor are connected in a series circuit, as shown.



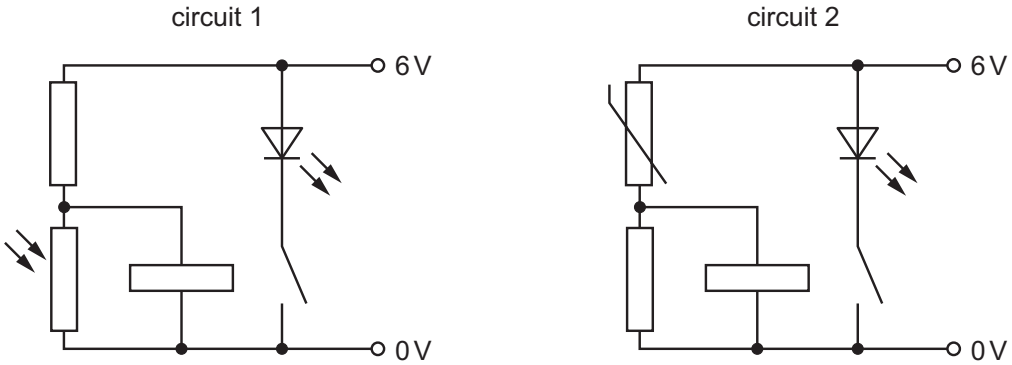
What happens to the readings on the ammeter and the voltmeter when the thermistor is heated?

	ammeter reading	voltmeter reading
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2025 夏季 0625/12 第29题）

5. The diagram shows two circuits.

Each relay is normally open when there is no current in the coil.



Which environmental conditions will cause the light-emitting diodes in circuit 1 and circuit 2 both to emit light?

	temperature	light intensity
A	high	high
B	high	low
C	low	high
D	low	low

（2024 夏季 0625/23 第31题）

题型 4：顺电流方向判断二极管（考频★★★☆☆）

知识点 二极管具有_____导电性：正向偏置时可导通，反向偏置时电阻很大，电路近似断路。
判断含二极管的电路时，从电源_____极出发，沿传统电流方向逐个检查；一条路径上的二极管均正向导通时，该路径才可能形成闭合通路。
发光二极管（LED）在正向偏置并有电流通过时发光，反向偏置时不发光；方向判断不涉及物理量单位。

答案：单向；正

怎么认 题目出现含二极管的电路图，并问电流或灯的状态时，先从电源正极沿传统电流方向检查各条路径。

一. 先从电源正极检查正向导通

例题 1 Fig. 6.1 shows the circuit diagram for a flashlight (torch).

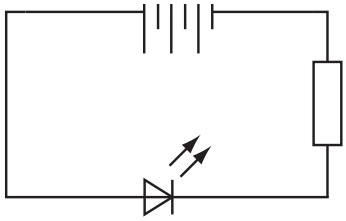


Fig. 6.1

The electromotive force (e.m.f.) of the battery is 4.5 V. The circuit contains a 60 Ω fixed resistor. The current in the light-emitting diode (LED) is 0.020 A.

(b) Explain why the LED does **not** light up if the battery is reversed.

（2023 冬季 0625/42 第6题(b)）

解：电池反接后，原来通过 LED 的传统电流方向反向，LED 处于反向偏置。
LED 反向电阻很大，电路中没有电流，因而不发光。
答：电池反接使 LED 反向偏置，电流不能通过。

针对练习

1. A student investigates the resistance *R* of a diode using the circuit shown in Fig. 2.1.

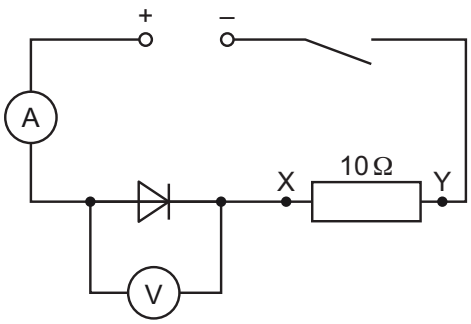


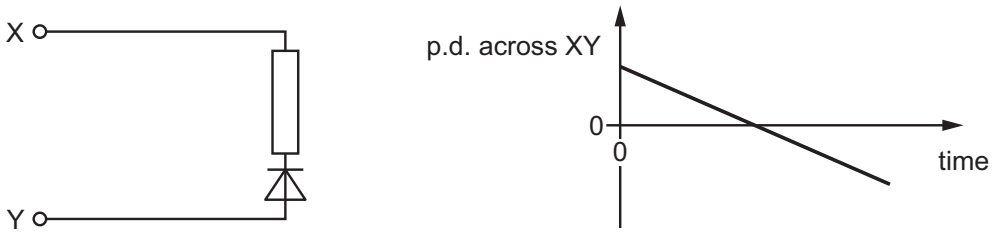
Fig. 2.1

(e) A student attempts to set up the circuit shown in Fig. 2.1. The student finds that the ammeter does **not** give a reading when the circuit is complete. The ammeter is **not** broken.

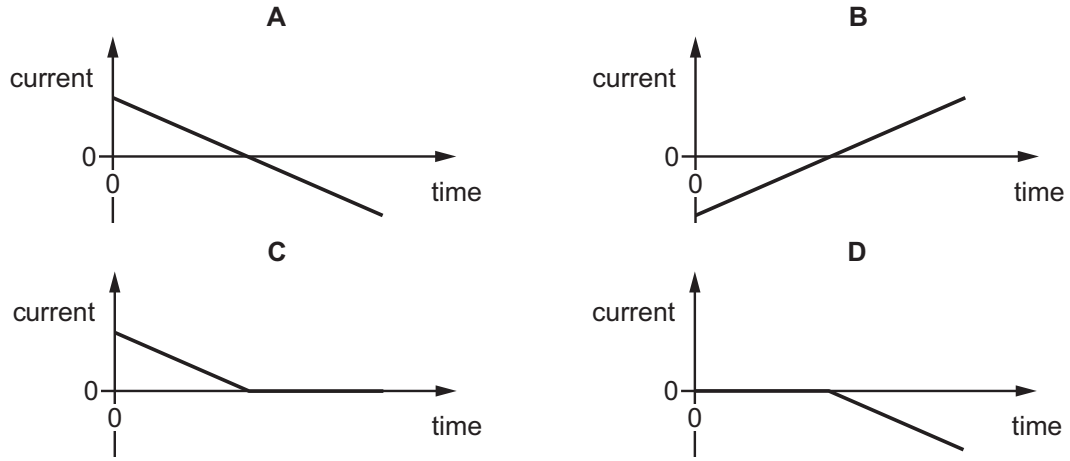
Suggest what the student may have done incorrectly while setting up the circuit.

（2024 夏季 0625/62 第2题(e)）

2. A diode and a resistor are connected across a variable d.c. supply. Terminal X is initially positive and at a maximum value. The potential difference (p.d.) across XY is adjusted so that it changes, as shown by the graph.

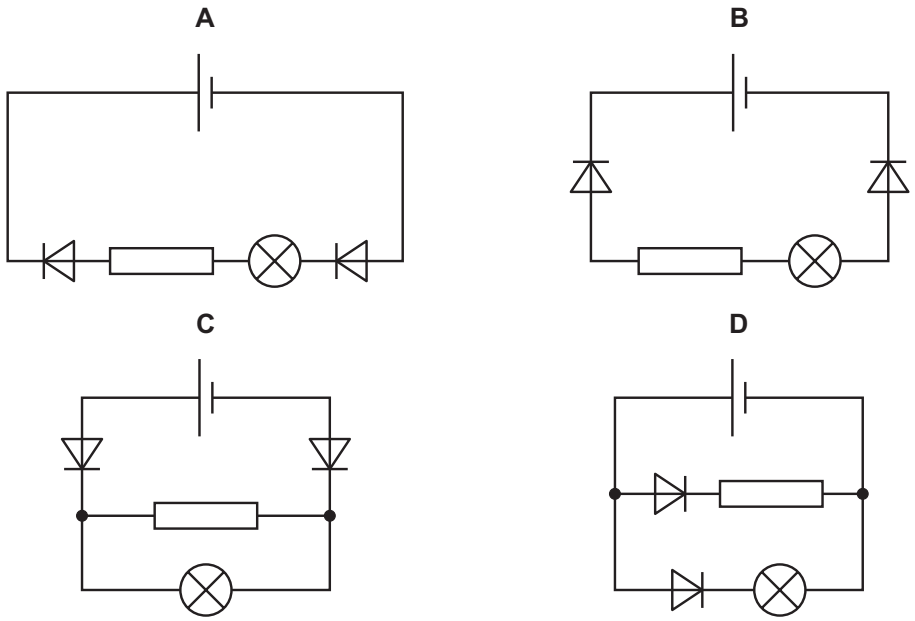


Which graph shows how the current in the circuit (from X to Y) varies during the same time interval?



（2024 夏季 0625/21 第27题）

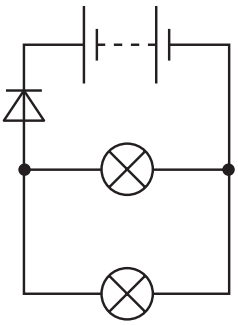
3. In which circuit does the lamp light?



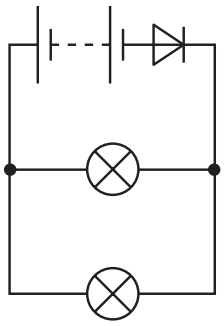
（2025 冬季 0625/23 第29题）

4. In which circuit do both lamps light?

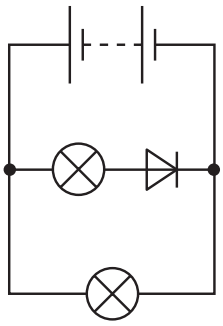
A



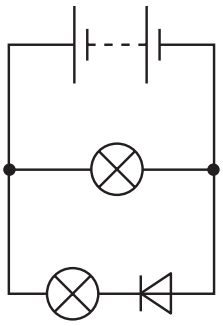
B



C



D



（2024 春季 0625/22 第29题）

二. 分正负半周分别判导通

知识点 二极管具有_____性，正向偏置时导通，反向偏置时截止。

交流电每个周期改变两次方向，串联一个二极管时，每个周期只有_____半周能通过负载，称为半波整流。

四个二极管组成桥式整流电路时，两个半周流过负载的方向相同，输出为_____电流。

答案：单向导电；一个；单向脉动

怎么认 题目出现交流电源、二极管和负载波形时，先分正、负半周判断二极管是否导通。

例题 2 Which electrical device is used to convert a.c. to d.c.?

A diode

B relay

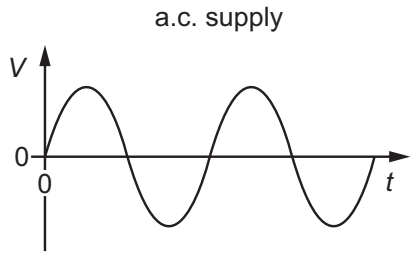
C thermistor

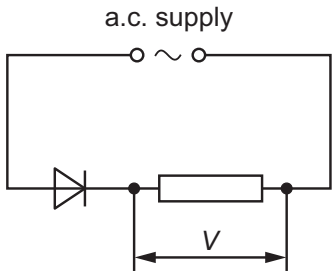
D transformer

（2025 夏季 0625/22 第30题）

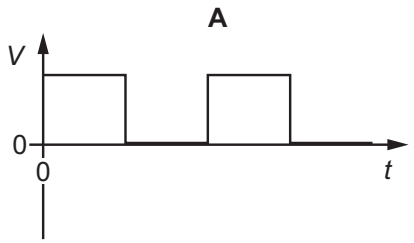
解： 二极管仅允许一个方向的电流通过，可使交流电变为单向脉动电流。故选 A。

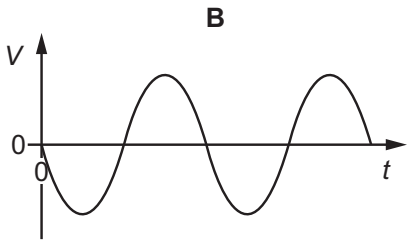
5. An alternating (a.c.) supply is connected to a diode and a resistor in series.

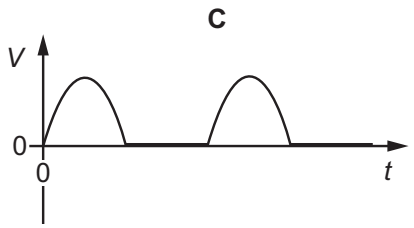


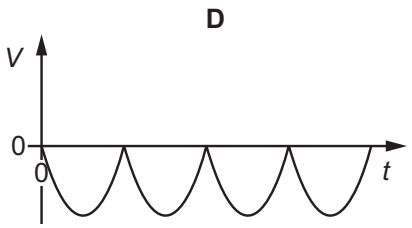


Which graph shows how the potential difference *V* across the resistor varies with time *t*?



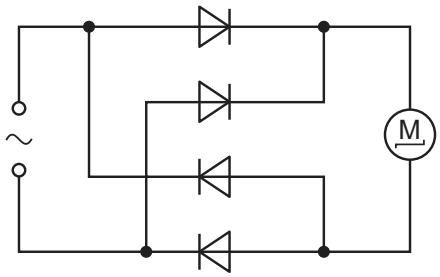




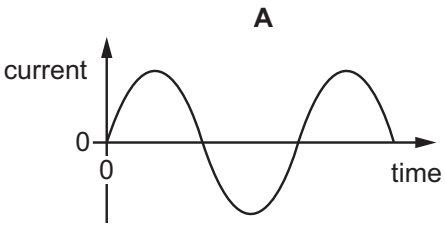


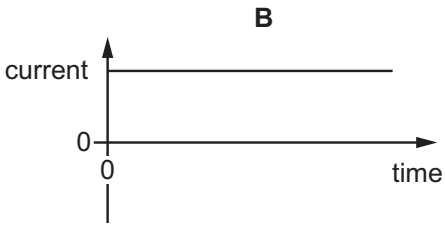
（2023 冬季 0625/21 第29题）

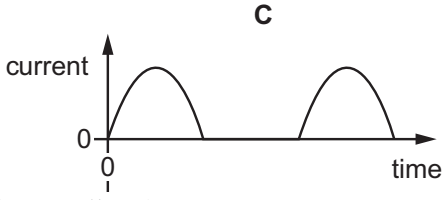
6. The circuit diagram shows a circuit used to run a d.c. motor from an a.c. supply.

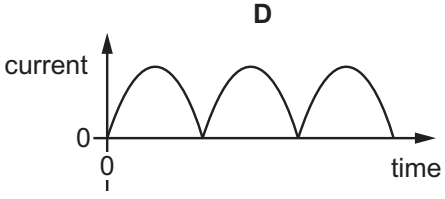


Which graph shows the current in the motor?









（2023 冬季 0625/22 第29题）

4.3.2 串联电路与并联电路

题型 1：先用串联规律（考频★★★★☆）

知识点 电动势表示电源使单位电荷获得能量的能力，单位是伏特，符号为 V。

多个电源串联时，先选定绕行方向；由负极到正极取正，由正极到负极取负，合电动势等于各电动势的_____。

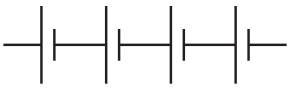
电源同向串联时电动势_____；反向串联时电动势相减。

答案：带符号的和；相加

怎么认 题目出现串联电池的极性图或给出每节电动势并求总电动势时，先按极性给各电动势标正负号。

一. 同向电动势相加，反向相减

例题 1 Four 2.0 V cells are connected together in series to make a battery, as shown.



What is the combined electromotive force (e.m.f.) of the battery?

A 0.50 V　　**B** 2.0 V　　**C** 6.0 V　　**D** 8.0 V

（2025 春季 0625/12 第32题）

解：四节电池同向串联，电动势相加，

$E = 4 \times 2.0\ \text{V}$

$E = 8.0\ \text{V}$

故选 D。

针对练习

1. Fig. 7.1 shows a lamp connected in series with four 1.5 V cells and an ammeter. A voltmeter is connected across the lamp.

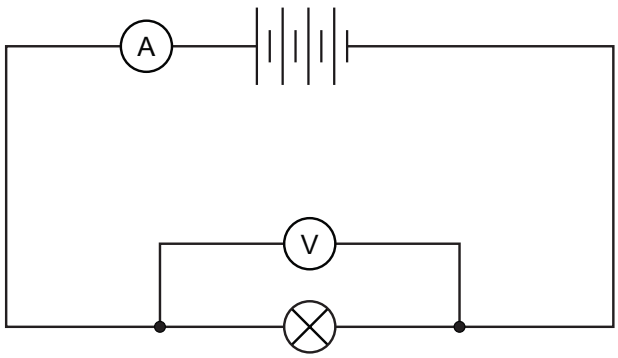
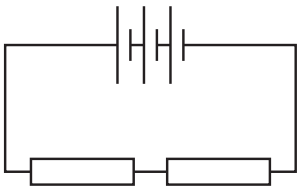


Fig. 7.1

(a) Determine the potential difference across the four cells.

（2025 冬季 0625/32 第7题(a)）

2. A teacher makes a circuit using three 1.5 V cells and two 20 Ω resistors connected in series.



Which row gives the combined electromotive force (e.m.f.) of the cells and the combined resistance of the resistors?

	combined e.m.f. / V	combined resistance / Ω
A	1.5	10
B	1.5	40
C	4.5	10
D	4.5	40

（2025 夏季 0625/11 第31题）

3. A student investigates an electric circuit. Fig. 9.1 shows the student's circuit.

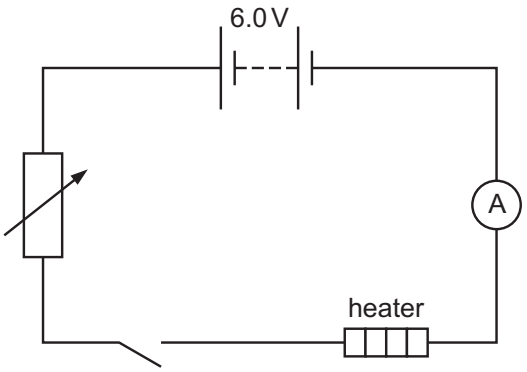


Fig. 9.1

(a) (i) Describe the purpose of the variable resistor in Fig. 9.1.

(ii) The student uses cells with an electromotive force (e.m.f.) of 1.5 V.

Determine the number of cells needed for the 6.0 V battery in Fig. 9.1.

（2023 冬季 0625/31 第9题(a)）

4. Fig. 8.1 shows an arrangement for making an electromagnet. The electromagnet consists of a solenoid and a core.

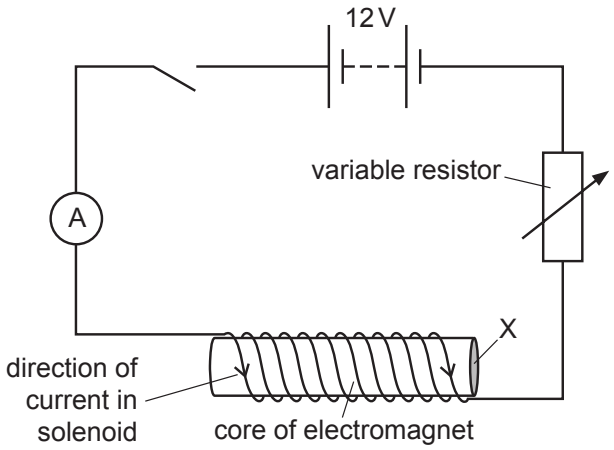


Fig. 8.1

(a) (i) The electromagnet is a temporary magnet.

State **one** material which is suitable for the core of the electromagnet.

(ii) The battery is made from cells connected in series. Each cell in the battery has an electromotive force (e.m.f.) of 1.5 V.

Calculate the number of cells in the battery in Fig. 8.1.

（2024 夏季 0625/31 第8题(a)）

二. 电阻相加且各处电流相同

知识点 电路中各元件首尾相接且没有分支时，元件为串联；串联电路各处的电流_____。

串联电阻的总电阻等于各电阻之_____：$R_{总} = R_1 + R_2 + \cdots$，电阻的单位是欧姆（Ω）。

答案：相同；和

怎么认 题目出现无分支电路并求总电阻或电流时，先写 $R_{总} = R_1 + R_2 + \cdots$。

例题 2 Fig. 9.1 shows two resistors connected in series.



Fig. 9.1

(a) Calculate the combined resistance of the two resistors in series.

（2025 夏季 0625/32 第9题(a)）

解： 两电阻串联，

$R_{总} = R_1 + R_2$

$= 20\ \Omega + 40\ \Omega$

$= 60\ \Omega$

答：两电阻的总电阻为 60 Ω。

5. Two identical resistors, R_1 and R_2, are connected to a 24 V battery, as shown in Fig. 7.1.

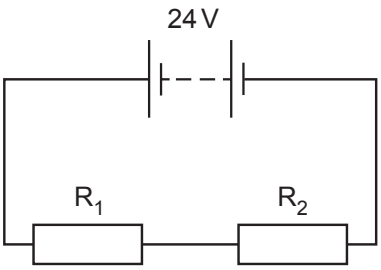


Fig. 7.1

The value of each resistor is 50 Ω.

(a) Calculate the combined resistance of R_1 and R_2 when they are connected as shown in Fig. 7.1.

（2023 冬季 0625/33 第7题(a)）

6. A teacher connects the circuit shown in Fig. 9.1.

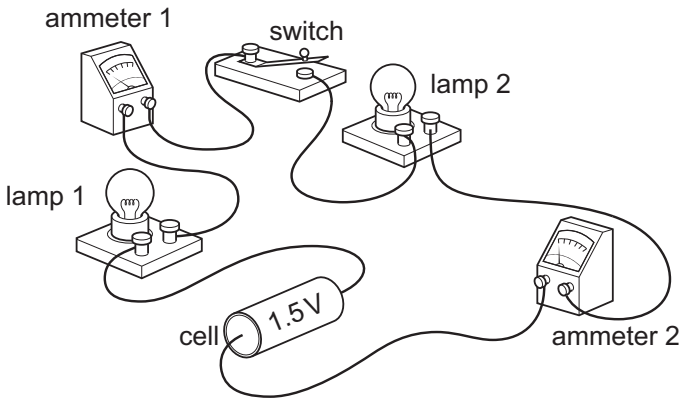
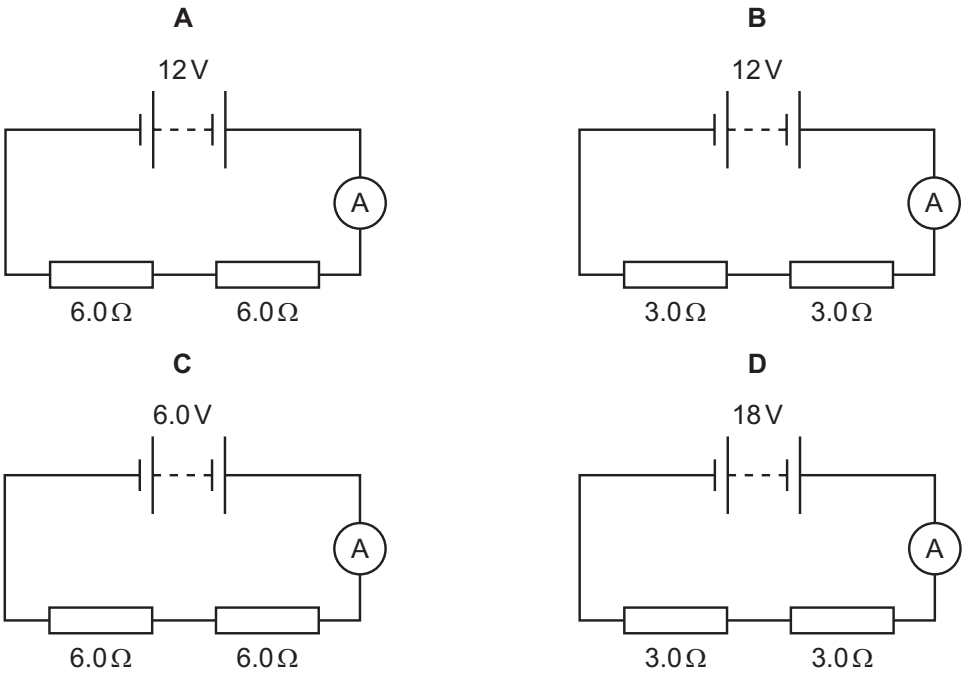


Fig. 9.1

(a) Give the name for the way the components are connected in this circuit.

