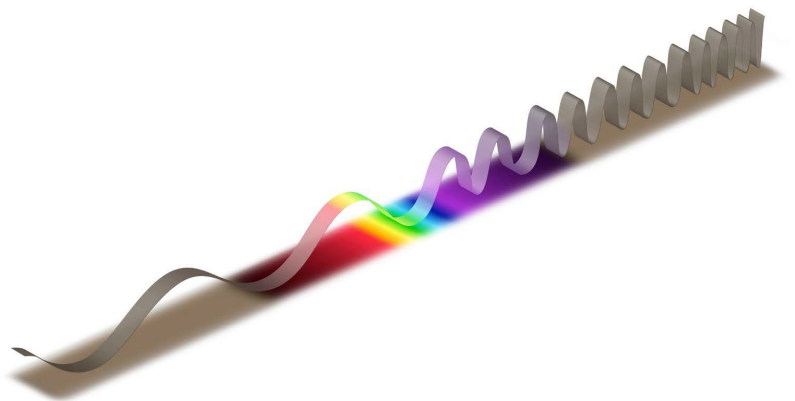


Specimen Paper Answers  
Paper 1: Multiple Choice  
**Cambridge O Level Physics**  
**5054**

For examination from 2023



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## Introduction

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The main aim of this booklet is to exemplify standards for those teaching Cambridge O Level Physics 5054, and to show examples of very good answers.

In this booklet, we have provided answers for all questions with examiner comments. These exercises require candidates to answer multiple choice questions and candidates are awarded maximum of 40 marks for this paper and the mark scheme provides the answers required to gain the marks.

Each question and answer is followed by an examiner comment on how each answer should be determined. Additionally, the examiner has set out a number of common mistakes that occur when candidates answer the questions. In this way, it is possible to understand what candidates have done to gain their marks and how they could avoid errors.

The mark schemes for the Specimen Papers are available to download from the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

### 2023 Specimen Paper 1 Mark Scheme

Past exam resources and other teaching and learning resources are available on the School Support Hub [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

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## Assessment at a glance

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The syllabus for Cambridge O Level Physics 5054 is available at [www.cambridgeinternational.org](http://www.cambridgeinternational.org)

All candidates take three papers. Candidates will be eligible for grades A\* to E.

Paper 1: Multiple Choice	Paper 2: Theory
1 hour	1 hour 45 minutes
40 Marks	80 Marks
30%	50%
40 four-option multiple-choice questions	Short-answer and structured questions
Externally assessed	Externally assessed

**And**

### Practical assessment

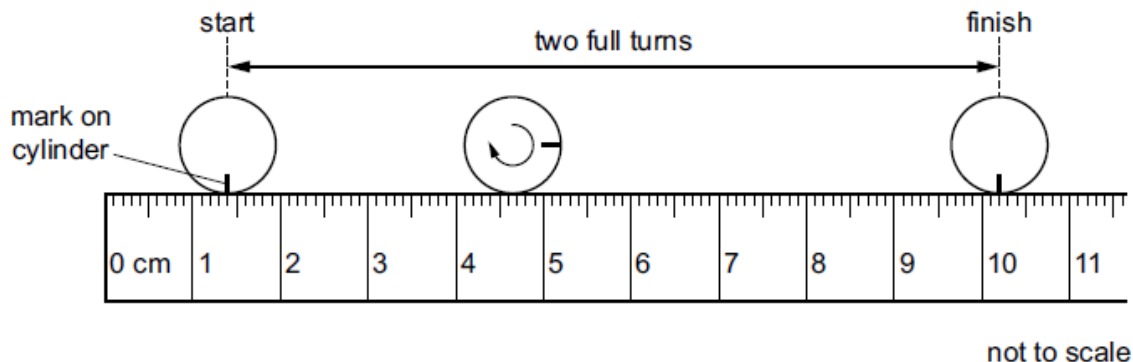
Paper 3: Practical Test	Paper 4: Alternative to Practical
1 hour 30 minutes	1 hour
40 Marks	80 Marks
20%	20%
Questions will be based on the experimental skills in Section 4	Questions will be based on the experimental skills in Section 4
Externally assessed	Externally assessed

**And**

## Specimen answers

### Question 1

1 A small cylinder is rolled along a ruler and completes two full turns as shown in the diagram.



What is the circumference of the cylinder?