（2025 冬季 0625/31 第9题(a)）

7. In which circuit does the ammeter read 2.0 A?



（2025 夏季 0625/12 第30题）

8. The electromotive force (e.m.f.) of a battery is 7.5 V.

(b) The battery is connected in series with a variable resistor and a 30 Ω resistor. The battery is made using 1.5 V cells.

(i) Draw a circuit diagram that shows all the 1.5 V cells connected to produce an e.m.f. of 7.5 V, the variable resistor and the 30 Ω resistor.

(ii) The resistance of the variable resistor can be varied from 0 Ω to a maximum resistance of 150 Ω.

Using the axes in Fig. 7.1, draw a graph to show how the current in the circuit varies with the resistance of the variable resistor as it increases from 0 Ω to 150 Ω.

Determine and label the value of the maximum current on the *y*-axis.

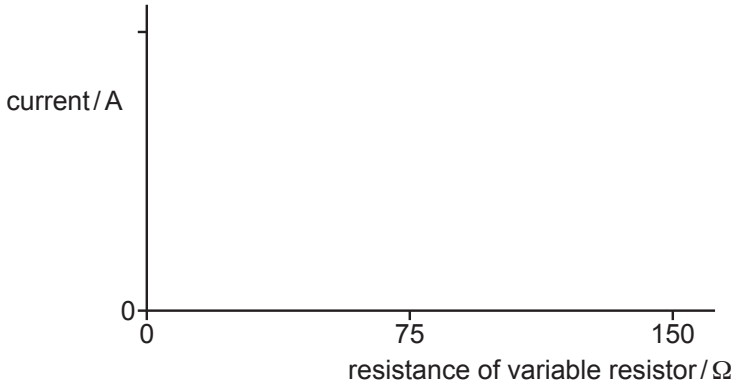


Fig. 7.1

（2024 夏季 0625/41 第7题(b)）

三. 先用总电压等于各分压之和

知识点 串联电路中，各处电流_____；当电源内阻和导线电阻可忽略时，电源电动势等于各串联元件两端电势差之_____：$E = V_1 + V_2 + ...$。

同一电流下，由 $V = IR$，元件两端电势差与其电阻成_____。

电动势和电势差的单位均为伏特（V），电阻单位为欧姆（Ω），电流单位为安培（A）。

答案：相等；和；正比

怎么认 题目出现元件串联，并给出电源电动势或某元件分压时，先写 $E = V_1 + V_2 + ...$。

例题 3 A potential divider is made by connecting a light-dependent resistor (LDR) and a thermistor in series. Fig. 6.1 shows the potential divider, a voltmeter and a direct current (d.c.) power supply connected into a circuit.

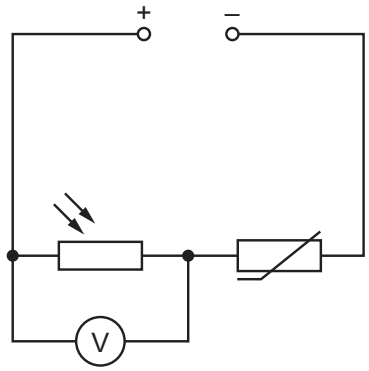


Fig. 6.1

The voltmeter measures the potential difference (p.d.) across the LDR.

(b) The electromotive force (e.m.f.) of the supply is *E*.

Describe how the p.d. across the thermistor can be determined using the reading on the voltmeter.

（2024 冬季 0625/41 第6题(b)）

解：设电压表读数为 V，由串联电路的电势差关系得

$E = V + V_{热敏电阻}$，

$V_{热敏电阻} = E - V$。

答：用 E 减去电压表读数，所得差值为热敏电阻两端的电势差。

针对练习

9. A 5.0 Ω resistor is connected in series with a 10 Ω resistor.

There is a constant current in the 5.0 Ω resistor.

Which statement about the two resistors is correct?

A The current is greater in the 5.0 Ω resistor.

B The current is greater in the 10 Ω resistor.

C The potential difference (p.d.) is greater across the 5.0 Ω resistor.

D The potential difference (p.d.) is greater across the 10 Ω resistor.

（2025 冬季 0625/11 第29题）

10. Fig. 6.1 shows the circuit diagram for a flashlight (torch).

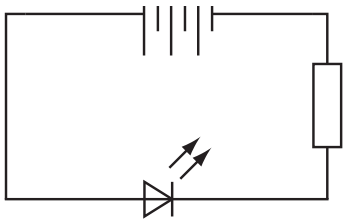


Fig. 6.1

The electromotive force (e.m.f.) of the battery is 4.5 V. The circuit contains a 60 Ω fixed resistor. The current in the light-emitting diode (LED) is 0.020 A.

(a) Calculate the potential difference (p.d.) across the LED.

（2023 冬季 0625/42 第6题(a)）

11. A student sets up the circuit shown in Fig. 7.1.

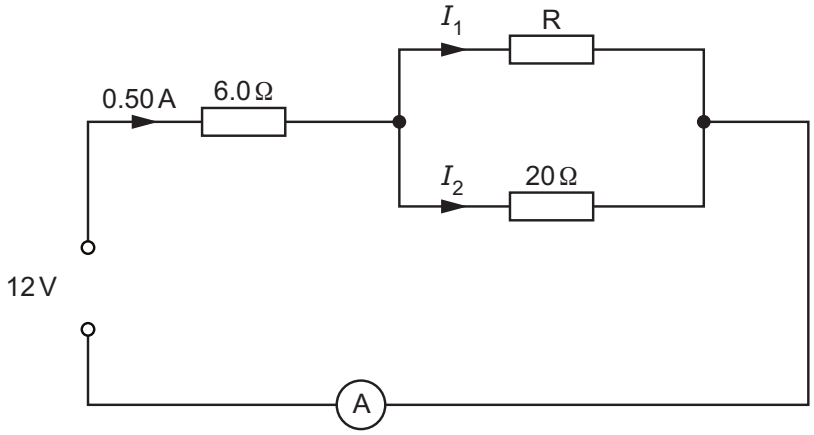


Fig. 7.1

(c) Show that the p.d. across the 20 Ω resistor is 9.0 V.

（2025 夏季 0625/43 第7题(c)）

题型 2：再用并联规律（考频★★★★☆）

知识点 并联电路中，各支路接在同一电源两端，因此各支路两端的_____相同，单位为 V；电源电流等于各支路电流之和，电流单位为 A。

各支路彼此独立；一条支路断开时，其余完好支路仍可构成_____，用电器可以继续工作。

电源电压不变时，接通新的并联支路会使总电阻减小，电源电流_____；由 $P = UI$，电源输出功率也增大，功率单位为 W。

答案：电压；闭合回路；增大

怎么认 题目出现并联灯泡、支路开关或新增支路时，先标出各支路的通断状态和两端共同电压。

一. 先标各支路同电压且彼此独立

例题 1 Fig. 2.1 shows solar-powered traffic warning lights.

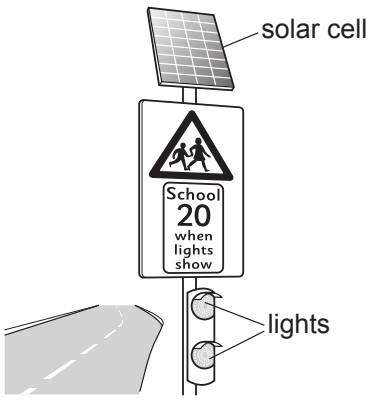


Fig. 2.1

The energy from the solar cell is stored in a battery.

(b) The two lights in Fig. 2.1 are connected in parallel.

State **one** advantage of a parallel connection in a lighting circuit.

（2024 夏季 0625/43 第2题(b)）

解：两灯并联，各支路彼此独立。若一盏灯损坏，该支路断开，另一支路仍与电源构成闭合回路。
答：一盏灯损坏时，另一盏灯仍能发光。

针对练习

1. Lamps can be connected in series or in parallel to a power supply.

What is an advantage of connecting the lamps in parallel rather than in series?

A All of the lamps can be switched on and off using the same switch.

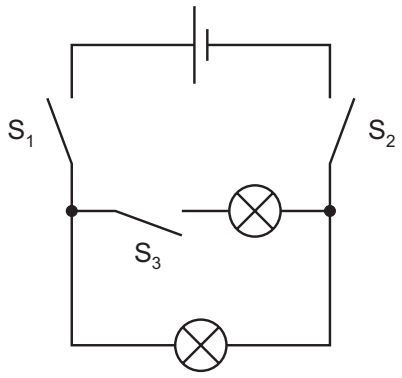
B Fewer connecting leads are needed to make the circuit.

C When one lamp stops working, the others may continue to work.

D Less power is transferred from the supply.

（2025 冬季 0625/21 第29题）

2. Two lamps are connected in parallel.



Which switches must be closed so that both lamps light?

A S_1 and S_2 only

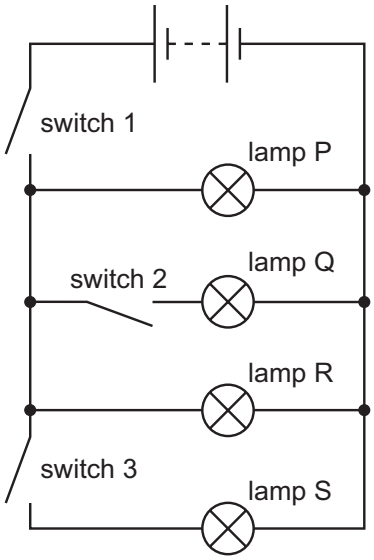
B S_1 and S_3 only

C S_2 and S_3 only

D S_1, S_2 and S_3

（2023 夏季 0625/12 第29题）

3. The circuit shown contains three switches and four lamps P, Q, R and S.



Which switches must be closed to light only lamps P and R?

A switch 1 only

B switch 1 and switch 2

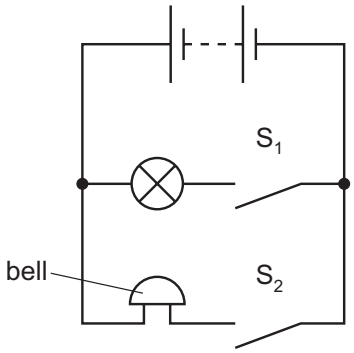
C switch 1 and switch 3

D switch 2 and switch 3

（2023 夏季 0625/13 第28题）

4. The battery on a bicycle is connected in parallel to its lamp and bell.

The circuit includes two switches, S_1 and S_2.



The cyclist closes S_1 to light the lamp.

She then also closes S_2 to sound the bell.

What happens to the current in the battery and the power output from the battery when the cyclist closes S_2?

	current in the battery	power output from the battery
A	increases	increases
B	increases	stays the same
C	stays the same	increases
D	stays the same	stays the same

（2023 夏季 0625/11 第27题）

二. 在节点写流入等于流出

知识点 电流在节点处分流或汇流时，流入节点的电流总和_____流出节点的电流总和。

并联电路的干路电流等于各支路电流_____，且大于任一支路电流；各支路两端电压相等。

上述关系适用于稳定电路，电流单位是安培，符号为 A。

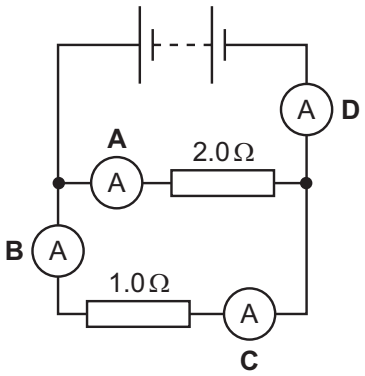
答案：等于；之和

怎么认 题目出现并联支路、节点或多个电流表读数时，先标清电流方向并列出流入等于流出。

例题 2

The circuit diagram shows a battery connected to two resistors. Four labelled ammeters are connected into the circuit.

Which ammeter shows the largest reading?



（2023 夏季 0625/12 第28题）

解： 设两条支路两端的电压为 U。

$I_A = \frac{U}{2.0\ \Omega}$

$I_B = I_C = \frac{U}{1.0\ \Omega}$

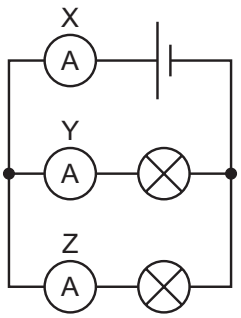
由节点电流规律得

$I_D = I_A + I_C$

$\therefore I_D$ 大于任一支路电流，电流表 D 的读数最大。故选 D。

针对练习

5. The circuit diagram shows two identical lamps connected in parallel to a cell. Three ammeters, X, Y and Z, are also connected in the circuit, as shown.



Which statement about the current in X is correct?

A It is equal to the current in Y and to the current in Z.

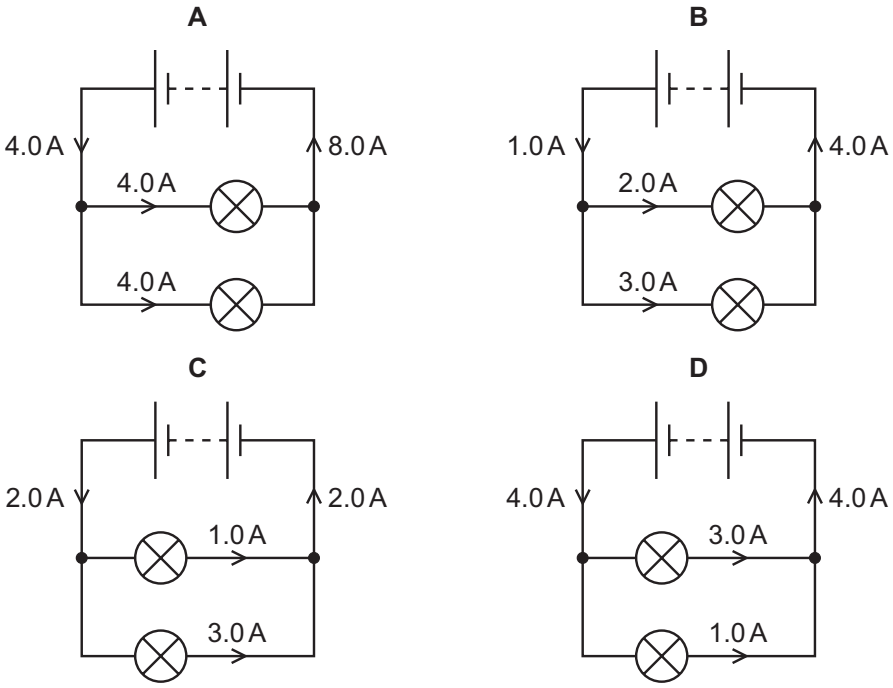
B It is less than either the current in Y or the current in Z.

C It is equal to the sum of the current in Y and the current in Z.

D It is equal to the difference between the current in Y and the current in Z.

（2023 夏季 0625/21 第28题）

6. Which circuit shows possible correct values for the currents?



（2025 冬季 0625/23 第30题）

7. A washing machine has an electric motor and an electric heater. Fig. 7.1 shows a simplified circuit diagram for the washing machine.

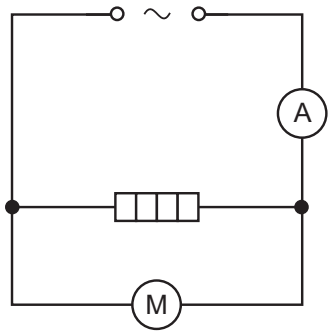


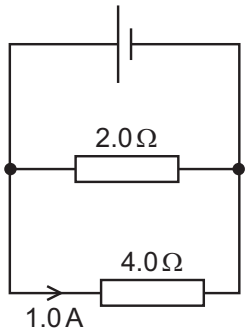
Fig. 7.1

The heater has a resistance of 25 Ω and the power supply has an electromotive force (e.m.f.) of 230 V.

(d) The current in the motor is 1.6 A.
Determine the reading on the ammeter in Fig. 7.1. Explain your answer.

（2024 冬季 0625/42 第7题(d)）

8. A cell is connected to a parallel combination of a 2.0 Ω resistor and a 4.0 Ω resistor. The current in the 4.0 Ω resistor is 1.0 A.



What is the current in the cell?

A 1.0 A **B** 1.5 A **C** 2.0 A **D** 3.0 A

（2025 夏季 0625/22 第31题）

三. 先写倒数和并检查上限

知识点 串联电阻首尾相接，总电阻等于各电阻之和：$R_{总}=R_1+R_2+\ldots$；电阻的单位是欧姆，符号为 Ω。

并联电阻的两端分别接在同一对节点上，总电阻满足 $\frac{1}{R_{总}}=\frac{1}{R_1}+\frac{1}{R_2}+\ldots$。

各支路电阻均大于零时，并联总电阻_____任一支路电阻，且_____零。

两只相同电阻并联时，$R_{总}=\frac{R}{2}$；增加并联支路会使总电阻_____。

答案：小于；大于；减小

怎么认 题目出现多个电阻接在同一对节点上并求总电阻时，先写各支路电阻的倒数和。

例题 3 Diagram 1 shows a resistor connected in a circuit. Diagram 2 shows an identical resistor connected in parallel with the first resistor.

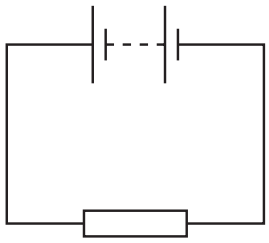


diagram 1

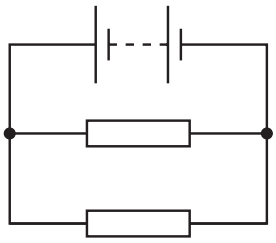


diagram 2

What is the combined resistance of the two resistors in diagram 2?

A greater than in the circuit of diagram 1

B less than in the circuit of diagram 1, but greater than zero

C the same as in the circuit of diagram 1

D zero

（2024 夏季 0625/12 第29题）

解： 设每只电阻的电阻为 R，由并联电阻关系得

$\frac{1}{R_{总}}=\frac{1}{R}+\frac{1}{R}=\frac{2}{R}$，

$R_{总}=\frac{R}{2}$。

因 $R>0$，所以 $0<R_{总}<R$。故选 B。

9. Fig. 8.1 shows the circuit diagram for a 16 Ω resistor and an 8.0 Ω resistor connected to a 6.0 V battery.

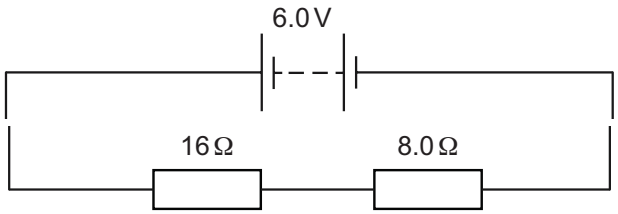


Fig. 8.1

(a) Calculate the combined resistance of the two resistors shown in Fig. 8.1.

（2025 夏季 0625/31 第8题(a)）

10. Two identical resistors, R_1 and R_2, are connected to a 24 V battery, as shown in Fig. 7.1.

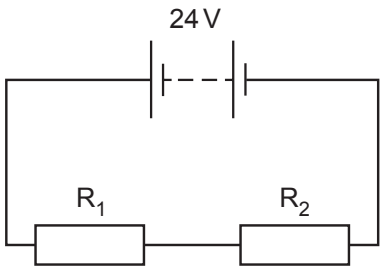


Fig. 7.1

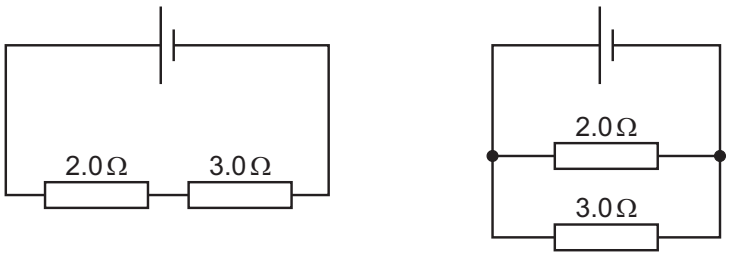
The value of each resistor is 50 Ω.

(e) A student connects R_1, R_2 and the battery to make a different circuit. The resistors R_1 and R_2 are connected so their combined resistance is as small as possible.

Draw a circuit diagram to show how R_1 and R_2 are connected to the battery.

（2023 冬季 0625/33 第7题(e)）

11. Resistors of resistance 2.0 Ω and 3.0 Ω are connected in two different circuits.

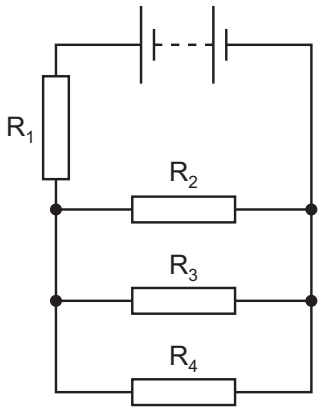


What is the total resistance in each circuit?

	series	parallel
A	less than 2.0 Ω	less than 2.0 Ω
B	less than 2.0 Ω	greater than 3.0 Ω
C	greater than 3.0 Ω	less than 2.0 Ω
D	greater than 3.0 Ω	greater than 3.0 Ω

（2023 冬季 0625/13 第29题）

12. Four identical resistors are connected to a battery as shown. Each resistor has a value of 120 Ω.



Resistor R_4 is removed.

Which effect does removing this resistor have on the effective resistance of the circuit?

A The effective resistance does **not** change.

B The effective resistance decreases by 20 Ω.

C The effective resistance increases by 20 Ω.

D The effective resistance decreases by 120 Ω.

（2025 春季 0625/22 第28题）

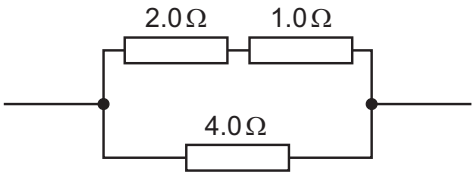
题型 3：混联电路逐级化简（考频★★☆☆☆）

知识点 串联部分中各处电流相同，两个串联电阻的等效电阻为 $R_s = R_1 + R_2$。
并联部分中各支路两端电压相同，两个并联电阻的等效电阻为 $R_p = \frac{R_1 R_2}{R_1 + R_2}$。
在节点处，流入的总电流等于各支路电流之和；沿闭合回路，各用电器两端电压之和等于电源电压。
混联电路先把局部_____或_____部分看作一个等效电阻，再向外逐级化简；电阻的单位是_____。

答案：串联；并联；欧姆

怎么认 题目出现同一电路中既有串联又有并联的电阻图时，先圈出最明确的局部串联或并联。

例题 1 The diagram shows part of a circuit.



What is the combined resistance of the resistors?

A 0.14 Ω　　**B** 0.57 Ω　　**C** 1.7 Ω　　**D** 7.0 Ω

（2023 春季 0625/22 第28题）

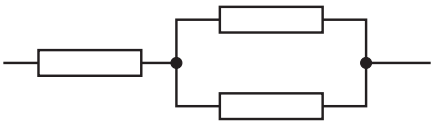
解：上支路中的两个电阻串联，故
$R_1 = 2.0\ \Omega + 1.0\ \Omega = 3.0\ \Omega$
上支路与下支路并联，故
$R = \frac{3.0 \times 4.0}{3.0 + 4.0}\ \Omega = 1.7\ \Omega$
故选 C。

针对练习

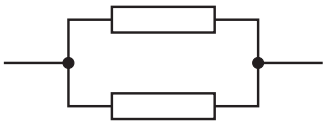
1. A number of identical resistors of resistance 10 Ω are arranged in circuits.

Which arrangement of resistors will give an overall resistance of 25 Ω?

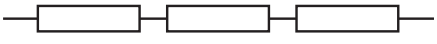
A



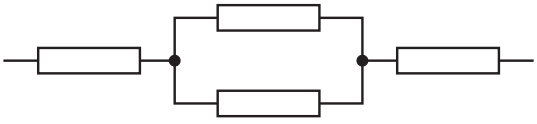
B



C



D



（2024 冬季 0625/23 第29题）

2. A student sets up the circuit shown in Fig. 7.1.

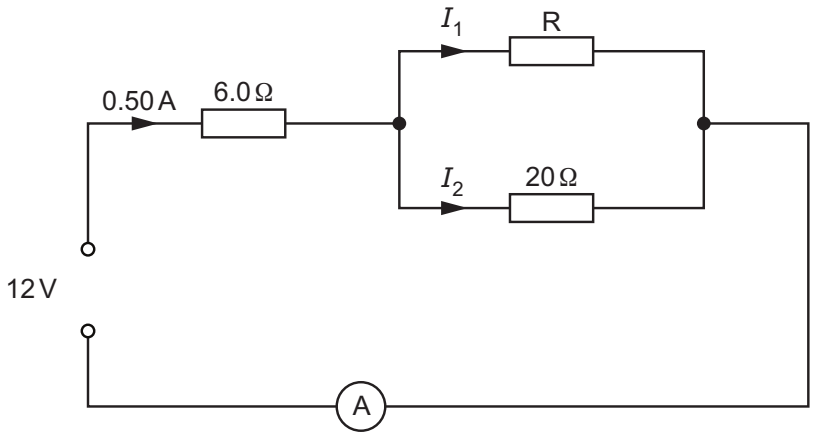


Fig. 7.1

(d) Calculate the resistance of resistor R.

（2025 夏季 0625/43 第7题(d)）

3. A circuit consists of an a.c. supply and two lamps. The lamps are connected in parallel.

(b) The electromotive force (e.m.f.) of the a.c. supply is 230 V. When connected to the 230 V supply, the resistance of one lamp is 1200 Ω and the resistance of the other lamp is 800 Ω.

(i) Calculate the current in the 800 Ω lamp.

(ii) Calculate the energy used by the 800 Ω lamp in 5.0 hours.

Give your answer in kWh.

(iii) Calculate the combined resistance of the two lamps in this circuit.

（2025 冬季 0625/42 第7题(b)）

4. Fig. 7.1 shows a circuit that contains a battery, a switch, a voltmeter and three 40 Ω resistors, R_1, R_2 and R_3.

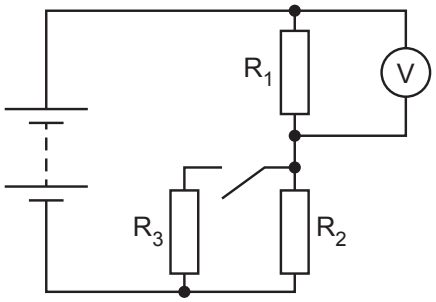


Fig. 7.1

The switch is open and resistors R_1 and R_2 form a potential divider.

(b) The reading on the voltmeter is 7.5 V.

(i) Calculate the electromotive force (e.m.f.) of the battery.

(ii) The switch is closed.

Calculate the resistance of the complete circuit.

（2023 夏季 0625/41 第7题(b)）

4.3.3 电路元件的作用与使用

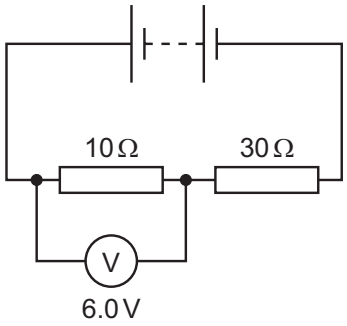
题型 1：用电阻比计算分压（考频★★☆☆☆）

知识点 两个电阻串联接在电源两端时，电源电压由两个电阻分担，这种电路称为_____。串联电路中电流相同，各电阻两端的电势差与电阻成_____，即 $\frac{R_1}{R_2}=\frac{V_1}{V_2}$。若输出电压跨在 R_2 两端，则 $V_{\text{out}}=V_{\text{in}}\frac{R_2}{R_1+R_2}$；电阻的单位为 Ω，电势差的单位为 V。

答案：分压器；正比

怎么认 题目出现两个串联电阻，并给出一个电阻两端电压，求另一个电压或电阻时，先把电压对应到具体电阻。

例题 1 The diagram shows a circuit which includes two resistors and a battery.



The voltmeter reads 6.0 V.

What is the potential difference across the 30 Ω resistor?

A 2.0 V　　**B** 6.0 V　　**C** 18 V　　**D** 24 V

（2023 春季 0625/22 第29题）

解：设 30 Ω 电阻两端的电势差为 V。由两电阻串联，电流相同，得

$$\frac{V}{6.0\ \text{V}}=\frac{30\ \Omega}{10\ \Omega}$$

$$V=18\ \text{V}$$

故选 C。

针对练习

1. Fig. 7.1 shows a circuit that contains a battery, a switch, a voltmeter and three 40 Ω resistors, R_1, R_2 and R_3.

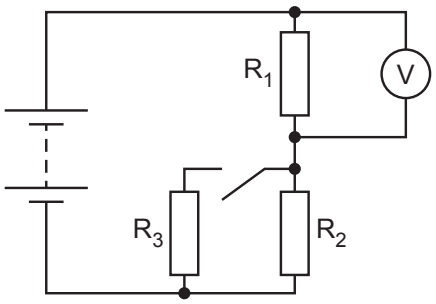


Fig. 7.1

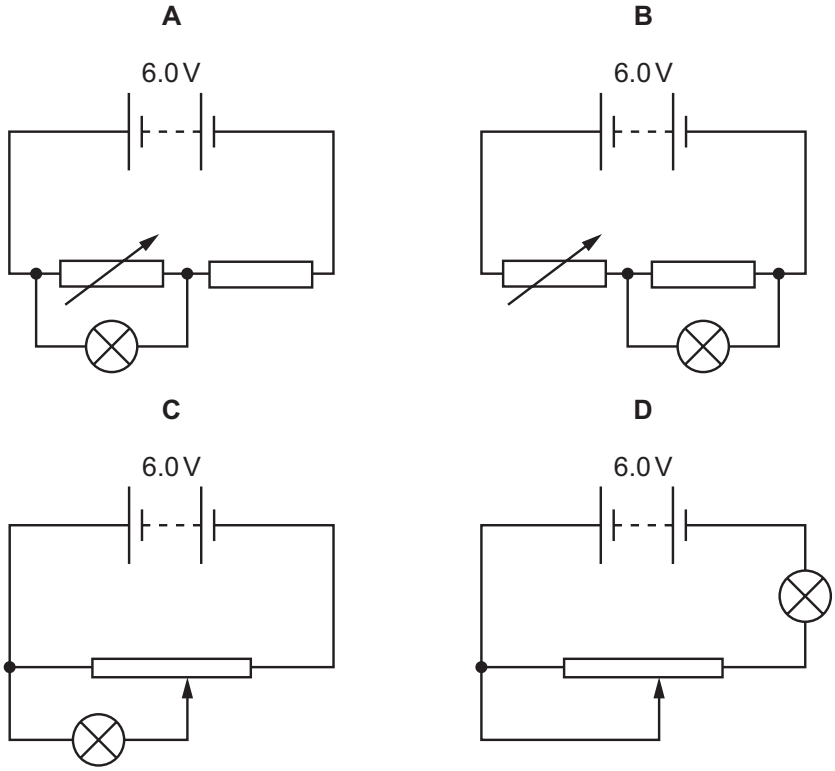
The switch is open and resistors R_1 and R_2 form a potential divider.

(a) Describe what is meant by a potential divider.

（2023 夏季 0625/41 第7题(a)）

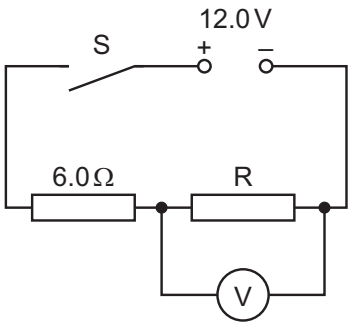
2. The circuit diagrams show circuits that can control the potential difference (p.d.) across a lamp.

Which circuit allows the p.d. across the lamp to be varied from 0 V to 6.0 V?



（2025 冬季 0625/23 第31题）

3. The diagram shows two resistors in series connected to a power supply.



The reading on the voltmeter is 3.0 V when the switch is closed.

What is the resistance of resistor R?

A 0.67 Ω **B** 1.2 Ω **C** 1.5 Ω **D** 2.0 Ω

（2025 冬季 0625/21 第28题）

4. **(a)** Fig. 8.1 shows a circuit. The circuit is designed to switch on a night light when the surroundings are dark.

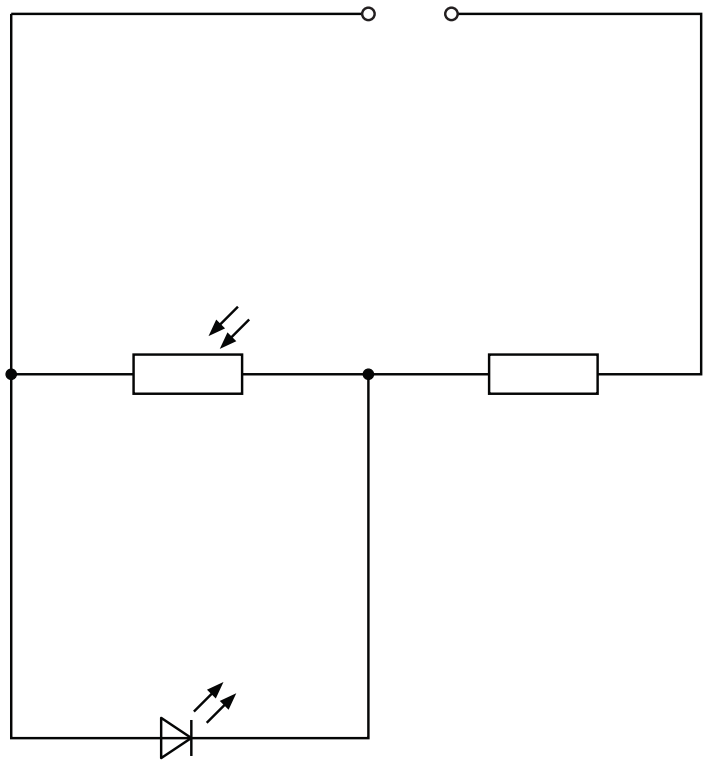


Fig. 8.1

(i) On Fig. 8.1, draw the circuit symbol for a voltmeter used to measure the potential difference (p.d.) across the light-dependent resistor (LDR).

(ii) The surroundings change from light to dark.

1. State the effect of this change on the resistance of the LDR.

2. State and explain the effect of this change on the p.d. across the light-emitting diode (LED).

（2024 夏季 0625/42 第8题(a)）

题型 2：看传感器阻值判断输出（考频★★☆☆☆）

知识点 两个电阻串联接在恒定电源两端时构成分压电路，电源电压在两个电阻之间分配。

对两个串联电阻，$\frac{R_1}{R_2}=\frac{V_1}{V_2}$；电阻的单位为 Ω，电势差的单位为 V。

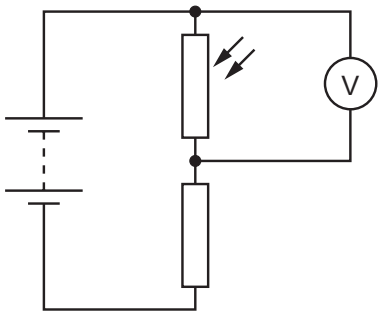
光照增强时，LDR 的电阻_____；温度升高时，NTC 热敏电阻的电阻_____。

电压表跨接某元件时，该元件的电阻所占比例越大，其分得的电势差越_____。

答案：减小；减小；大

怎么认 题目出现 LDR 或热敏电阻组成的分压电路并问电压表示数时，先确定电压表跨接的元件。

例题 1 The diagram shows a light-dependent resistor (LDR) connected in a potential divider circuit.



The brightness of the light falling on the LDR is increased.

Which row shows what happens to the resistance of the LDR and what happens to the reading on the voltmeter?

	resistance of LDR	reading on voltmeter
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

（2023 冬季 0625/23 第30题）

解： 光照增强，LDR 的电阻减小。电压表测量 LDR 两端的电势差。

设电源电压为 E，下方定值电阻为 R，由分压关系得

$V_{\text{LDR}}=E\frac{R_{\text{LDR}}}{R_{\text{LDR}}+R}$

E 与 R 不变，R_{LDR} 减小时，V_{LDR} 减小。故选 A。

针对练习

1. **(a)** Fig. 6.1 shows a circuit which includes an LDR (light-dependent resistor).

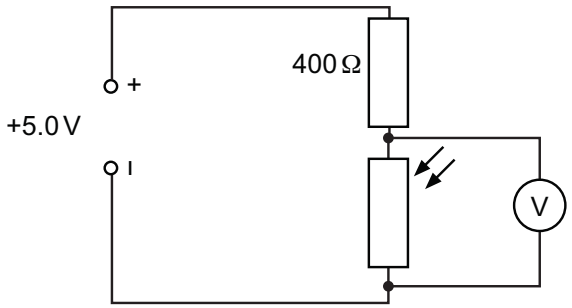


Fig. 6.1

The LDR is in a brightly lit room. The voltmeter reads 1.8 V.

(i) Calculate the current in the 400 Ω resistor.

(ii) The light level in the room changes from bright to dark.

State and explain the effect on the voltmeter reading.

（2025 冬季 0625/43 第6题(a)）

2. A light-dependent resistor (LDR) has a low resistance in high light intensity and a high resistance in the dark.

(b) Fig. 5.1 shows part of the electric circuit used to turn on a light when it is dark.

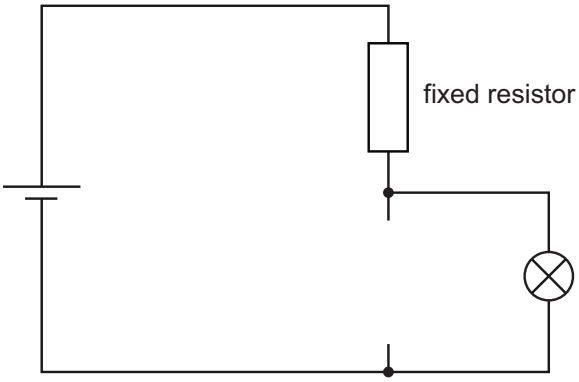


Fig. 5.1

(i) Complete the circuit in Fig. 5.1 with the symbol for a light-dependent resistor (LDR). [1]

(ii) Explain why the lamp is off in the light and the lamp is on in the dark. Use ideas about potential difference (p.d.) in your answer.

（2025 春季 0625/42 第5题(b)）

3. A potential divider is made by connecting a light-dependent resistor (LDR) and a thermistor in series. Fig. 6.1 shows the potential divider, a voltmeter and a direct current (d.c.) power supply connected into a circuit.

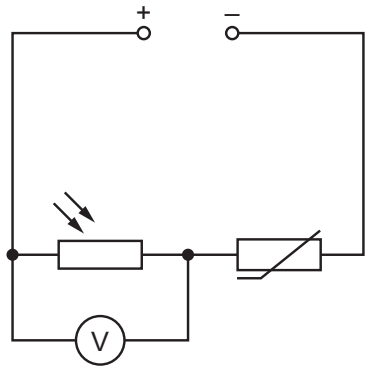


Fig. 6.1

The voltmeter measures the potential difference (p.d.) across the LDR.

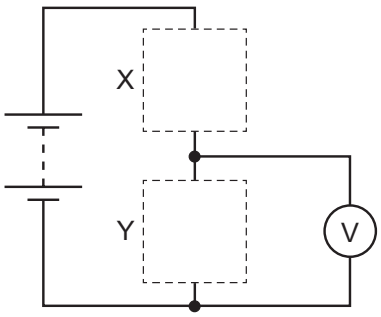
(c) The resistance of the LDR decreases and the resistance of the thermistor increases.

(i) State what has happened to the light intensity incident on the LDR and the temperature of the thermistor.

(ii) Explain what happens to the reading on the voltmeter.

（2024 冬季 0625/41 第6题(c)）

4. The circuit shown can be completed by inserting components at X and at Y. The completed circuit is a potential divider in which the potential difference across component Y increases when the temperature increases.



Which row shows the components X and Y?

	X	Y
A	light-dependent resistor	resistor
B	resistor	light-dependent resistor
C	resistor	thermistor
D	thermistor	resistor

（2023 冬季 0625/22 第30题）

4.4 用电安全

题型 1：先找用电隐患（考频★★☆☆☆）

知识点 用电安全隐患是可能导致人体触电或设备过热起火的供电状态。

绝缘层破损或环境潮湿时，人体更容易接触带电部分，_____风险增大。

插头、延长线或插座过载时，总电流超过安全值，导线会过热，可能使绝缘层熔化或引起_____。

市电电缆通常含火线、中性线和_____；电流的单位是安培（A）。

答案：触电；火灾；地线

怎么认 题目出现绝缘破损、潮湿、插头过多或电流超过额定值时，先判断触电或过热起火。

例题 1 **(a)** Fig. 9.1 shows an electricity cable that has a fault.

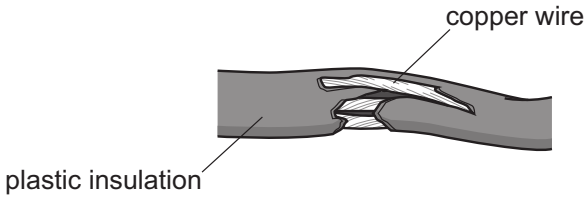


Fig. 9.1

The cable is used for supplying electricity at a high voltage.

State the fault and describe the hazard shown in Fig. 9.1.

（2024 夏季 0625/32 第9题(a)）

解：图中塑料绝缘层破损，铜导线外露。

电缆用于高电压供电，人体接触外露导线会遭受电击，严重时可致触电死亡。

答：故障为绝缘层破损；危险为电击或触电死亡。

针对练习

1. Fig. 8.1 shows a mains-powered electric fan heater fixed on a bathroom wall.

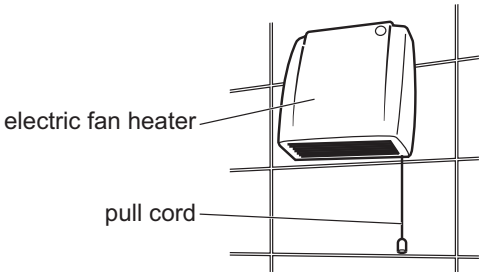


Fig. 8.1

The pull cord switches the fan heater on and off.

(a) Suggest why a pull cord is safer than a push switch for a fan heater in a bathroom.

（2025 夏季 0625/32 第8题(a)）

2. Fig. 9.1 shows an electric kettle.

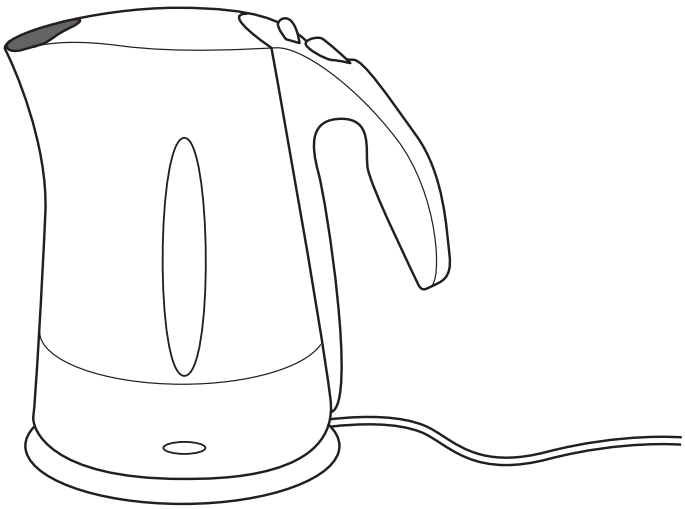


Fig. 9.1

(b) Fig. 9.2 shows an overloaded extension lead.

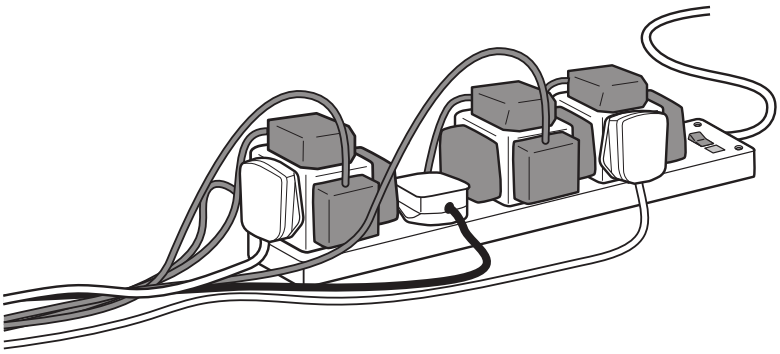


Fig. 9.2

Explain the danger of connecting too many plugs to an extension lead.

（2023 春季 0625/32 第9题(b)）

3. **(a)** Fig. 9.1 shows the power cable for connecting a desktop computer to the mains electricity circuit.

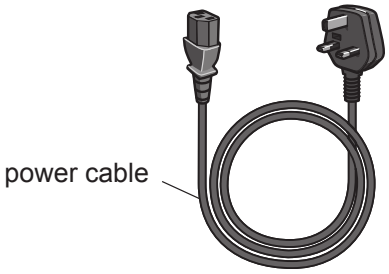


Fig. 9.1

(i) State the name of each of the **three** wires inside the power cable.

(ii) The cable is designed for a maximum current of 13A.

Suggest **one** hazard due to a current of 30A in the cable.

（2024 夏季 0625/31 第9题(a)）

题型 2：把开关和保险丝接在火线（考频★★☆☆☆）

知识点 家用交流电路由火线（live 或 line）、零线（neutral）和地线（earth）组成。

火线相对地具有_____，零线用于构成回路，地线用于安全保护。

开关和保险丝都应串联在_____中；断开后，用电器与火线隔离，才能安全断电。

答案：高电势；火线

怎么认 题目出现家用电器的开关、保险丝或三线电缆时，先判断能否使电器与火线隔离。

例题 1 Into which wire is a switch connected in order to switch a mains appliance on and off safely?

A live

B negative

C neutral

D positive

（2024 春季 0625/12 第27题）

解：家用电器的开关应串联在火线上，使开关断开时用电器与火线隔离。

故选 A。

针对练习

1. In an experiment, a student uses an electrical heater connected to a power supply.

(b) The power supply is connected to the electrical mains by a cable that consists of three wires.

State the name for each of the three wires in the cable.

（2024 冬季 0625/31 第10题(b)）

2. Which statement explains where the switch for an electric lamp is connected?

A The switch is in **either** the live wire **or** in the neutral wire as both wires carry the current.

B The switch is in the earth wire to prevent the fuse from blowing when the lamp is in use.

C The switch is in the live wire so that the lamp is disconnected from the mains supply when the switch is off.

D The switch is in the neutral wire to prevent current leakage when the lamp is switched off.

（2025 冬季 0625/11 第30题）

3. An electric heater has a metal frame.

The heating element is connected to the live and neutral wires of an a.c. supply. The metal frame is connected to the earth wire.

Which row gives the correct connections for the fuse and the switch?

	fuse	switch
A	in the earth	in the live
B	in the earth	in the neutral
C	in the live	in the live
D	in the live	in the neutral

（2023 夏季 0625/13 第29题）

4. A student has a desktop computer that connects to the 240 V a.c. mains electrical supply. Fig. 9.1 shows the desktop computer.

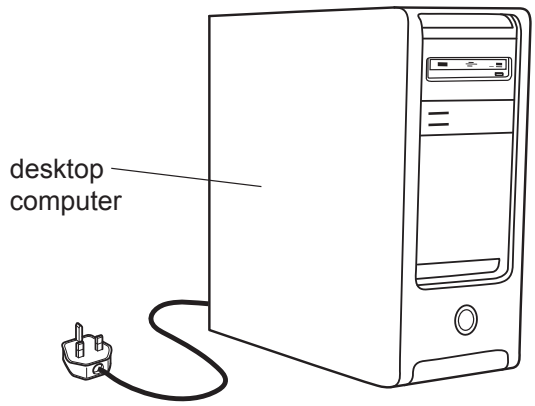


Fig. 9.1

(a) The desktop computer has an on-off switch in one of the wires that connect it to the mains supply.

State and explain which wire includes the switch.

（2023 夏季 0625/32 第9题(a)）

题型 3：按工作电流选择过流保护（考频★★☆☆☆）

知识点 用电器正常工作时，电流满足 $I=\frac{P}{V}$；P 以瓦特为单位、V 以伏特为单位时，I 的单位为安培。

熔断器的额定电流应_____正常工作电流，并且不超过电缆允许的安全电流。

电流过大时，低熔点熔丝受热并_____，使电路断开，用电器与电源隔离。

开关和熔断器均接在_____线上，使其断开时用电器与火线分离。

答案：略大于；熔化；火

怎么认 题目出现功率、电压或工作电流并要求选择熔断器时，先求正常工作电流，再选略高的额定值。

例题 1 The current in a kettle is 10 A and the kettle is protected by a 13 A fuse.