- A 4.4 cm      B 5.1 cm      C 8.8 cm      D 10.2 cm

Candidate answer: A

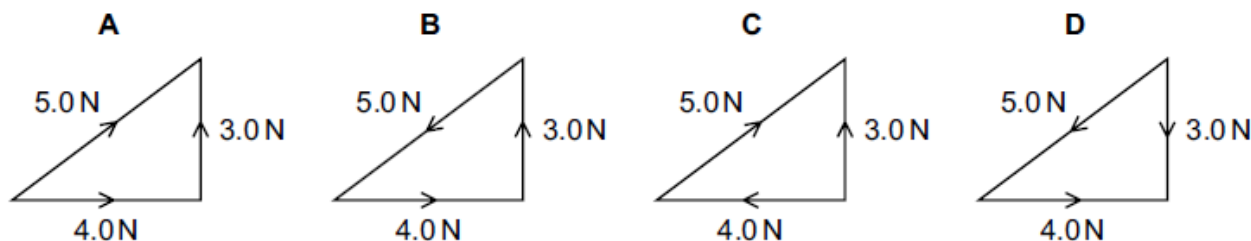
Mark awarded = 1

#### Examiner comment

Reading from the marks on the cylinder, at the start and finish points, shows the cylinder travelled  $10.2 - 1.4 = 8.8$  cm in two full turns. The circumference of the cylinder is  $\frac{8.8}{2} = 4.4$  cm

### Question 2

2 Which diagram shows the vector addition of a 4.0 N force and a 3.0 N force?



Candidate answer: A

Mark awarded = 1

#### Examiner comment

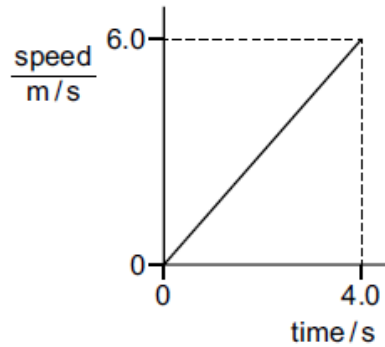
The 3 N and 4 N force must be positioned tip-to-tail. Then, the resultant 5 N force must show the same direction of displacement as the 3 N force followed by the 4 N force.

### Common mistakes

B is wrong because the arrow on the 5 N force points in the wrong direction. C is wrong because the resultant of the 3 N and 4 N forces is directed towards the top left. D is wrong because the resultant of the 3 N and 4 N forces is directed towards the bottom right.

### Question 3

3 The diagram shows the speed-time graph for an object moving with constant acceleration.



What is the distance travelled in the first 4.0 s?

- A 0.67 m      B 1.5 m      C 12 m      D 24 m

Candidate answer: C

Mark awarded = 1

### Examiner comment

Recall the distance travelled is given by the area under a speed-time graph.

$$d = \frac{1}{2} \times 4.0 \times 6.0 = 12 \text{ m}$$

### Question 4

4 An astronaut travels to Mars.

Which row describes how his mass and his weight compare with their sizes on Earth?

	mass	weight
A	different	different
B	different	the same
C	the same	different
D	the same	the same

Candidate answer: C

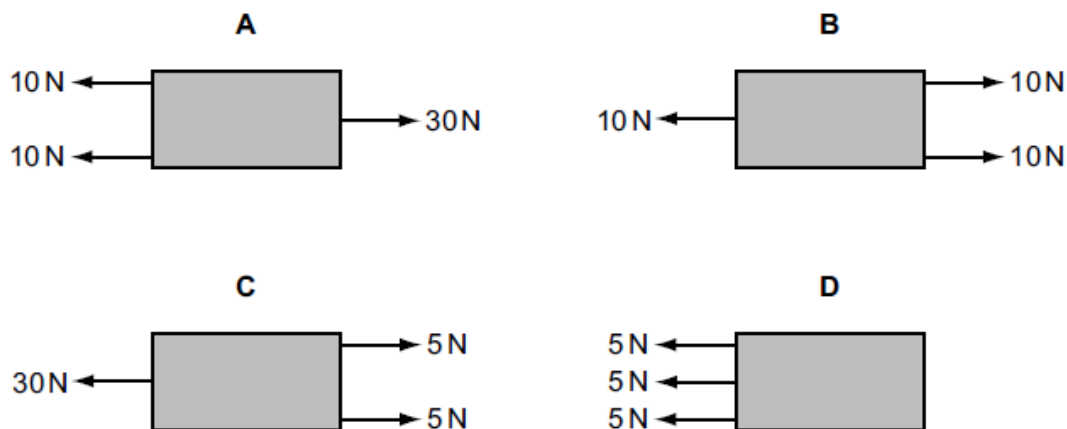
Mark awarded = 1

## Examiner comment

Mass is the amount of matter. Weight is the gravitational force acting on the object. The astronaut's mass remains the same (he doesn't lose any parts of his body!) but his weight changes because the gravitational field strength on Mars is different to that on Earth.

## Question 5

5 Which object has the largest resultant force acting on it?



Candidate answer: C

Mark awarded = 1

## Examiner comment

Add up all the forces acting on the object as vectors i.e. if a force acts in the opposite direction to another force, they should be subtracted whereas forces acting in the same direction are added.