The owner of the kettle replaces the 13 A fuse with a 3 A fuse.

What happens when the kettle is switched on?

A The fuse melts and the kettle might be damaged.

B The fuse melts and the kettle is undamaged.

C The fuse does not melt and the kettle works correctly.

D The fuse does not melt but the kettle fails to work.

（2023 春季 0625/12 第30题）

解： 水壶的工作电流与熔断器的额定电流满足

$10\ \mathrm{A} > 3\ \mathrm{A}$

熔丝因电流过大而熔化，电路断开，水壶与电源隔离，水壶不受损坏。

故选 B。

针对练习

1. In which mains electric wires are the fuse and the switch placed?

	fuse	switch
A	earth	live
B	live	live
C	live	neutral
D	neutral	neutral

（2025 夏季 0625/23 第29题）

2. Fig. 9.1 shows a router. The router emits Wi-Fi signals.

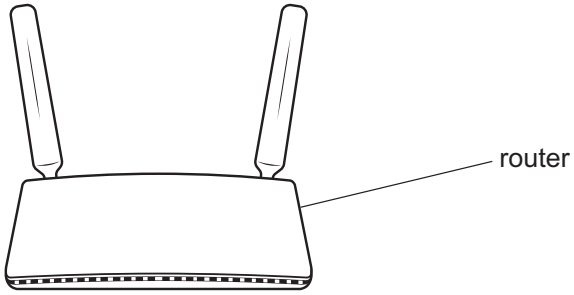


Fig. 9.1

(d) The mains plug for the router includes a fuse that protects the router.

Explain how a fuse works.

（2025 夏季 0625/31 第9题(d)）

3. **(c)** A plug connects the transformer to the mains supply. There is a fuse in the plug.
Describe how a fuse works.

（2024 冬季 0625/32 第9题(c)）

4. The mains voltage is 120 V.

Which fuse should be fitted to an electric kettle with a power of 1.5 kW?

A 3 A **B** 5 A **C** 10 A **D** 13 A

（2024 冬季 0625/11 第30题）

题型 4：按外壳判断接地或双重绝缘（考频★★☆☆☆）

知识点 金属外壳是导体，使用市电的金属外壳电器应接地；地线将外壳与大地相连。

火线碰到外壳时，地线提供_____故障通路，使大电流流向大地并促使保险丝熔断或跳闸开关断开，防止外壳持续带电。

双重绝缘电器的带电部分与外界之间有两层绝缘保护，使用_____软电缆，无需_____，但仍需保险丝或断路器防止过大电流。

答案：低电阻的；两芯；地线

怎么认 题目出现金属外壳、接地线或双重绝缘标志时，先按外壳是否导电判断是否需要接地。

例题 1 Fig. 3.1 shows a mains electric heater used to heat a small room.

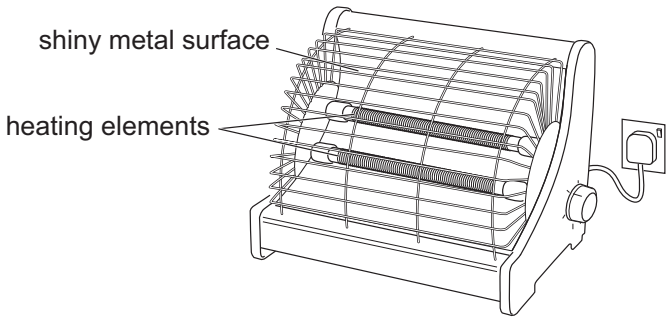


Fig. 3.1

(c) The metal outer casing of the heater is earthed. State why this is an important safety feature.

（2025 春季 0625/42 第3题(c)）

解：若火线碰到金属外壳，电流经低电阻的地线流向大地，使外壳不持续带电。

答：可防止使用者触电。

针对练习

1. Which component is **not** needed when using an appliance that is double-insulated?

A earth wire

B fuse

C live wire

D neutral wire

（2025 冬季 0625/13 第33题）

2. An electrical appliance has a symbol on it to indicate it is double-insulated.

Which statement is correct?

A A two-core, flexible cable with **no** earth wire is used to connect it to the mains supply.

B It needs an earth wire that is connected to a fuse.

C **No** fuse or circuit breaker is needed.

D The cable should be connected to the live and earth connectors of the plug but **not** the neutral.

（2025 冬季 0625/22 第29题）

3. Four statements about safety when designing electrical products are listed.

1 If the outer casing is a conductor, it should be earthed.

2 If the outer casing is a conductor, it should **not** be earthed.

3 If the outer casing is an insulator, it should be earthed.

4 If the outer casing is an insulator, it should **not** be earthed.

Which statements are correct?

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

（2024 夏季 0625/13 第29题）

4. A double-insulated electrical appliance must be connected safely to the electricity supply.

Which statement is correct?

A It must be connected with a fuse and an earth wire.

B It can be connected with a fuse only.

C It can be connected with an earth wire only.

D It does not need a fuse or an earth wire.

（2023 夏季 0625/11 第30题）

4.5.1 电磁感应

题型 1：先判断磁场联系是否改变（考频★★★☆☆）

知识点 导体切割磁场线，或与导体相联系的磁场发生变化时，导体中会产生_____，这种现象称为电磁感应。
产生感应电动势的条件是导体相对磁场运动并切割磁场线，或穿过线圈的_____发生变化。
感应电动势的大小随磁场强度、相对运动速率及线圈匝数的增大而增大，单位为伏特（V）。
感应电流产生的磁场总是_____引起它的磁场变化；力、磁场与感应电流的相对方向可用发电机右手定则判断。

答案：感应电动势；磁场联系；阻碍

怎么认 题目出现导体在磁场中运动或磁铁靠近、远离线圈时，先判断导体是否切割磁场线或磁场联系是否改变。

一. 先看是否有相对运动切割磁场

例题 1 A copper wire rests in a uniform magnetic field.

Which change causes an induced electromotive force (e.m.f.) in the wire?

A connecting the wire to a power supply

B connecting the wire to earth

C heating the wire

D moving the wire

（2025 春季 0625/12 第35题）

解：导线静止在均匀磁场中，磁场联系不变；接通电源、接地或加热均不使导线切割磁场线。
移动导线时，导线切割磁场线，产生感应电动势。
故选 D。

针对练习

1. Fig. 10.1 shows the apparatus used by a student to demonstrate electromagnetic induction.

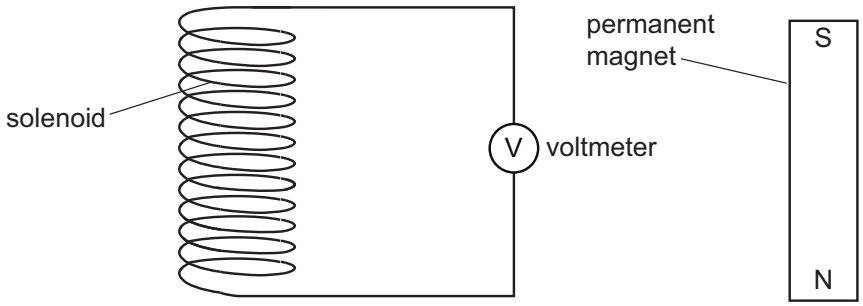


Fig. 10.1

(a) Describe how the student uses the apparatus to demonstrate electromagnetic induction.

（2025 春季 0625/32 第10题(a)）

2. **(a)** Fig. 10.1 shows an arrangement used to demonstrate electromagnetic induction.

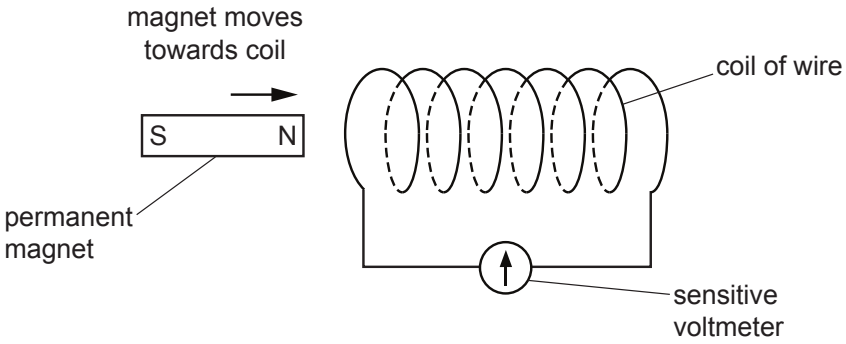


Fig. 10.1

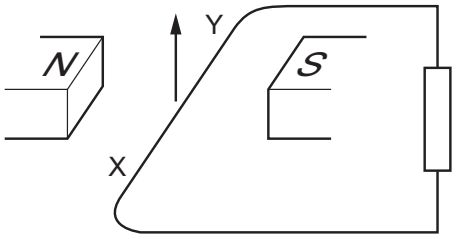
(i) When the magnet moves towards the coil of wire, the pointer on the sensitive voltmeter deflects to the right.

Explain why the pointer deflects.

(ii) State **two** changes that increase the deflection on the sensitive voltmeter.

（2023 夏季 0625/31 第10题(a)）

3. The diagram shows a wire XY moving upwards in a magnetic field.



A current is induced in the wire.

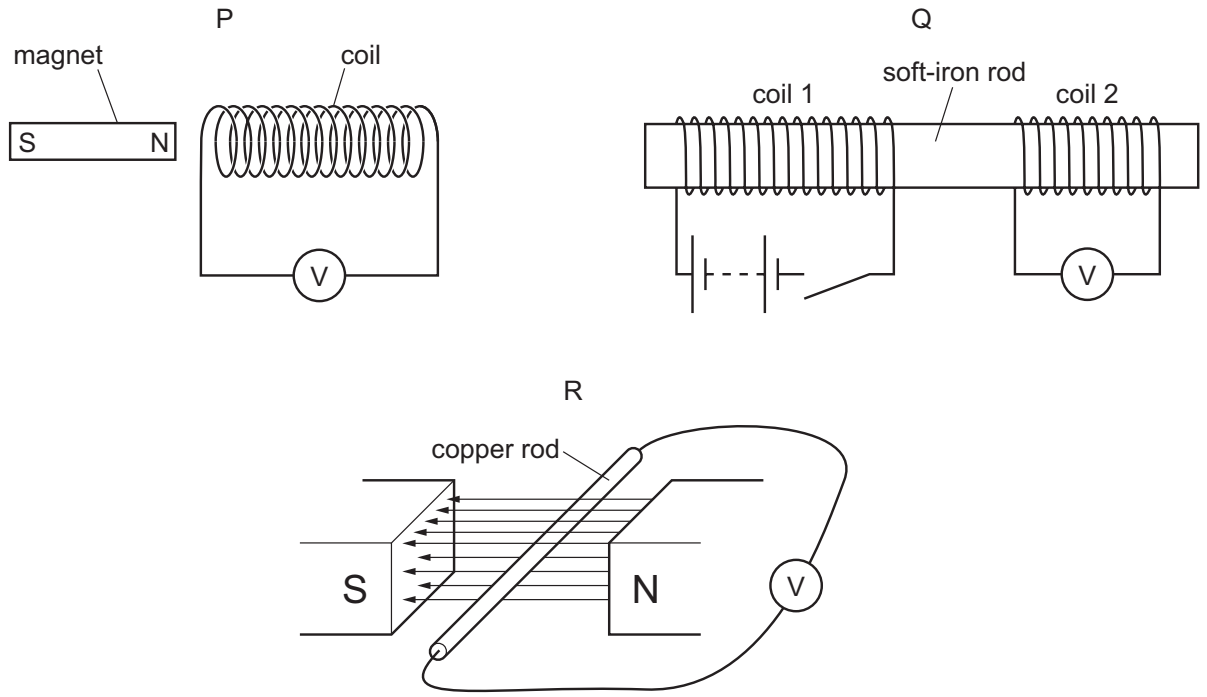
The current-carrying wire XY experiences a force because of its interaction with the magnetic field.

Which row gives the direction of the induced current and the direction of the force experienced by the wire XY?

	direction of induced current	direction of the force
A	from X to Y	downwards
B	from X to Y	upwards
C	from Y to X	downwards
D	from Y to X	upwards

（2024 冬季 0625/22 第31题）

4. A teacher sets up the equipment for three demonstrations, P, Q and R.



In demonstration P, the magnet is moved to the right.

In demonstration Q, the switch is closed.

In demonstration R, the copper rod is moved vertically upwards.

Which demonstrations can be used to demonstrate electromagnetic induction?

A P and Q only **B** P and R only **C** Q and R only **D** P, Q and R

（2023 冬季 0625/11 第31题）

二. 先找电流或磁场是否随时间改变

知识点 穿过线圈的磁场发生变化时，线圈中产生感应电动势；若回路闭合，则产生感应电流。

邻近线圈中的电流_____、交流电流或磁铁转动，均可使与另一线圈相联系的磁场发生变化。

当电流和磁场_____时，磁场联系不再改变，因而没有持续的感应电动势；感应电动势的单位是_____。

答案：随时间改变；保持不变；伏特（V）

怎么认 题目出现邻近线圈、交流电、转动磁铁或改变电阻时，先判断穿过线圈的磁场是否随时间改变。

例题 2

(a) Fig. 10.1 shows two coils of wire P and Q, each in a circuit. The ends of the coils are close but not touching.

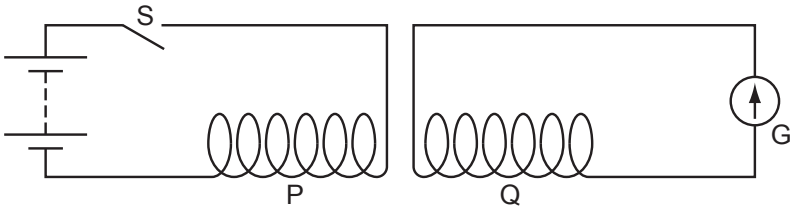


Fig. 10.1

Now, switch S is closed. The pointer in the sensitive ammeter G deflects and then returns to its zero position.

Explain why the pointer in sensitive ammeter G deflects.

（2023 春季 0625/32 第10题(a)）

解：闭合开关 S 时，线圈 P 中的电流由零开始增大，P 产生的磁场随之改变。
线圈 P 的磁场与线圈 Q 相联系，穿过 Q 的磁场发生变化，Q 中产生感应电动势和感应电流。
感应电流通过灵敏电流计 G，故指针发生偏转。
答：线圈 Q 中产生感应电流，使灵敏电流计 G 的指针偏转。

针对练习

5. **(a)** Fig. 9.1 shows a magnet spinning steadily near to a coil. There is a reading on the voltmeter.

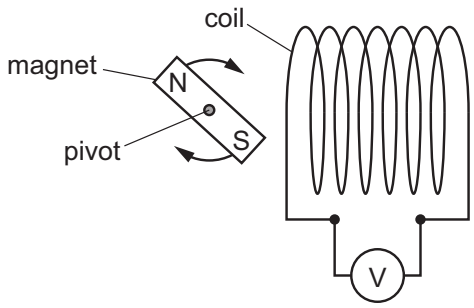


Fig. 9.1

Explain why there is a reading on the voltmeter.

（2024 冬季 0625/33 第9题(a)）

6. Fig. 8.1 shows a solenoid (long coil of wire) connected in a circuit. When the switch is closed, there is a large current in the circuit.

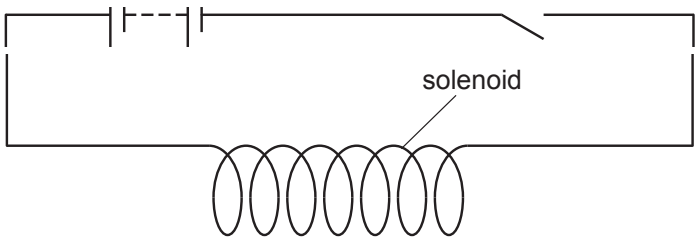


Fig. 8.1

(b) A solenoid P is placed close to another solenoid Q. Solenoid Q is connected to a sensitive voltmeter.
The arrangement is shown in Fig. 8.2.

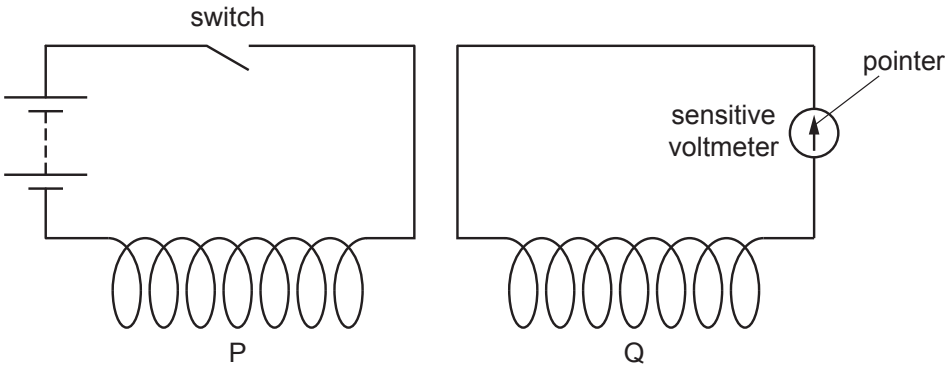


Fig. 8.2

Describe and explain what happens when the switch is closed.

（2023 冬季 0625/31 第8题(b)）

7. Fig. 9.1 shows a mobile phone (cell phone) being charged on a wireless charging plate.

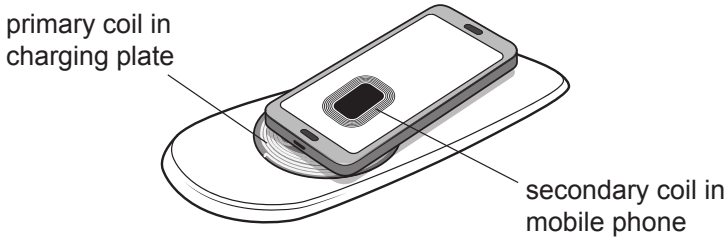


Fig. 9.1

(a) When the charging plate is switched on, there is an alternating current (a.c.) in the primary coil. A secondary coil is in the mobile phone.

Explain how a current is produced in the secondary coil.

（2024 夏季 0625/43 第9题(a)）

8. A solid bar is inside a copper solenoid. Fig. 7.1 shows that the copper solenoid is connected in series with a battery and a variable resistor.

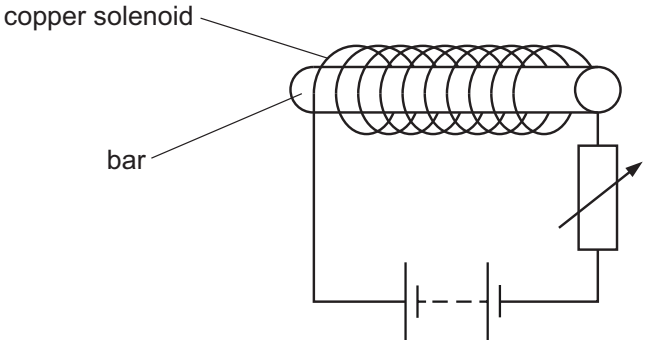


Fig. 7.1

The device shown in Fig. 7.1 is an electromagnet.

(c) A square coil of many turns is placed close to the bar. Fig. 7.3 shows the plane of the square coil parallel to the flat circular surface at the right-hand end of the bar.

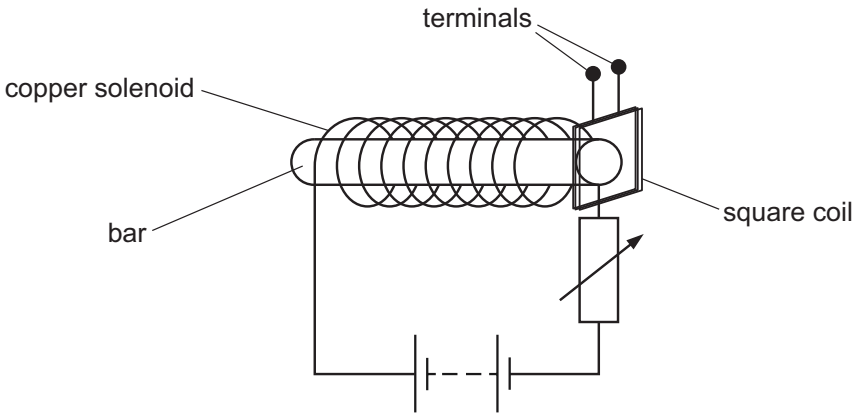


Fig. 7.3

The resistance of the variable resistor is alternately increased and decreased.

Explain what happens in the wires of the square coil.

（2024 冬季 0625/41 第7题(c)）

题型 2：比较感应电动势大小（考频★★☆☆☆）

知识点 导体切割磁场，或穿过导体的磁场发生变化时，导体中会产生_____。

在其他条件相同时，磁场越强、相对运动或磁场变化越快、线圈匝数越多，感应电动势越_____。

感应电动势的单位是_____，符号为 V。

答案：感应电动势；大；伏特

怎么认 题目出现导体或线圈与磁体相对运动，并要求比较感应电动势时，先比较磁场强弱、变化快慢和线圈匝数。

例题 1 A simple electric generator induces an electromotive force (e.m.f.).

Which modification would increase the induced e.m.f.?

A Increase the number of turns in the coil of the generator.

B Increase the distance between the magnetic poles.

C Reduce the strength of the magnetic field around the coil.

D Reverse the direction of the magnetic field.

（2023 夏季 0625/11 第31题）

解： 在磁场强弱和转动快慢不变时，线圈匝数越多，感应电动势越大。
增加发电机线圈的匝数，感应电动势增大。故选 A。

针对练习

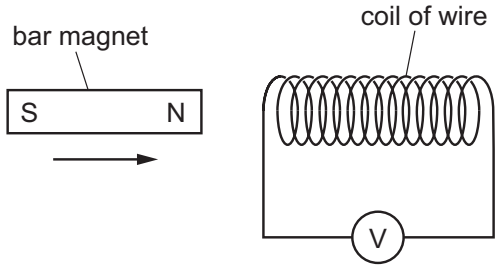
1. A length of wire moves across the space between the poles of a magnet. A voltmeter measures the electromotive force (e.m.f.) generated between the two ends of the wire.

What gives the highest reading on the voltmeter?

	speed of wire	strength of magnet
A	fast	weak
B	fast	strong
C	slow	weak
D	slow	strong

（2025 冬季 0625/22 第30题）

2. A student investigates electromagnetic induction. She moves the N pole of a magnet quickly towards a coil of wire. There is a reading on the sensitive voltmeter.



What can she do to get a greater reading on the sensitive voltmeter?

A Hold the bar magnet stationary inside the coil.

B Move the bar magnet slowly away from the coil.

C Use a coil of wire with fewer turns on it.

D Use a stronger bar magnet.

（2024 冬季 0625/13 第31题）

3. Fig. 10.1 shows the apparatus used by a student to demonstrate electromagnetic induction.

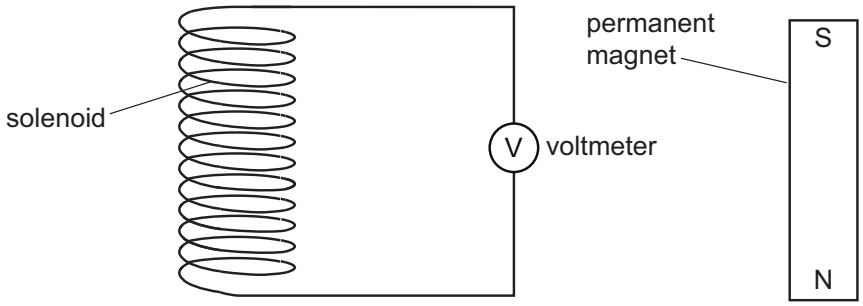
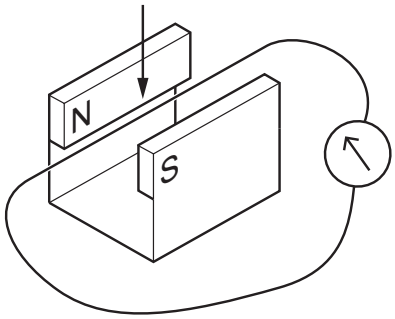


Fig. 10.1

(b) State **two** separate changes the student must make to the apparatus to increase the electromotive force (e.m.f.) induced in the coil.

（2025 春季 0625/32 第10题(b)）

4. A wire is moved down in a direction perpendicular to the magnetic field.



Three changes are suggested.

1 The speed of the movement of the wire is increased.

2 The magnetic field strength is decreased.

3 The direction of the magnetic field is reversed.

Which changes increase the electromotive force (e.m.f.) induced in the wire?

A 1 and 3 **B** 1 only **C** 2 and 3 **D** 3 only

（2023 春季 0625/12 第31题）

题型 3：判断感应电流与反作用方向（考频★★☆☆☆）

知识点 导体切割磁场，或穿过线圈的磁场发生变化时，导体中产生感应电动势；电路闭合时形成感应电流。

感应电流产生的磁场总是_____引起感应电流的变化，这一规律称为楞次定律。

三向互相垂直时，发电机右手定则中拇指指运动方向，食指指磁场方向，中指指感应电流方向。

感应电流在原磁场中受到的力总是_____；感应电动势和感应电流的单位分别为伏特和安培。

答案：反抗；与导体运动方向相反

怎么认 题目出现运动导体、磁场与感应电流的方向或反作用力时，先用右手定则或楞次定律判断。

例题 1

A wire is moved across a magnetic field. This causes an induced current in the wire.

The induced current interacts with the magnetic field to produce a force on the wire.

In which direction is this force?

A in the direction of the current

B in the direction of movement of the wire

C in the opposite direction to the current

D in the opposite direction to the movement of the wire

（2023 春季 0625/22 第31题）

解： 导线运动切割磁场，产生感应电流。
由楞次定律，感应电流产生的效应反抗引起它的变化，故导线所受磁场力与导线运动方向相反。
故选 D。

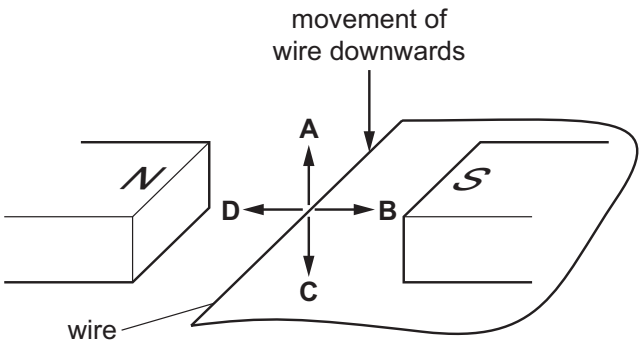
针对练习

1. The diagram shows a wire moving downwards in a magnetic field between two magnetic poles.

There is an induced current in the wire because of the movement.

The induced current produces a force on the wire.

In which direction is this force?



（2025 夏季 0625/23 第30题）

2. When a conductor in a complete circuit cuts across a magnetic field, a current is induced in the conductor.

Which statement about the induced current is correct?

A The induced current is in the same direction as the motion of the conductor.

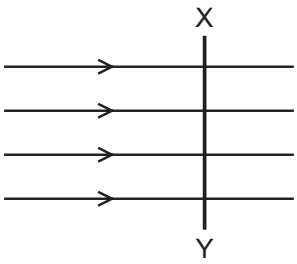
B The induced current is in the opposite direction to the motion of the conductor.

C The direction of the induced current is in the same direction as the magnetic field.

D The direction of the induced current opposes the change causing it.

（2024 夏季 0625/21 第28题）

3. A metal rod, XY, is placed in a magnetic field so that it is perpendicular to the field, as shown.



In which direction is the rod moved so that there is an induced current from Y to X?

A left to right

B right to left

C into the paper, away from the observer

D out of the paper, towards the observer

（2024 冬季 0625/21 第31题）

4. **(b)** Fig. 8.1 shows an ammeter connected to a coil wound on a thin plastic cylinder. A small trolley is placed on a curved track which passes through the cylinder.

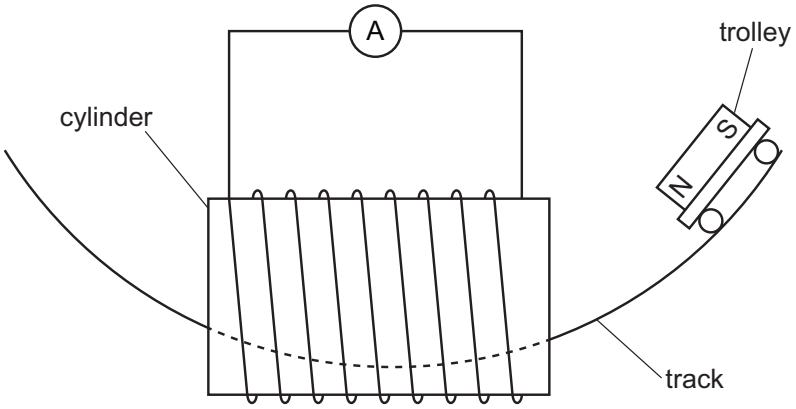


Fig. 8.1

The trolley is released from the position shown in Fig. 8.1. It travels through the coil from right to left. The trolley travels back from left to right. It has a lower maximum speed when it travels from left to right.

The plastic cylinder does not affect any magnetic field. A magnet is fixed to the trolley.

(i) State why there is a lower maximum speed when the trolley travels back from left to right.

(ii) Fig. 8.2 shows a close-up view of the ammeter.

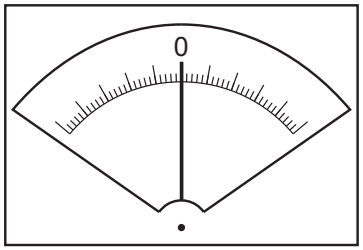


Fig. 8.2

As the trolley enters the coil moving from right to left, the ammeter needle deflects to the left and then returns to zero.

State and explain any changes to the deflection on the ammeter as the trolley enters the coil when moving back from left to right.

（2025 冬季 0625/42 第8题(b)）

4.5.2 交流发电机

题型 1：辨交流发电机结构（考频★★☆☆☆）

知识点 交流发电机使线圈或磁体在磁场中转动，使穿过线圈的磁场联系持续改变，从而产生方向周期性改变的感应电动势；电动势的单位为伏特（V）。

线圈两端分别连接两个_____，它们随线圈转动；静止的_____与滑环接触，使线圈和外电路保持连续连接。

交流发电机不用_____；软铁芯可增强磁场。

增强磁场、提高转速或增加线圈匝数，均可增大最大感应电动势；外电路电阻不变时，最大电流也随之增大。

答案：滑环；电刷；裂环换向器

怎么认 题目出现交流发电机图或询问其部件时，先找与线圈两端相连的滑环及接触滑环的电刷。

例题 1 Which component is **not** found in an a.c. generator?

A coil of wire

B split-ring commutator

C magnetic poles

D slip rings

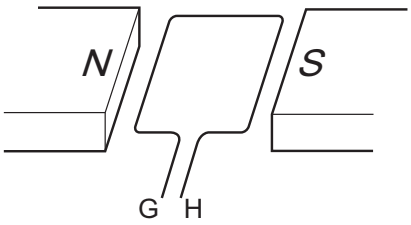
（2025 夏季 0625/21 第30题）

解：交流发电机用线圈和磁极产生感应电动势，用滑环把线圈两端接入外电路。

裂环换向器不属于交流发电机。故选 B。

针对练习

1. The diagram shows a simple a.c. generator.



What is connected to G and H so that alternating current can be provided to an external circuit?

A cell

B commutator

C slip rings

D soft iron core

（2025 冬季 0625/22 第31题）

2. Fig. 8.1 shows a diagram of part of a simple a.c. generator.

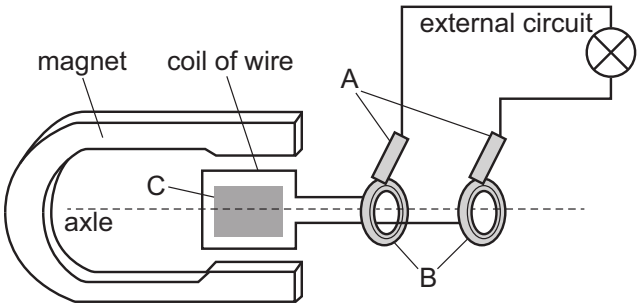


Fig. 8.1

(a) (i) Identify components A and B in Fig. 8.1.

(ii) Component C is made of soft iron.

Describe the effect of this component on the generator.

（2025 夏季 0625/41 第8題(a)）

3. Fig. 7.1 shows a simple a.c. generator.

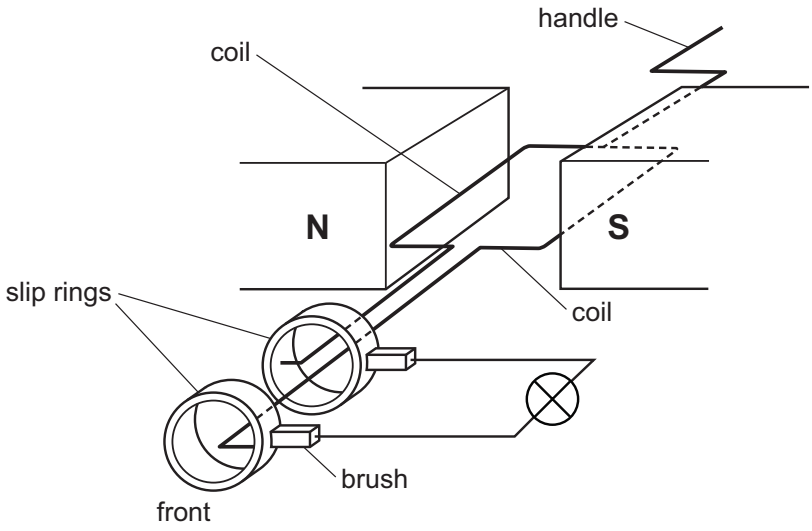


Fig. 7.1

(a) (i) Explain the function of the slip rings and brushes.

(ii) Describe how an alternating current is generated in the lamp.

(iii) State **two** possible changes that cause a larger maximum current in the lamp.

（2025 冬季 0625/43 第7題(a)）

4. **(a)** Fig. 8.1 shows a simplified diagram of an a.c. generator.

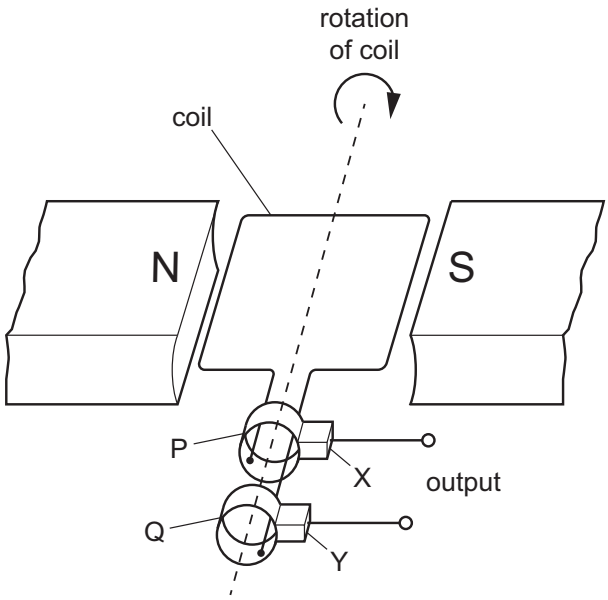


Fig. 8.1

(i) State the names of components:

(ii) Explain why an electromotive force (e.m.f.) is only induced when the coil is turning.

(iii) State **one** possible change that causes a larger e.m.f. to be induced.

（2025 夏季 0625/42 第8题(a)）

题型 2：把转动位置对应交流波形（考频★★★☆☆）

知识点 交流发电机使线圈与磁场发生相对转动，线圈的磁通联系周期性变化，产生方向周期性改变的电动势。

感应电动势的大小由磁通联系的_____决定，磁通联系发生变化时这一关系成立。

磁通联系为零但变化最快时，电动势大小达到_____；磁通联系达到正、负极值时，电动势为零。

电动势的正负由磁通联系的变化方向决定，单位是_____。

答案：变化率；最大值；伏特（V）

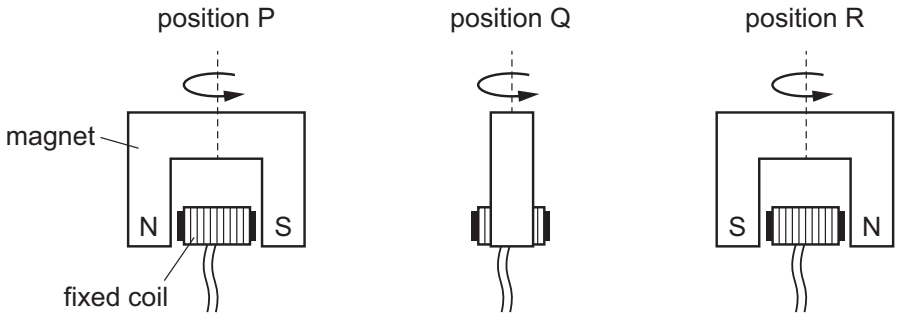
怎么认 题目出现线圈或磁体的转动位置及交流波形时，先比较磁通联系变化率，再按转动方向判正负。

一. 先比磁场联系变化率而不是磁场大小

例题 1

The diagram shows a simple a.c. generator. The magnet rotates around a fixed coil wound round a fixed iron core. The electromotive force (e.m.f.) output is a sine wave, a series of crests, zeros and troughs.

The magnet is shown in three positions, P, Q and R, during its rotation. The magnetic field in the coil is zero at Q but changing most rapidly.



Which statement about the induced e.m.f. in the coil is correct?

A The magnitude of the e.m.f. at position Q is larger than that at position P.

B The magnitude of the e.m.f. at position Q is zero.

C The magnitude of the e.m.f. at position Q is smaller than at position R, but not zero.

D The magnitude of the e.m.f. at position R is larger than at position P.

（2024 夏季 0625/22 第31题）

解：由电磁感应，感应电动势的大小由线圈中磁通联系的变化率决定。
在 Q 处磁场虽为零，但变化率最大，故电动势大小最大。
在 P、R 处磁场分别达到正、负极值，瞬时变化率为零，故电动势大小均为零。
因此 Q 处的电动势大小大于 P 处。故选 A。

针对练习

1. When the generator shown rotates, there is an a.c. electromotive force (e.m.f.) across the resistor between points P and Q.

Diagram 1 shows the position of the coil at time $t = 0$.

The coil rotates clockwise. At time t_1, the coil position is horizontal, as shown in diagram 2.

diagram 1

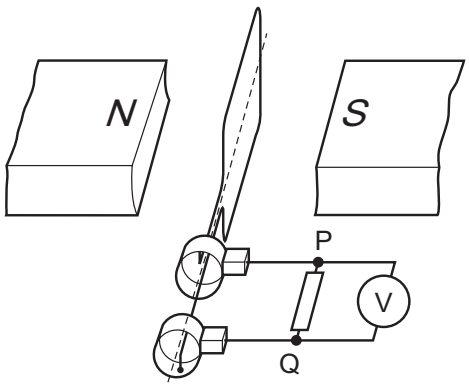
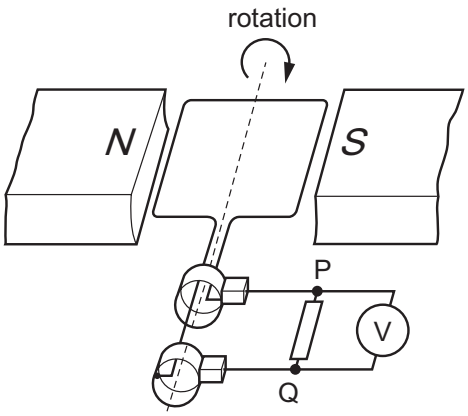
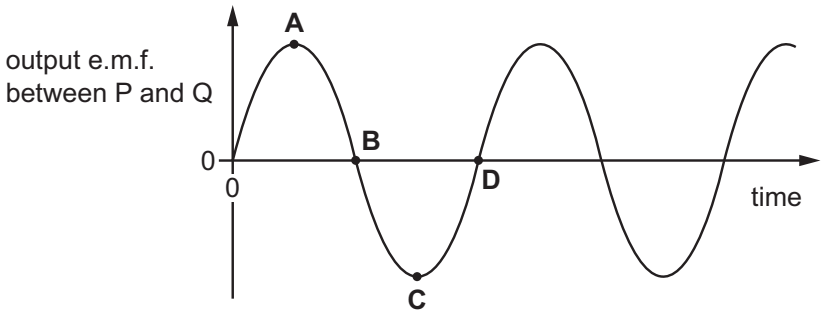


diagram 2



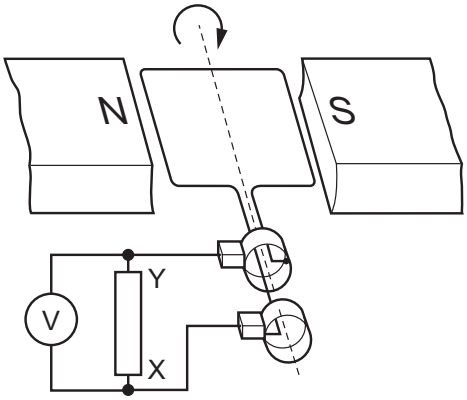
The graph shows the output e.m.f. between points P and Q plotted against time.

Which point shows the e.m.f. at time t_1?

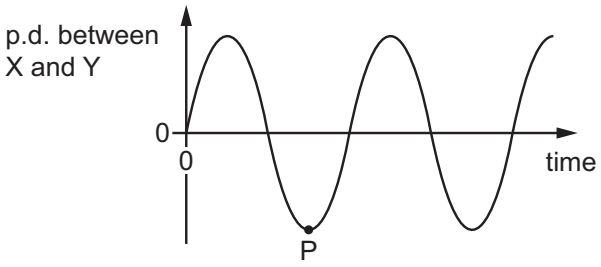


（2025 夏季 0625/23 第31题）

2. The diagram shows an a.c. generator.

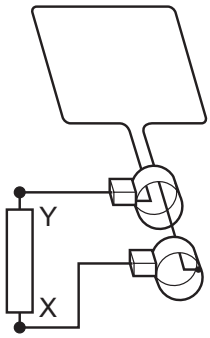


The graph shows the potential difference (p.d.) between points X and Y plotted against time. A positive value of p.d. indicates that X is more positive than Y.

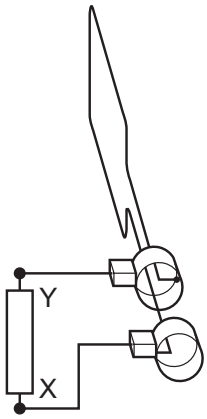


Which diagram shows the position of the coil at point P on the graph?

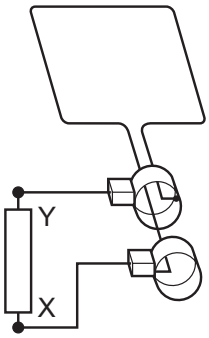
A



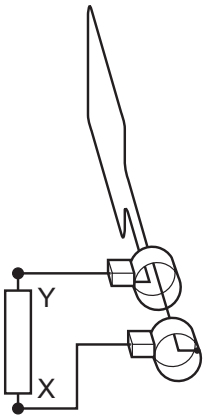
B



C



D



（2023 夏季 0625/21 第30题）

3. **(b)** Fig. 8.2 is a voltage–time graph showing the output of a simple alternating current (a.c.) generator at times t_0, t_1, t_2 and t_3.

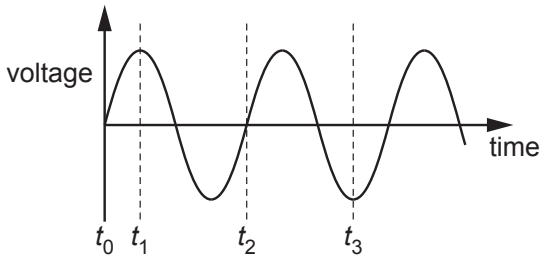


Fig. 8.2

Fig. 8.3 is an end view of the plane of the coil of the generator at time t_0. The coil is rotating clockwise.

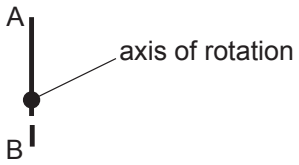


Fig. 8.3

(i) Draw an end view of the position of the plane of the coil at time t_1. Include the labels A and B.

(ii) Draw an end view of the position of the plane of the coil at time t_2. Include the labels A and B.

(iii) Draw an end view of the position of the plane of the coil at time t_3. Include the labels A and B.

（2023 冬季 0625/43 第8题(b)）

二. 一整圈先对应一个完整周期

知识点 线圈在匀强磁场中匀速转动时，每转一整圈，感应电动势完成_____，周期为 T，单位是 s。

线圈平面与磁场方向垂直时，电动势为零；线圈平面与磁场方向平行时，电动势的大小为峰值。

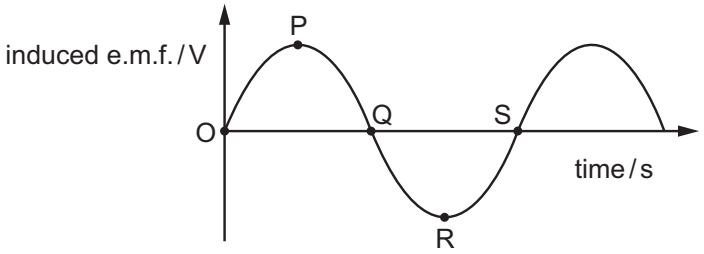
频率表示单位时间内完成的周期数，$f = \frac{1}{T}$，单位是 Hz。

转速增大时，周期_____，频率与峰值电动势均_____。

答案：一个完整周期；减小；增大

怎么认 题目出现线圈转数、转速和电动势–时间图时，先把一整圈配成一个完整周期。

例题 2 An a.c. generator is set up so that its coil of wire is perpendicular to the magnetic field. The coil of wire is rotated slowly to produce an alternating electromotive force (e.m.f.). A graph of the induced e.m.f. against time is plotted as the coil rotates.



Which section of the graph represents a rotation of three-quarters of a turn?

A OP **B** OQ **C** OR **D** OS

（2025 春季 0625/22 第33题）

解：线圈转一整圈，感应电动势完成一个完整周期。
图中从 O 到下一次同方向过零的 S 为一个周期，对应一整圈。
P、Q、R 分别对应 $\frac{1}{4}$、$\frac{1}{2}$、$\frac{3}{4}$ 个周期。
故三分之四圈对应 OR，故选 C。

针对练习

4. A simple a.c. generator has a coil rotating in a magnetic field.

What happens to the peak electromotive force (e.m.f.) and to the frequency of the a.c. output when the coil is rotated faster?

	peak e.m.f.	frequency
A	greater	greater
B	greater	no change
C	no change	greater
D	no change	no change

（2023 冬季 0625/23 第31题）

5. Fig. 8.1 shows a diagram of part of a simple a.c. generator.

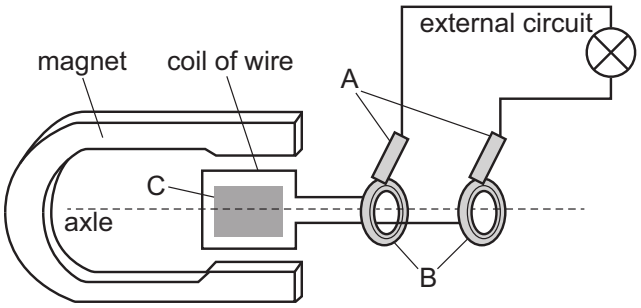


Fig. 8.1

(b) The coil of the generator rotates at a constant speed of two complete revolutions per second. Sketch a graph of the e.m.f. generated against time on the axes in Fig. 8.2. The coil is in the position shown in Fig. 8.1 at time = 0.

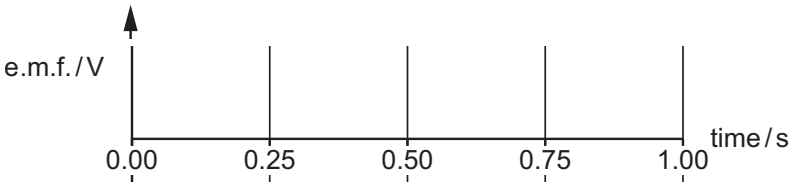


Fig. 8.2

（2025 夏季 0625/41 第8题(b)）

6. Fig. 7.1 shows a simple a.c. generator.

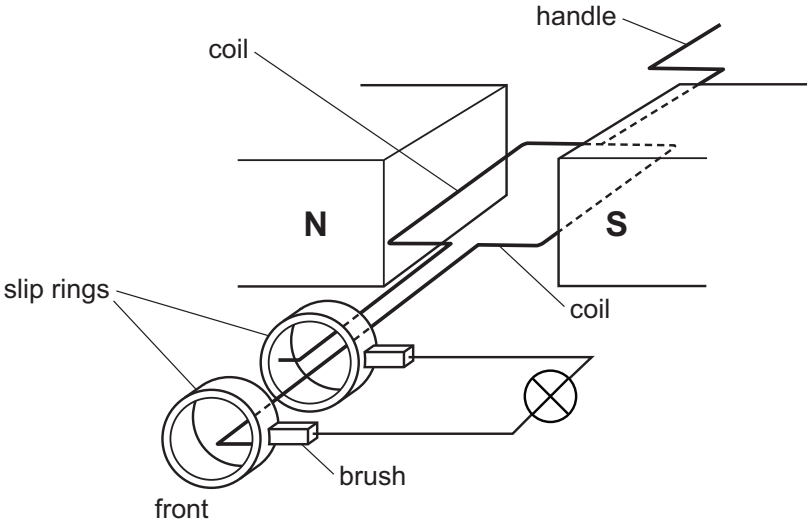


Fig. 7.1

(b) Fig. 7.2 is a graph to show how the electromotive force (e.m.f.) varies with time for the coil.

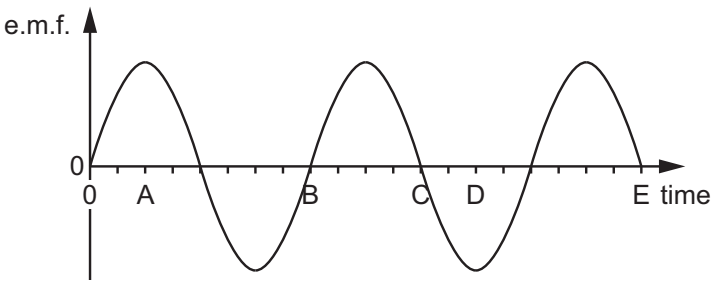


Fig. 7.2

(i) Determine how many revolutions the coil has made, from time = 0 to E.

(ii) Fig. 7.3 shows the end view of the position of the plane of the coil at time = 0. The coil is rotating anti-clockwise.

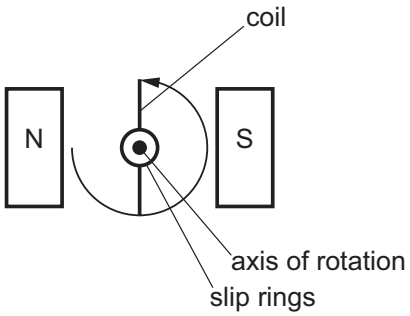


Fig. 7.3

On Fig. 7.4, draw **four** lines to match the coil position to the times A, B, C and D. The coil is viewed from the front.

Each coil position may be used once, more than once or not at all.

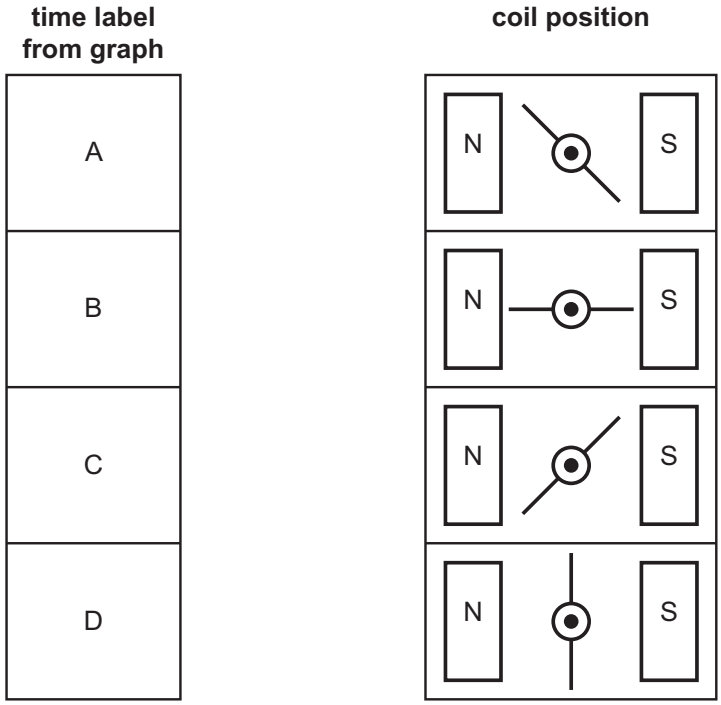


Fig. 7.4

（2025 冬季 0625/43 第7題(b)）

4.5.3 电流的磁效应

题型 1：画直导线周围磁场（考频★★☆☆☆）

知识点 通电长直导线周围的磁场线是以导线为圆心的_____，所在平面与导线垂直。

用右手握线定则判断方向：拇指指向电流，四指弯曲方向为磁场方向；电流垂直进入纸面时，磁场沿_____方向。

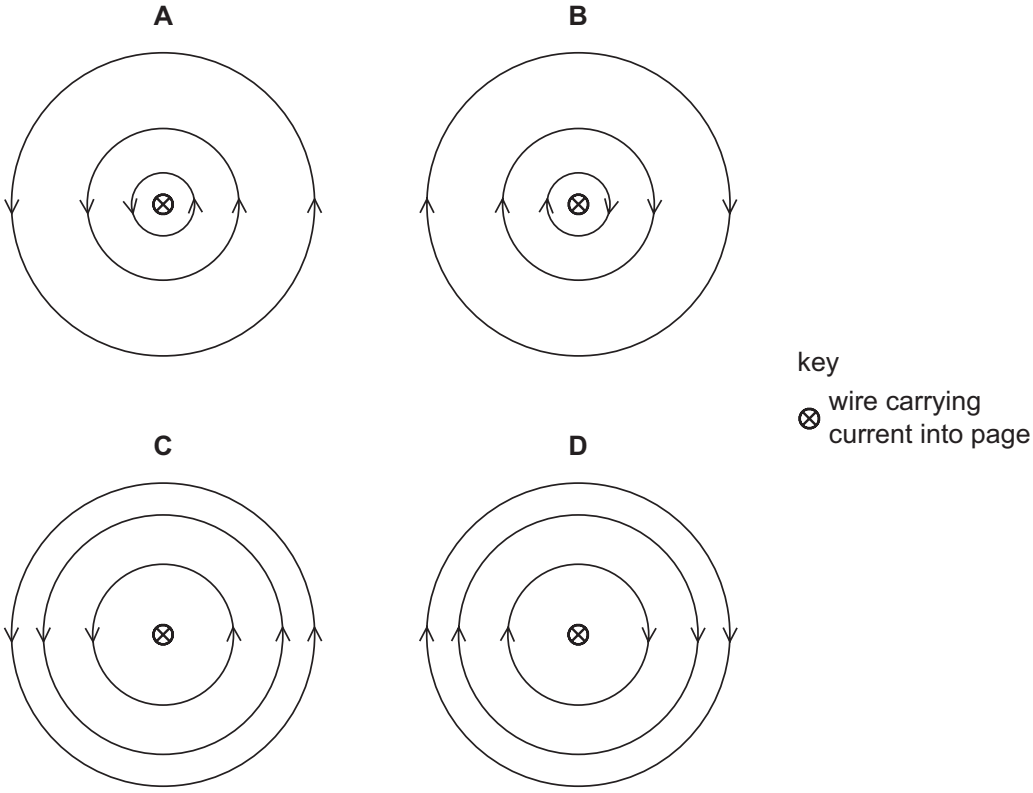
电流越大、离导线越近，磁场越_____；电流方向反向时，磁场方向反向。

答案：同心圆；顺时针；强

怎么认 题目出现长直导线、电流方向及周围磁场线时，先用右手握线定则判断方向，再看疏密。

例题 1 When there is an electric current in a long straight wire, a magnetic field is created around the wire.

Which diagram shows the correct pattern and direction of magnetic field lines around a long straight wire carrying current into the page?



（2025 夏季 0625/22 第32题）

解： 长直导线周围的磁场线为以导线为圆心的同心圆。

电流进入纸面，由右手握线定则，磁场方向为顺时针。

离导线越远，磁场越弱，磁场线应越疏。

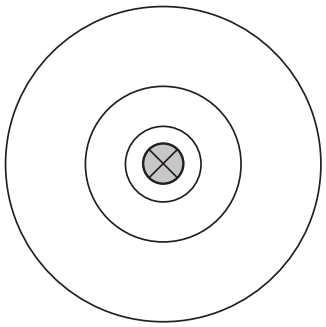
故选 B。

针对练习

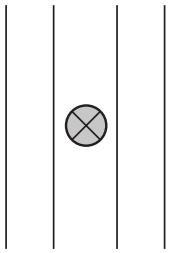
1. The direction of the current in a straight wire X is into the paper.

Which diagram shows the shape of the magnetic field pattern around the wire?

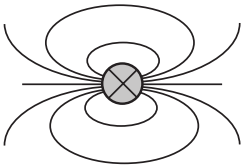
A



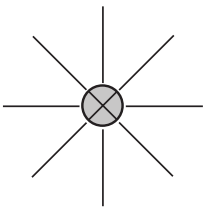
B



C



D



（2024 冬季 0625/13 第32题）

2. What is used to identify the pattern and direction of the magnetic field due to the current in a straight wire?

A an ammeter

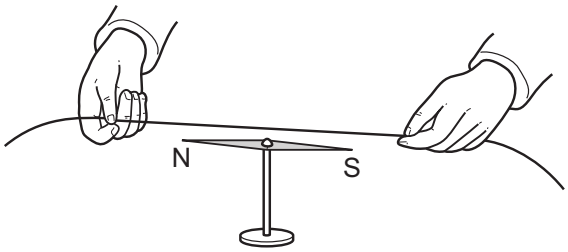
B a compass

C iron filings

D a voltmeter

（2025 冬季 0625/11 第32题）

3. In an experiment, a wire is held above a compass needle as shown.



An electric current is switched on in the wire and the compass needle is deflected.

Which row explains why this happens and then describes what happens when the current is reversed?

	why this happens	what happens when the current is reversed
A	there is a magnetic field inside the wire	the compass needle deflects in the opposite direction
B	there is a magnetic field inside the wire	the compass needle remains deflected in the same direction
C	there is a magnetic field around the wire	the compass needle deflects in the opposite direction
D	there is a magnetic field around the wire	the compass needle remains deflected in the same direction

（2023 春季 0625/12 第32题）

4. **(a)** Fig. 8.1 shows a wire carrying a large current.

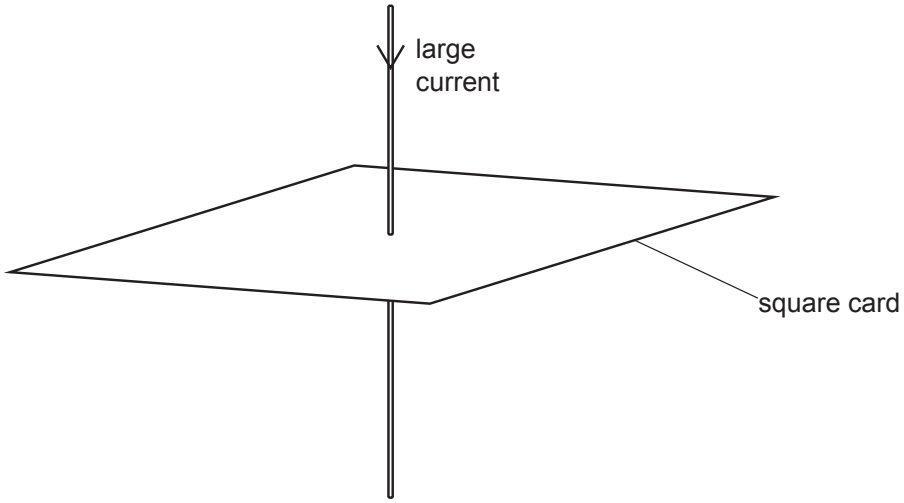


Fig. 8.1

(i) Fig. 8.2 shows the square card viewed from above.

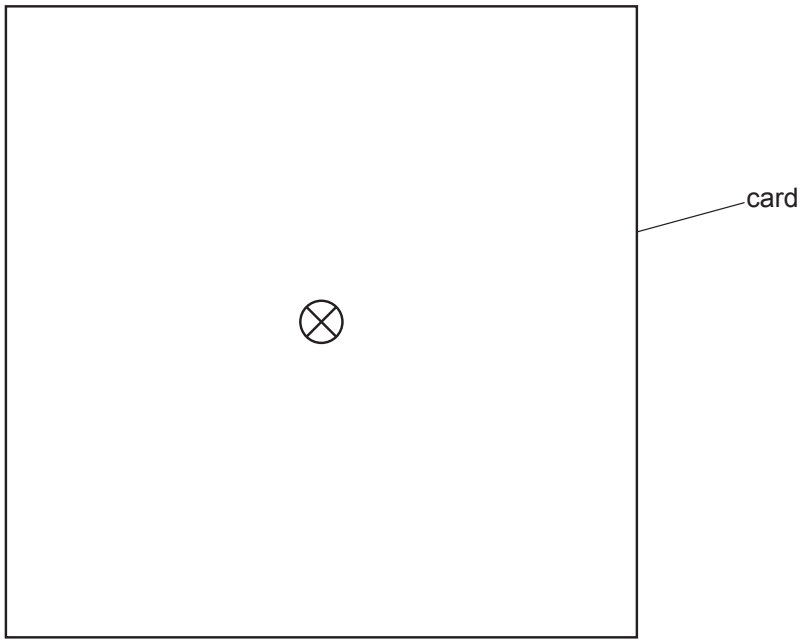


Fig. 8.2

On Fig. 8.2, draw **three** magnetic field lines that indicate the direction of the magn field and how its strength varies with distance from the wire.

(ii) The current in the wire increases and the direction of the current is reversed.

State how these changes affect the magnetic field.

（2024 春季 0625/42 第8题(a)）

题型 2：判断螺线管磁极与场强（考频★★☆☆☆）

知识点 通电螺线管的磁场分布与条形磁铁相似，内部磁场线近似平行，外部磁场线从 N 极指向 S 极并构成闭合曲线。

右手四指沿线圈中的_____方向弯曲，拇指所指的一端为_____极。

在线圈匝数、形状和铁芯不变时，电流越大，磁场越强，同一区域的磁场线越_____；电流反向，磁场方向反向。

磁场强弱可用磁通密度 B 表示，其单位是特斯拉（T）。

答案：电流；N；密集

怎么认 题目出现螺线管的电流方向、磁极或电流变化时，先用右手握螺线管定则判方向，再由电流大小判场强。

例题 1 When there is a current in a solenoid, a magnetic field is formed around it.

How does the magnetic field change if the current is increased?

	spacing of field lines	strength of field
A	closer together	stronger
B	closer together	weaker
C	further apart	stronger
D	further apart	weaker

（2024 冬季 0625/23 第32题）

解： 在线圈结构不变时，增大电流使螺线管的磁场增强。

磁场越强，同一区域内的磁场线越密，间距越小。

故选 A。

针对练习

1. Fig. 8.1 shows an arrangement for making an electromagnet. The electromagnet consists of a solenoid and a core.

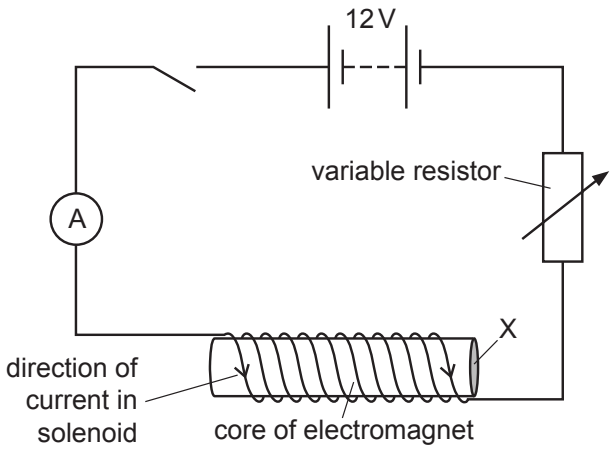


Fig. 8.1

(b) The switch is closed. The direction of the current in the solenoid is shown in Fig. 8.1.

(i) There is a magnetic field around the electromagnet.

State the name of a piece of equipment that can show the direction of a magnetic field.

(ii) State the name of the pole labelled X on the core of the electromagnet.

（2024 夏季 0625/31 第8题(b)）

2. A current in a solenoid produces a uniform magnetic field inside the solenoid. The magnetic field direction is due east.

Which changes will produce a stronger magnetic field with a direction due west?

A Use a smaller current and turn the solenoid through 180°.

B Use a smaller current and reverse the current.

C Use a larger current and turn the solenoid through 90°.

D Use a larger current and reverse the current.

（2023 冬季 0625/21 第31题）

3. There is a current of 3.0 A in a conductor.

The current is changed to 6.0 A in the opposite direction.

Which effect does this have on the magnetic field around the conductor?

A It decreases and it acts in the opposite direction.

B It decreases and it acts in the same direction.

C It increases and it acts in the opposite direction.

D It increases and it acts in the same direction.

（2025 夏季 0625/11 第33题）

4. A solid bar is inside a copper solenoid. Fig. 7.1 shows that the copper solenoid is connected in series with a battery and a variable resistor.

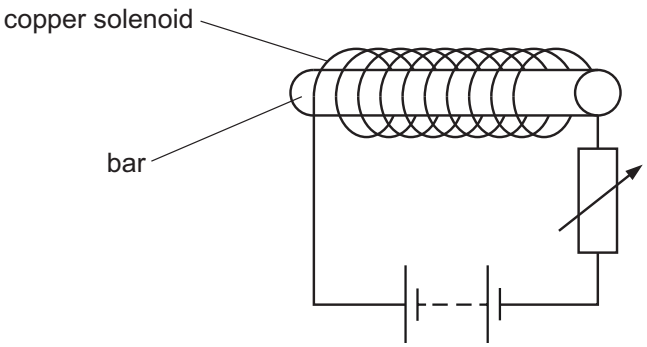


Fig. 7.1

The device shown in Fig. 7.1 is an electromagnet.

(b) The right-hand end of the bar is the S pole.

(i) Fig. 7.2 shows the bar viewed from above.

On Fig. 7.2, draw at least six field lines to show the pattern and direction of the magnetic field surrounding the bar.

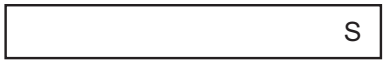


Fig. 7.2

(ii) The resistance of the variable resistor increases.

Explain what happens to the magnetic field surrounding the bar and state how the pattern of field lines that represents the field changes.

（2024 冬季 0625/41 第7题(b)）

题型 3：用电流磁效应解释装置（考频★★★☆☆）

知识点 电流通过导线或线圈时，周围产生_____，这种现象称为电流的磁效应。
线圈中放入软铁芯，通电后铁芯被磁化，形成_____；继电器利用它吸引衔铁，使触点开合。
扬声器利用通电线圈在磁场中受力而振动。通电是产生电流磁效应的条件，本题不涉及物理量单位。

答案：磁场；电磁铁

怎么认 题目出现装置是否利用电流磁效应时，先找通电后产生磁场的导线或线圈。

一. 先找通电后形成电磁铁的线圈

例题 1 Which device uses the magnetic effect of an electric current?

A heater

B lamp

C relay

D thermistor

（2024 春季 0625/12 第28题）

解：A 中电热器利用电流的热效应；B 中灯丝通电发热并发光；C 中继电器的线圈通电后形成电磁铁并吸引衔铁；D 中热敏电阻的电阻随温度变化。
故选 C。

针对练习

1. In which device is the magnetic effect of a current **not** used?

A electromagnet

B loudspeaker

C potential divider

D relay

（2023 夏季 0625/22 第32题）

2. Four appliances all use an electric current to operate.

Which appliance uses the magnetic effect of the current?

A a heater

B a light bulb

C a relay

D a remote controller

（2023 夏季 0625/13 第31题）

二. 按通电受力到断电复位写过程

知识点 电流的磁效应是电流周围产生磁场；线圈通电后产生磁场，绕有软铁芯时成为_____。
软铁在磁场中被磁化并受到吸引；线圈电阻不变时，电流越大，磁场越强，吸引力越大。
触点断开后线圈中无电流，电磁铁的磁性_____，弹性金属使部件复位并再次接通电路。
交流电方向反复改变，线圈的受力方向也反复改变，使相连部件振动；振动频率的单位为 Hz。
软铁断电后易失磁，钢较易保留磁性而成为_____，故需迅速复位的装置使用软铁。

答案：电磁铁；消失；永久磁体

怎么认 题目出现线圈、软铁部件、触点或交流电，并要求解释运动时，先写线圈通电产生磁场。

例题 2

(b) A teacher uses the arrangement in Fig. 10.1 to demonstrate an electric bell. When the switch is closed, the hammer repeatedly hits the metal gong.

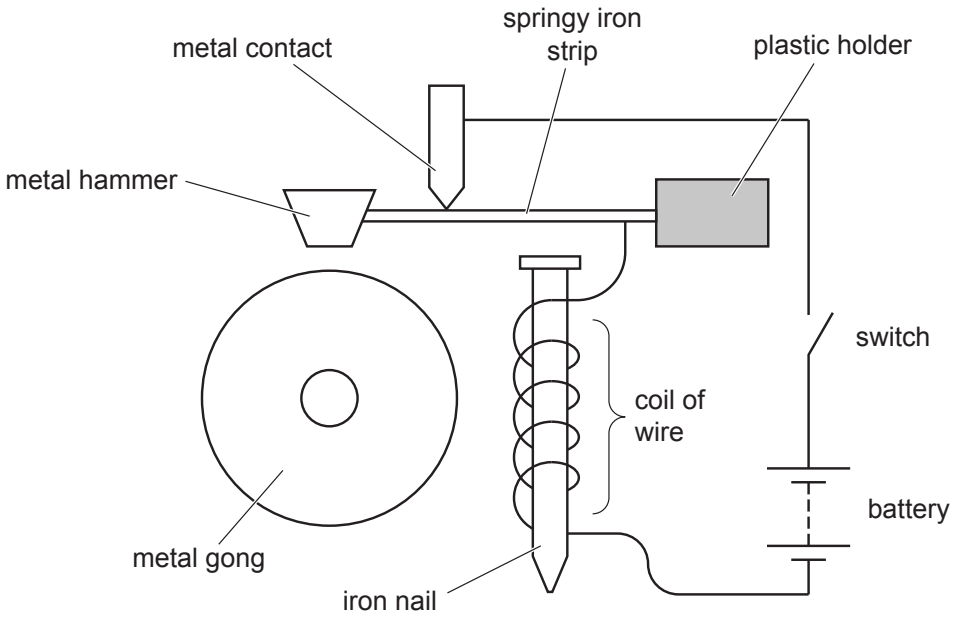


Fig. 10.1

Using the information in Fig. 10.1, explain why the hammer repeatedly hits the metal gong when the switch is closed.

（2023 冬季 0625/32 第10题(b)）

解：闭合开关后电路接通，线圈中有电流，电流的磁效应使线圈和铁钉成为电磁铁。
电磁铁吸引弹性铁片，铁片带动金属锤敲击金属锣，同时铁片离开金属触点，使电路断开。
线圈中电流消失，电磁铁失去磁性，弹性铁片弹回并重新接触金属触点，电路再次接通。
通电、吸引、断电、复位的过程反复发生。答：金属锤反复敲击金属锣。

3. Fig. 8.1 shows a solenoid.

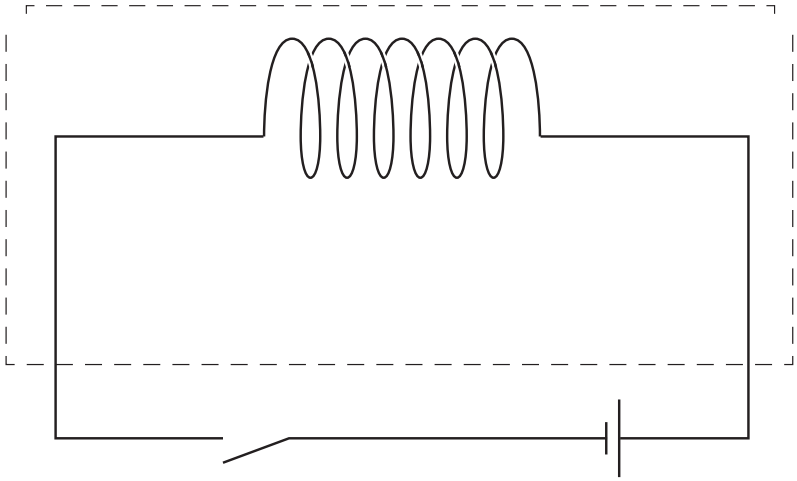


Fig. 8.1

(b) Fig. 8.2 shows a solenoid in an electric circuit for a bell.

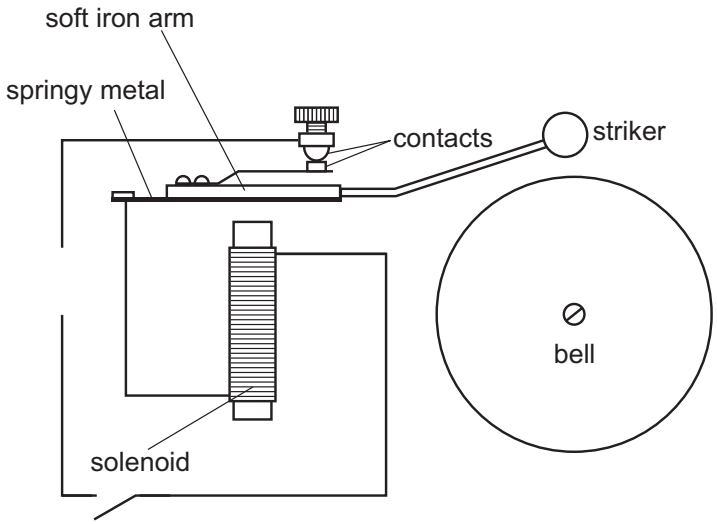


Fig. 8.2

(i) Complete the circuit in Fig. 8.2 with the symbol for a direct current (d.c.) power supply.

(ii) Explain why the soft iron arm pivots, making the striker hit the bell when the switch is closed.

(iii) Explain why the arm pivots back to its original position after the striker hits the bell.

（2025 冬季 0625/41 第8题(b)）

4. Fig. 7.1 shows a barrier at the entrance to a car park. The wooden barrier arm has a weight of 60 N which acts through the centre of gravity at the position shown on Fig. 7.1.

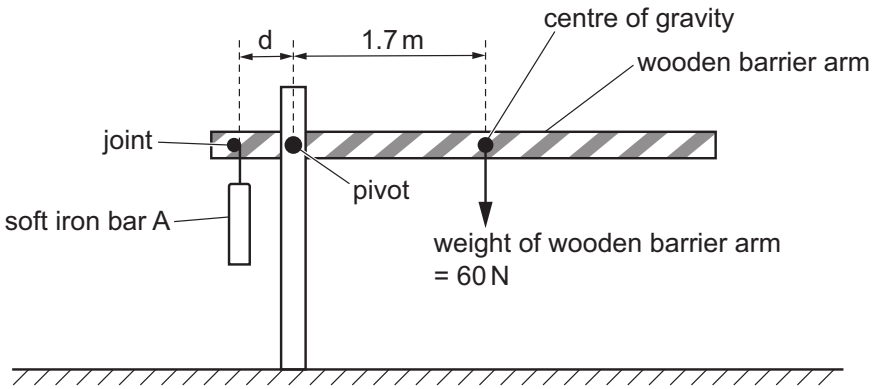


Fig. 7.1

(b) Fig. 7.2 shows a coil attached to a power supply placed below the soft iron bar A.

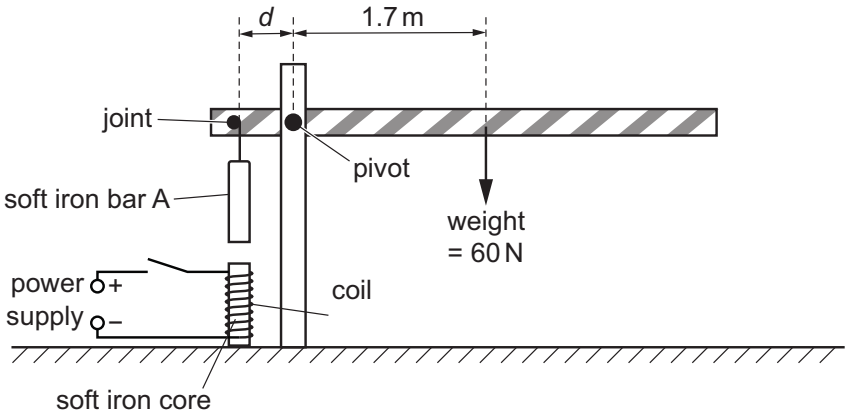


Fig. 7.2

(i) State and explain what happens to the wooden barrier arm when the switch in the coil circuit is closed.

(ii) The switch is opened. An operator decreases the potential difference across the coil and the switch is closed.

State and explain how the effect on the wooden barrier arm compares with the effect in **(b)(i)**.

(iii) A student suggests that the soft iron bar A is replaced by a steel bar. Explain why a steel bar is less effective than a soft iron bar in the barrier.

（2024 冬季 0625/43 第7题(b)）

5. **(b)** A teacher demonstrates how a loudspeaker works by using the equipment shown in Fig. 9.1.

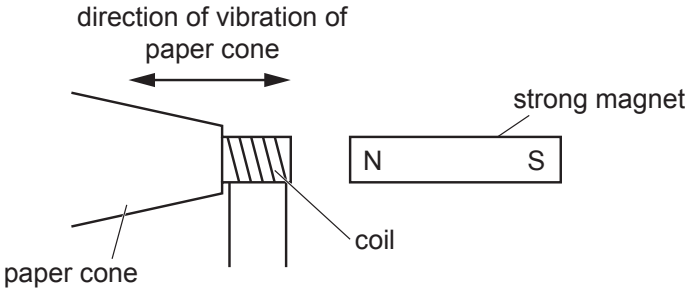


Fig. 9.1

There is an alternating current in the coil. The paper cone and coil vibrate as shown in Fig. 9.1.

(i) Explain why the paper cone vibrates. Use your ideas about magnetism.

(ii) When the paper cone vibrates, the teacher hears a sound.

Suggest a value for the frequency of the alternating current. Include the unit.

（2023 冬季 0625/33 第9题(b)）

4.5.4 通电导体所受的力

题型 1：用左手定则判断导体受力（考频★★★☆☆）

知识点 通电导体在磁场中，且电流方向不与磁场方向平行时，导体受到磁场力，力的单位为牛顿（N）。

磁场方向规定为从 _____ 极指向 _____ 极，传统电流方向为正电荷定向移动的方向。

当电流方向与磁场方向垂直时，力、电流和磁场三者两两 _____；左手定则中食指指磁场，中指指电流，拇指指力。

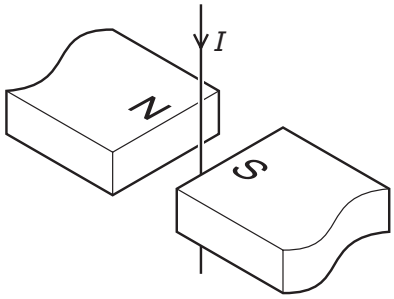
电流方向或磁场方向单独反向，力的方向反向；二者同时反向，力的方向不变。

答案：N；S；垂直

怎么认 题目出现 N、S 极、导线电流和受力方向时，先标 N 极到 S 极的磁场及传统电流，再用左手定则。

一. 先标 N 到 S 和传统电流

例题 1 The diagram shows a vertical wire carrying a current I placed between the poles of a magnet.



What is the direction of the force on the wire exerted by the magnetic field?

A from N to S

B from S to N

C horizontal and at right angles to the direction from N to S

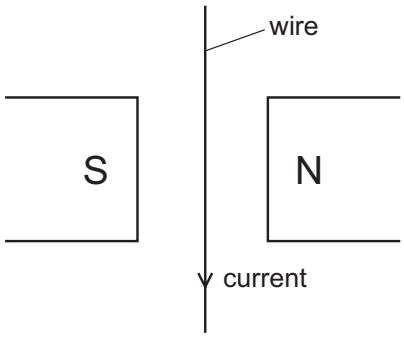
D parallel to the wire

（2023 夏季 0625/11 第32题）

解：磁场方向由 N 极指向 S 极，电流 I 沿导线向下。
由左手定则，力的方向与电流方向、N 极到 S 极的方向均垂直，故为水平方向且垂直于 N 极到 S 极。
故选 C。

针对练习

1. The diagram shows a wire hanging freely between the poles of a magnet. There is a current in the wire in the direction shown.



The magnet and current cause a force to act on the wire.

In which direction does this force act?

A into the page (away from you)

B out of the page (toward you)

C to the left

D to the right

（2023 夏季 0625/23 第30题）

2. Fig. 8.1 shows a horizontal, flat coil in a magnetic field

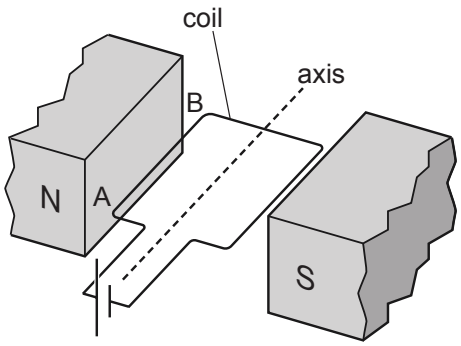


Fig. 8.1

The coil is connected to a cell. The coil rotates.

(a) Determine the direction of movement of the side AB relative to the plane of the coil.

（2023 春季 0625/42 第8題(a)）

3. Fig. 8.1 shows a metal rod suspended in the magnetic field produced by a pair of permanent magnets. The metal rod is connected to a cell and there is a current in the metal rod.

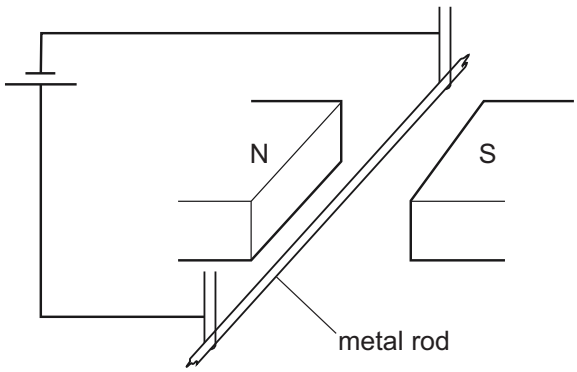


Fig. 8.1

(a) State the direction of the force on the metal rod due to the current.

Explain your answer.

（2025 春季 0625/42 第8題(a)）

4. Fig. 8.1 shows a horizontal, flat coil in a magnetic field

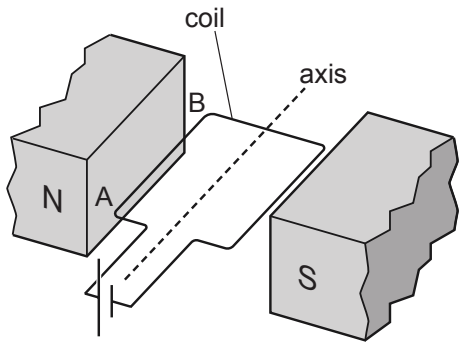


Fig. 8.1

The coil is connected to a cell. The coil rotates.

(a) Determine the direction of movement of the side AB relative to the plane of the coil.

(b) Explain how you determined the direction in **(a)**.

（2023 春季 0625/42 第8题(b)）

二. 只反转一个方向，力就反向

知识点 通电导体处在磁场中，且电流方向与磁场方向不平行时，导体受到磁力，力的单位是_____。
当电流方向与磁场方向垂直时，左手食指指向磁场，中指指向传统电流，拇指指向受力方向。
磁场或电流只反转一个，受力方向_____；两者同时反转，受力方向_____。

答案：牛顿（N）；反转；不变

怎么认 题目出现通电导体在 N、S 极间，并改变电池接线或磁极时，先判断电流或磁场反转了几个。

例题 2 Fig. 8.1 shows a metal rod suspended in the magnetic field produced by a pair of permanent magnets. The metal rod is connected to a cell and there is a current in the metal rod.

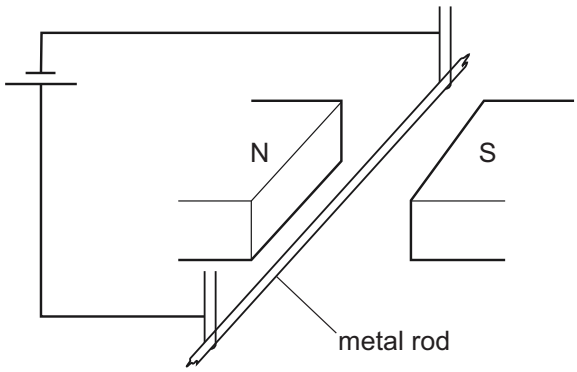


Fig. 8.1

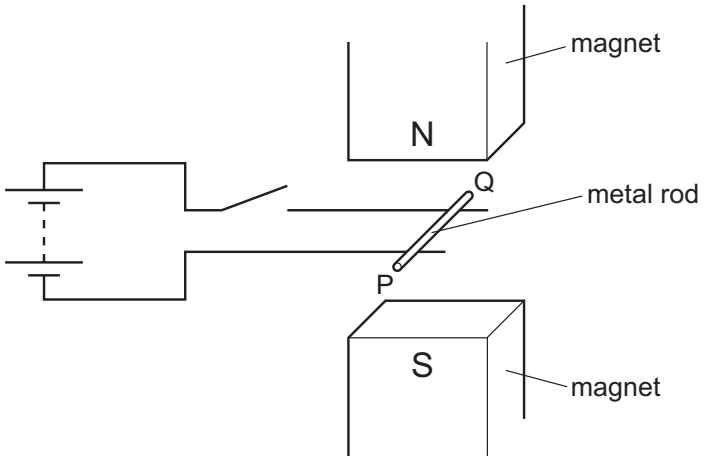
(b) The connections to the cell are reversed.

State how this change affects the force on the metal rod.

（2025 春季 0625/42 第8题(b)）

解：电池接线反接，金属棒中的电流方向反转，磁场方向不变。
由左手定则，电流方向单独反转时，导体受力方向反转。
答：金属棒所受力的方向反转，改变 180°。

5. A metal rod PQ rests on two horizontal metal wires that are attached to a battery. The rod lies between the poles of a magnet.



When the switch is closed, the rod moves to the right.

What could be changed so that the rod moves to the left?

A Open the switch.

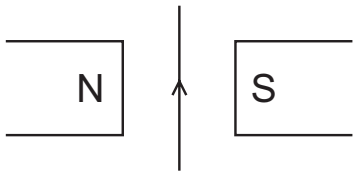
B Reverse the battery terminals and exchange the poles of the magnet.

C Reverse the battery terminals but without exchanging the poles of the magnet.

D Turn the metal rod around (P and Q exchanged).

（2023 冬季 0625/11 第32题）

6. The diagram shows a wire hanging vertically between the poles of a magnet.



There is a current in the wire in the direction shown. The wire moves into the plane of the page away from the observer.

In which direction does the wire move when the current is reversed?

A The wire moves into the plane of the page, away from the observer.

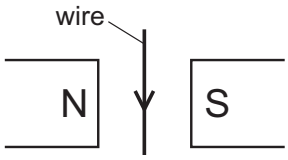
B The wire moves to the left.

C The wire moves to the right.

D The wire moves out of the plane of the page, towards the observer.

（2024 冬季 0625/12 第32题）

7. A conducting wire is placed between the poles of a magnet. When an electric current in the wire is in the direction shown, then the force on the wire acts out of the page.



Three statements of different conditions and how the wire is affected are given.

1 When the current is towards the top of the page and the direction of the magnetic field is unchanged, the force produced acts into the page.

2 When the current is towards the bottom of the page and the magnetic field is reversed, the force produced acts into the page.

3 When the current in the wire is alternating, the wire vibrates into and out of the page.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 夏季 0625/21 第30题）

题型 2：判断带电粒子的磁偏转（考频★★☆☆☆）

知识点 运动电荷在磁场中可能受到磁力；当运动方向与磁场方向不平行时，磁力方向同时垂直于这两个方向，当二者平行时磁力为零。

用左手定则判断三向关系：食指指向磁场方向，中指指向_____方向，拇指指向磁力方向。

正电荷的运动方向与传统电流方向相同，负电荷的运动方向与传统电流方向_____；做圆周运动时，磁力指向_____。

磁感应强度的单位是特斯拉（T），磁力的单位是牛顿（N）。

答案：传统电流；相反；圆心

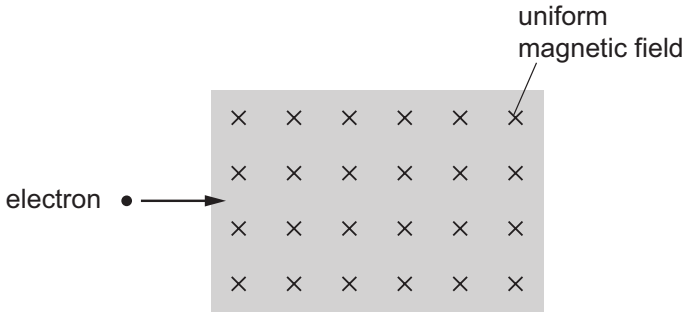
怎么认 题目出现运动方向、磁场方向和受力方向中的两个时，先把运动方向换成传统电流方向。

例题 1

An electron moves into a uniform magnetic field.

The arrow shows the initial direction of motion of the electron.

The direction of the magnetic field is into the plane of the page.



In which direction does a force act on the electron when it enters the magnetic field?

A into the page

B out of the page

C towards the bottom of the page

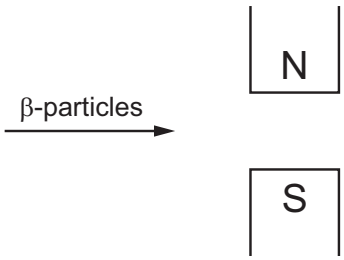
D towards the top of the page

（2023 夏季 0625/21 第31题）

解：电子带负电，其运动方向向右，故传统电流方向向左。
磁场垂直纸面向里，由左手定则，磁力方向朝向页面底部。
故选 C。

针对练习

1. The diagram shows β-particles being directed between the poles of a magnet.



In which direction will the particles be deflected?

A into the page

B out of the page

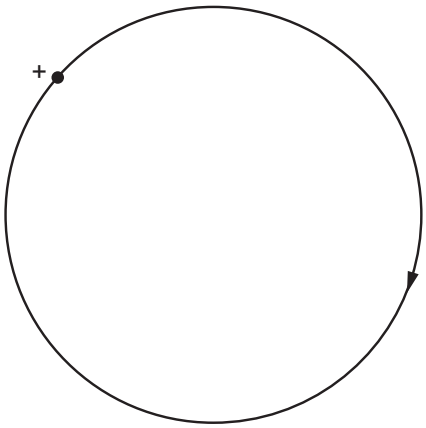
C towards the bottom of the page

D towards the top of the page

（2024 冬季 0625/22 第34题）

2. In an experiment, strong magnetic fields provide a force that keeps charged particles moving with a horizontal circular motion.

Positive particles are accelerated clockwise when viewed from above as shown.



In which direction is the magnetic field?

A vertically into the page

B vertically out of the page

C pointing away from the centre of the circular motion

D pointing towards the centre of the circular motion

（2024 冬季 0625/23 第31题）

4.5.5 直流电动机

题型 1：按部件解释直流电动机（考频★★☆☆☆）

知识点 载流线圈处在磁场中时，线圈两边受到方向相反的磁力，形成使线圈转动的_____；力的方向用左手定则判断。

在线圈形状等其他条件相同时，增加匝数、增大电流或增强磁场，转动效应均会_____；电流单位为安培 A，磁感应强度单位为特斯拉 T。

直流电动机中，分裂环换向器每半周反转线圈电流，使转矩保持同一转向；电刷在外电路与转动部件之间维持_____。

答案：转矩；增强；电接触

怎么认 题目出现直流电动机的构成、载流线圈受力或电刷和分裂环时，先判断线圈受力与换向作用。

例题 1 Which electrical device uses the turning effect produced by a current-carrying coil in a magnetic field?

A a.c. generator

B d.c. motor

C relay

D transformer

（2023 夏季 0625/13 第30题）

解：载流线圈处在磁场中时，线圈两边所受磁力形成转矩，使线圈转动。
直流电动机利用这一转动效应工作。
故选 B。

针对练习

1. A student makes a small d.c. motor. The teacher supplies the following equipment.

- battery
- ammeter
- voltmeter
- coil of wire
- magnets
- resistor

The student is also able to use other equipment if he wishes.

Which equipment **must** be used?

A ammeter, battery and resistor

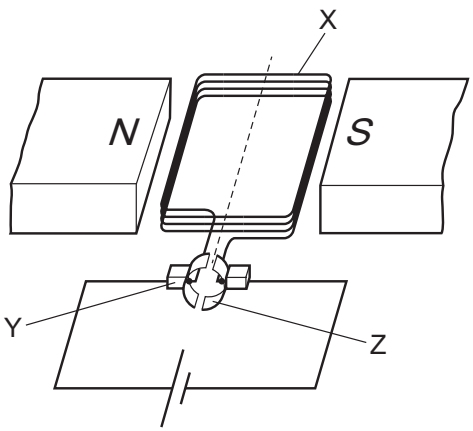
B ammeter, coil of wire and voltmeter

C battery, coil of wire and magnets

D magnets, resistor and voltmeter

（2024 夏季 0625/11 第31题）

2. The diagram shows a basic electric motor.



What are the names of the features?

	X	Y	Z
A	axle	battery	brushes
B	coil	brushes	commutator
C	generator	wires	transformer
D	solenoid	connectors	switch

（2024 冬季 0625/21 第32题）

3. Fig. 8.1 shows a metal rod suspended in the magnetic field produced by a pair of permanent magnets. The metal rod is connected to a cell and there is a current in the metal rod.

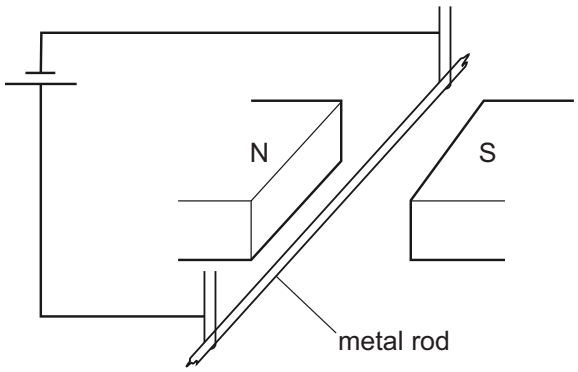


Fig. 8.1

(c) Two magnets and a cell are used to make a simple electric motor as shown in Fig. 8.2.

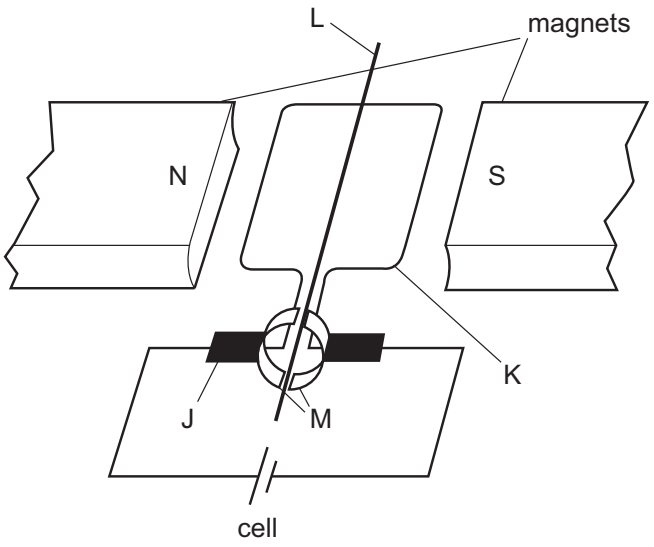


Fig. 8.2

Describe the function of parts J, K, L and M.

（2025 春季 0625/42 第8題(c)）

4. **(a)** Fig. 8.1 shows the single turn coil of a simple direct current (d.c.) motor.

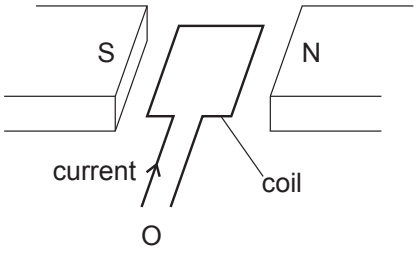


Fig. 8.1

(i) Explain the direction of the turning effect as seen by an observer at O.

(ii) The coil is replaced by an otherwise identical new coil with three turns and the same current in the coil.

State how the turning effect compares with the turning effect in **(i)**.

(iii) A third coil is identical to the coil in **(i)** except that its resistance is three times greater. The potential difference (p.d.) across the coil is the same as the p.d. in **(i)**.

State how the turning effect compares with the turning effect in **(i)**.

（2023 冬季 0625/43 第8题(a)）

题型 2：增大线圈转动效应（考频★★☆☆☆）

知识点 通电线圈处在磁场中时，线圈两侧所受磁力可使线圈产生转动效应；转动效应用转矩表示，单位为_____。

在线圈大小、位置及磁场方向不变时，转动效应随线圈中的电流、磁场强度和线圈匝数的增大而_____。

减小线圈中的电流、磁场强度或线圈匝数，会使转动效应_____。

答案：牛顿米（N m）；增大；减小

怎么认 题目出现通电线圈在磁场中转动，并问转动效应或转速的变化时，先比较电流、磁场强度和匝数。

例题 1 A class is designing a d.c. motor. To achieve a greater turning effect, three suggestions are made.

1 Have a larger current in the coil of the motor.

2 Have a stronger magnet in the motor.

3 Put a larger number of turns on the coil.

Which suggestions will help to increase the turning effect?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

（2024 夏季 0625/13 第31题）

解：在线圈大小、位置及磁场方向不变时，转动效应随电流、磁场强度和匝数的增大而增大。
建议 1 增大线圈中的电流，建议 2 增强磁场，建议 3 增加线圈匝数，三项均能增大转动效应。
故选 A。

针对练习

1. **(a)** Fig. 9.1 represents part of a d.c. electric motor. The coil of wire rotates at a steady speed.

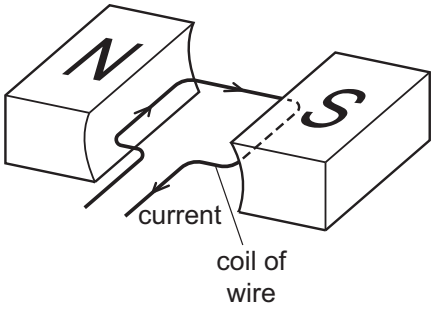


Fig. 9.1

State **two** ways to make the coil rotate faster.

（2024 冬季 0625/32 第9题(a)）

2. A student investigates the turning effect on a current-carrying coil placed in a magnetic field.

The student changes the current in the coil and the number of turns on the coil.

Which two changes together **must** increase the turning effect?

A decreasing the current and decreasing the number of turns

B decreasing the current and increasing the number of turns

C increasing the current and decreasing the number of turns

D increasing the current and increasing the number of turns

（2025 夏季 0625/11 第32题）

3. A current-carrying coil in the magnetic field between the poles of two magnets experiences a turning effect.

Which change would decrease the turning effect?

A decreasing the distance between the magnets

B increasing the current in the coil

C using stronger magnets

D decreasing the number of turns on the coil

（2025 冬季 0625/21 第31题）

4. Over time, the strength of the magnets in an electric motor decreases.

Which row describes **two** ways to keep the motor running at its original speed?

	current in the coil	number of turns on the coil
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

（2023 春季 0625/12 第33题）

4.5.6 变压器

题型 1：先认变压器结构与感应（考频★★☆☆☆）

知识点 简单变压器由绕在_____上的原线圈和副线圈组成，线圈用绝缘_____线绕制。
原线圈中的交流电产生变化的磁场，软铁芯把变化的磁场传递到副线圈。
副线圈处在变化的磁场中，因电磁感应产生_____电压；接成闭合电路后产生交流电流。
铁芯中传递的是变化的磁场，不是从原线圈流向副线圈的电流。

答案：软铁芯；铜；交流

怎么认 题目出现原线圈、副线圈和铁芯，或问感应过程时，先写原线圈中的交流电产生变化磁场。

例题 1 Which statement about a transformer is correct?

A There is an alternating current in the iron core from the primary coil to the secondary coil.

B An alternating current in the iron core induces an alternating current in the secondary coil.

C An alternating current in the primary coil induces a direct current in the secondary coil.

D An alternating current in the primary coil induces an alternating voltage across the secondary coil.

（2023 夏季 0625/21 第32题）

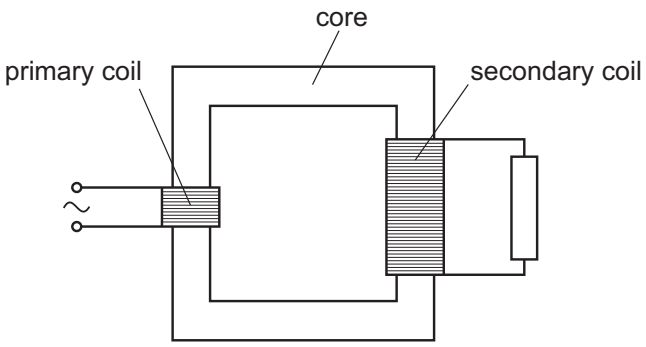
解：原线圈中的交流电产生变化的磁场，软铁芯把变化的磁场传递到副线圈，副线圈中感应出交流电压。
铁芯中没有电流从原线圈流向副线圈，感应得到的也不是直流电。
故选 D。

针对练习

1. **(b)** Another toy train uses a transformer.
State which metals are used in a transformer.

（2025 冬季 0625/32 第8题(b)）

2. The diagram shows the structure of a simple transformer.



Which row shows the correct conditions for the efficiency of the transformer to be as high as possible?

	primary and secondary coils	core
A	thick copper wire	soft iron
B	thin copper wire	soft iron
C	thick iron wire	copper
D	thin iron wire	copper

（2024 冬季 0625/23 第33题）

3. The electricity supplied to a town is transmitted using a high-voltage cable. A transformer in the town has a soft-iron core.

(a) Explain the principle of operation of a simple iron-cored transformer.

（2023 夏季 0625/41 第8题(a)）

4. Fig. 9.1 shows a wireless charging plate used to charge the battery in a mobile phone (cell phone). The coil of wire is part of an electric circuit.

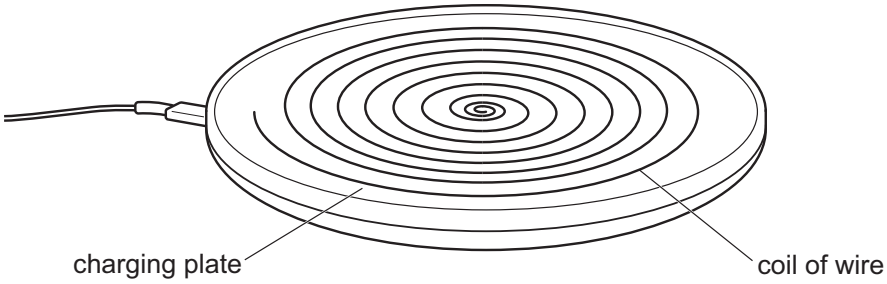


Fig. 9.1

The charging plate is connected to an a.c. power supply. The power supply is turned on.

(b) A mobile phone is placed on the charging plate as shown in Fig. 9.2. The coil in the mobile phone is part of a separate circuit that charges the battery.

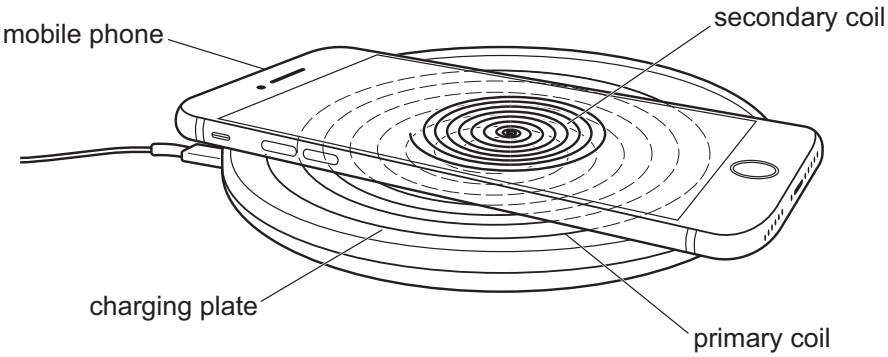


Fig. 9.2

The coil in the charging plate and the coil in the mobile phone act like a transformer.

(i) Explain why there is a current in the secondary coil shown in Fig. 9.2.

(ii) Suggest why the transformer made from the charging plate and mobile phone is not 100% efficient.

（2024 冬季 0625/42 第9题(b)）

题型 2：比较原副边判断升降压（考频★★★☆☆）

知识点 简单变压器由两个彼此绝缘的铜线线圈绕在同一软铁芯上组成。

接交流电源的一侧称为_____，另一侧称为_____。

理想变压器满足 $\frac{V_p}{V_s}=\frac{N_p}{N_s}$，电压单位为 V，匝数无单位；该关系适用于变化电流。

升压变压器的副线圈匝数比原线圈_____，降压变压器则相反。

答案：原线圈；副线圈；多

怎么认 题目出现变压器结构或升降压时，先定接电源的一侧为原线圈，再比较两侧电压或匝数。

一. 先定输入原边，再比副边电压或匝数

例题 1

(b) Describe the construction of a step-up transformer. You may draw a labelled diagram as part of your answer.

（2023 春季 0625/32 第10题(b)）

解：升压时 $V_s > V_p$，由 $\frac{V_p}{V_s} = \frac{N_p}{N_s}$ 得 $N_s > N_p$。
答：将两个铜线线圈绕在同一软铁芯上，副线圈匝数多于原线圈。

针对练习

1. **(c)** Describe the construction and materials of a simple step-down transformer. You may draw a labelled diagram as part of your answer.

（2025 冬季 0625/33 第8题(c)）

2. What does a step-up transformer increase?

A current

B energy

C power

D voltage

（2024 冬季 0625/13 第33题）

3. An electrical device changes the voltage of an electrical supply from 240 V a.c. to 20 V a.c.

What is this device?

A a generator

B a relay

C a transformer

D a voltmeter

（2025 春季 0625/22 第32题）

4. A student has a desktop computer that connects to the 240 V a.c. mains electrical supply. Fig. 9.1 shows the desktop computer.

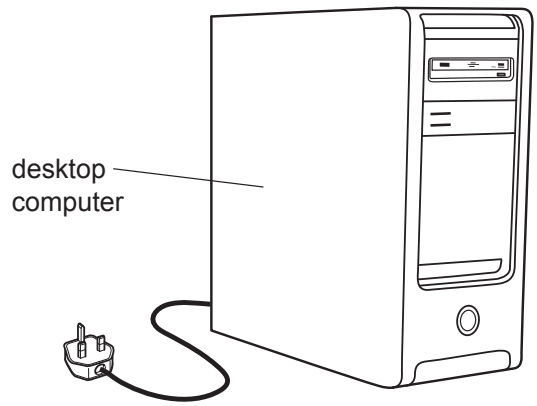


Fig. 9.1

(b) The desktop computer uses a transformer to change the 240 V a.c. voltage to a 12 V a.c. voltage.

(i) State the name of this type of transformer.

(ii) Describe the construction of this transformer. You may include a labelled diagram.

（2023 夏季 0625/32 第9题(b)）

二. 对应原副边写 Vp/Vs=Np/Ns

知识点 接交流电源的线圈称为_____线圈，输出电压的线圈称为_____线圈。
理想变压器中，电压与线圈匝数成正比，即 $\frac{V_p}{V_s}=\frac{N_p}{N_s}$；电压的单位是 V，匝数没有单位。
当 $V_s<V_p$ 时为降压变压器，且 $N_s<N_p$；当 $V_s>V_p$ 时为升压变压器，且 $N_s>N_p$。

答案：原；副

怎么认 题目出现原、副线圈的电压和匝数，且已知三项求一项时，先写 $\frac{V_p}{V_s}=\frac{N_p}{N_s}$。

例题 2 A transformer has 200 turns on its primary coil and is connected to a 240 V a.c. supply.

The output voltage of the transformer is 60 V a.c.

How many turns are on the secondary coil of the transformer?

A 20 **B** 50 **C** 72 **D** 800

（2024 春季 0625/12 第29题）

解：由变压器电压与匝数关系得
$\frac{V_p}{V_s}=\frac{N_p}{N_s}$
$\frac{240}{60}=\frac{200}{N_s}$
$N_s=\frac{60}{240}\times 200=50$
$60\ \text{V}<240\ \text{V}$，且 $50<200$，符合降压关系。
故选 B。

针对练习

5. **(b)** A step-down transformer reduces the mains voltage of 220 V a.c. to 12 V a.c.
The transformer has 5000 turns on the primary coil.

Calculate the number of turns on the secondary coil.

（2024 冬季 0625/33 第9题(b)）

6. Fig. 9.1 shows a router. The router emits Wi-Fi signals.

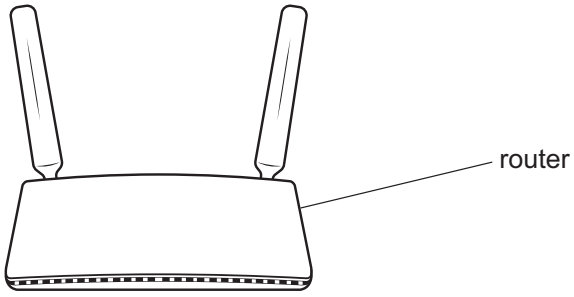


Fig. 9.1

(c) The router uses a transformer. The number of turns N_p on the primary coil of the transformer is 3600. The primary voltage V_p to the transformer is 240 V. The secondary voltage V_s of the transformer is 12 V.

Calculate the number of turns N_s on the secondary coil of the transformer.

（2025 夏季 0625/31 第9题(c)）

7. A transformer in a computer is used to transform the mains voltage of 240 V to 12 V.

The number of turns on the secondary coil is 2000.

Which statement about the transformer is correct?

A It is a step-down transformer and has 100 turns on its primary coil.

B It is a step-down transformer and has 40 000 turns on its primary coil.

C It is a step-up transformer and has 100 turns on its primary coil.

D It is a step-up transformer and has 40 000 turns on its primary coil.

（2023 冬季 0625/21 第33题）

8. **(a)** Fig. 9.1 shows a transformer.

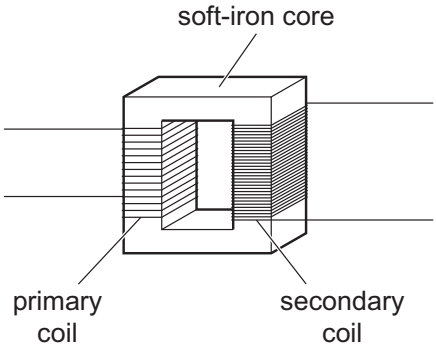


Fig. 9.1

(i) There is an alternating current in the primary coil.

Describe how an alternating current is produced in the secondary coil.

(ii) A step-up transformer has a turns ratio of 1 : 20. The voltage across the primary coil is 12 V.

Calculate the voltage across the secondary coil.

（2025 夏季 0625/43 第9题(a)）

题型 3：用理想功率守恒求电流（考频★★☆☆☆）

知识点 变压器效率为百分之百时，输入功率等于输出功率，即 $V_pI_p = V_sI_s$。

式中下标 p 表示初级线圈，下标 s 表示次级线圈；V 的单位为 V，I 的单位为 A。

降压变压器满足 $V_s < V_p$，由功率守恒可得 I_s _____ I_p。

已知两侧电压和一侧电流时，先列 _____，再求另一侧电流。

答案：大于；$V_pI_p = V_sI_s$

怎么认 题目出现百分之百高效变压器，且给出两侧电压和一侧电流时，先列 $V_pI_p = V_sI_s$。

例题 1

A step-down transformer is 100% efficient. It has an input voltage of 240 V a.c. and an output voltage of 60 V a.c.

The current in the primary coil is 0.50 A.

What is the current in the secondary coil?

A 0.13 A **B** 0.50 A **C** 2.0 A **D** 8.0 A

（2023 夏季 0625/22 第30题）

解：变压器效率为百分之百，由输入功率等于输出功率得

$V_pI_p = V_sI_s$

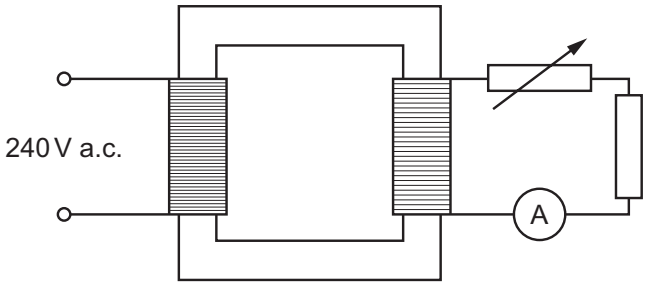
$240\ \text{V} \times 0.50\ \text{A} = 60\ \text{V} \times I_s$

$I_s = \frac{240\ \text{V} \times 0.50\ \text{A}}{60\ \text{V}} = 2.0\ \text{A}$

故选 C。

针对练习

1. A fixed resistor is connected to the secondary coil of a step-down transformer. The transformer is 100% efficient.



The variable resistor is adjusted so that the current in the fixed resistor decreases by 0.25 A.

What is the change to the current in the primary circuit?

A It decreases by 0.25 A.

B It decreases by less than 0.25 A.

C It decreases by more than 0.25 A.

D There is no change.

（2025 春季 0625/22 第31题）

2. **(b)** Fig. 7.2 shows a circuit diagram of a step-down transformer.

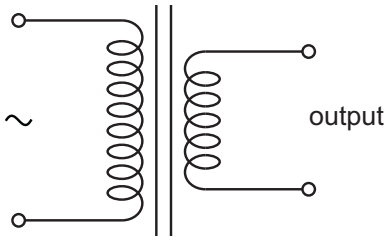


Fig. 7.2

(i) The mains voltage supplied to the transformer is 240 V. The output power of the transformer is 45 W. The transformer is 100% efficient.

Calculate the input current to the transformer.

(ii) Draw a labelled diagram of a step-down transformer. On the labels, state a suitable material for each of the components.

（2024 夏季 0625/42 第7题(b)）

3. Two transformers, P and Q, each have 2000 turns on their primary coils and 1000 turns on their secondary coils. Both transformers are 100% efficient.

The secondary of transformer P is connected to the primary of transformer Q.

Q provides a motor with a current of 0.2 A.

What is the current being supplied to the primary of transformer P?

A 0.8 A **B** 0.4 A **C** 0.1 A **D** 0.05 A

（2024 冬季 0625/21 第33题）

4. **(b)** There is a transformer in the desktop computer.
The input voltage to the primary coil V_p is 230 V (a.c.).
The number of turns on the primary coil N_p is 720.
The number of turns on the secondary coil N_s is 50.

(i) Calculate the output voltage V_s of the secondary coil.

(ii) The current in the input coil of the transformer is 1.4 A.

Calculate the input power to the desktop computer.

（2024 夏季 0625/31 第9题(b)）

题型 4：用高压减小输电损耗（考频★★☆☆☆）

知识点 输电功率 P、输电电压 V 与输电电流 I 满足 $P=VI$；输送功率一定时，电压升高，电流_____。

电缆电阻为 R 时，发热损耗功率满足 $P_{损}=I^2R$；电流减小使发热损耗_____，输电效率提高。

较细导线的电阻较大；若电流平方减小的影响大于电阻增大的影响，发热损耗仍会减小。

功率、电压、电流和电阻的单位分别为 W、V、A 和 Ω。

答案：减小；减小

怎么认 题目出现远距离高压输电、输电损耗或导线粗细时，先由 $P=VI$ 判断电流，再由 $P_{损}=I^2R$ 判断损耗。

例题 1 What is an advantage of transmitting electricity at a high voltage?

A It is faster.

B It is safer.

C Less energy is wasted.

D Less equipment is needed.

（2023 夏季 0625/11 第33题）

解： 输送功率一定，输电功率满足

$P=VI$

电压升高时电流减小。电缆发热损耗功率为

$P_{损}=I^2R$

因而发热损耗减小，浪费的能量减少。故选 C。

针对练习

1. **(a)** A coal-fired power station is far from a city. The electricity generated by the power station is transmitted to the city at a high voltage.

State **two** advantages of high-voltage transmission of electricity.

（2025 冬季 0625/33 第8题(a)）

2. Fig. 3.1 represents a hydroelectric power station transmitting electrical energy to homes and factories far away.

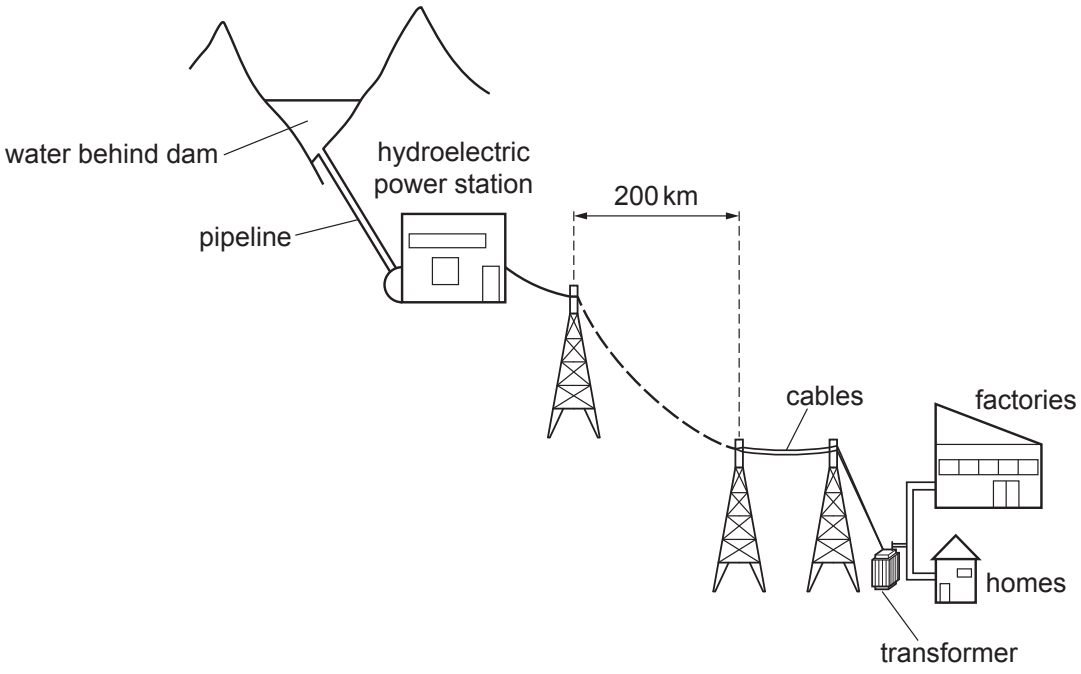


Fig. 3.1

(b) **(i)** State the type of transformer shown in Fig. 3.1.

(ii) Give **two** reasons why the power station uses high voltages to transmit electrical energy over long distances.

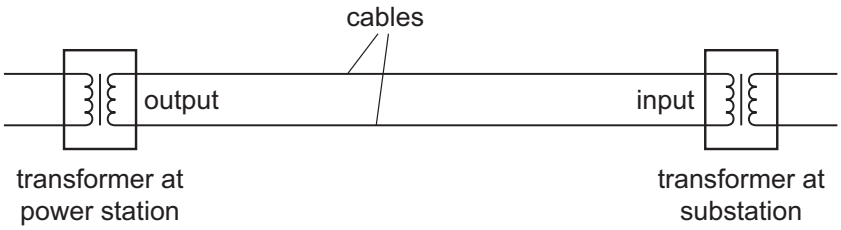
（2024 夏季 0625/33 第3题(b)）

3. **(b)** Electricity is transmitted at high voltage.

Explain why a high voltage increases the efficiency of transmission even with thinner wires.

（2024 春季 0625/42 第8题(b)）

4. Cables transmit electrical power from the output of the transformer at a power station to the input of another transformer at a substation.



The power at the output of the transformer at the power station is 400 MW.

Which situation delivers the most power to the input of the transformer at the substation?

	potential difference at power station transformer output / kV	diameter of cables
A	200	large
B	200	small
C	400	large
D	400	small

（2025 冬季 0625/21 第32题）