A gives  $30 - 10 - 10 = 10$  N

B gives  $10 + 10 - 10 = 10$  N

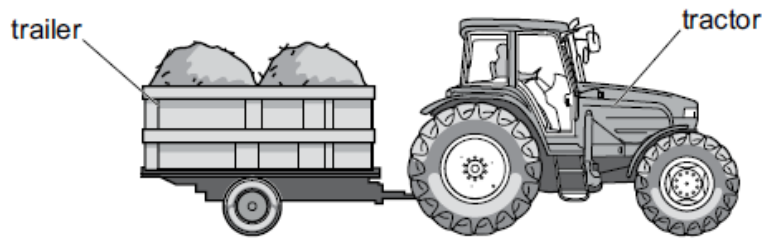
C gives  $-30 + 5 + 5 = -20$  N

D gives  $-5 - 5 - 5 = -15$  N



## Question 6

6 A tractor pulls a trailer at a constant speed.



The tractor exerts a force of 1600 N forwards on the trailer.

What force is exerted by the trailer on the tractor?

- A 0 N
- B 1600 N backwards
- C 1600 N forwards
- D 3200 N forwards

**Candidate answer: B**

**Mark awarded = 1**

## Examiner comment

Newton's Third Law of Motion shows that because the speed is constant (i.e. there is no acceleration) if the tractor pulls forwards on the trailer with 1600 N, the trailer will pull backward on the tractor with 1600 N. "The forces have equal magnitude and opposite direction."

## Question 7

7 A skydiver is falling at terminal velocity.



Which row describes the acceleration of the skydiver and the velocity of the skydiver?

	acceleration of the skydiver	velocity of the skydiver
A	downwards	constant
B	downwards	zero
C	zero	constant
D	zero	zero

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

Recall that terminal velocity is a constant velocity and this means the acceleration is zero.

### Question 8

- 8 Which car experiences a resultant force that is **not** zero?
- A a car moving along a straight horizontal road at constant speed
  - B a car moving around a bend at constant speed
  - C a car moving up a hill at constant velocity
  - D a car that is at rest

**Candidate answer: B**

**Mark awarded = 1**

### Examiner comment

If the resultant force is not zero, the car must be accelerating. B describes a car with a constant speed but a changing direction. B is the only option with the changing velocity that is required for acceleration.

### Question 9

- 9 A car is designed to be stable.
- Where **must** the centre of gravity of the car be?
- A above the front wheels
  - B above the rear wheels
  - C as high in the car as possible
  - D as low in the car as possible

**Candidate answer: D**

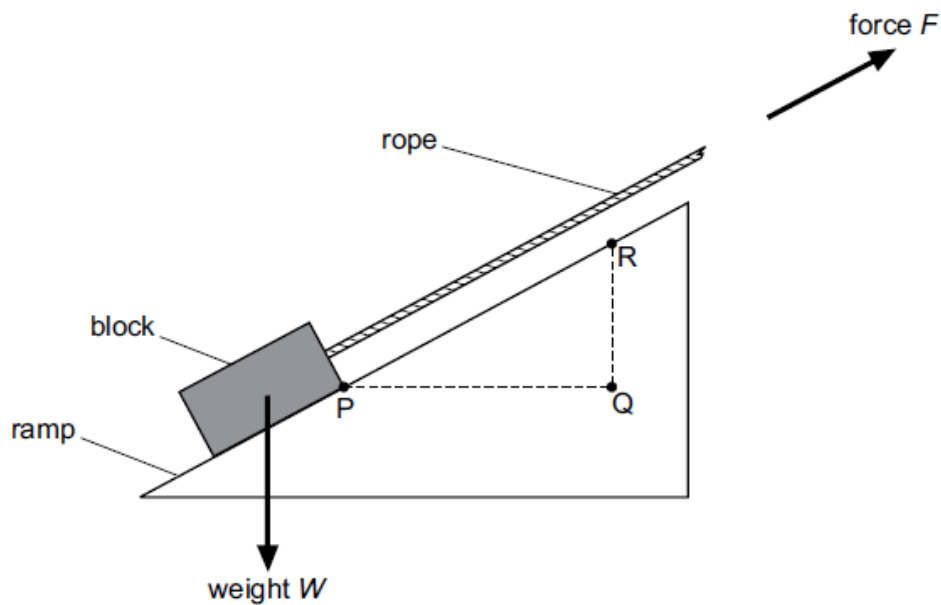
**Mark awarded = 1**

### Examiner comment

Recall that stability is increased when the centre of gravity is low and the base is wide.

## Question 10

10 The diagram shows a block being pulled up a ramp by a rope.



The block has weight  $W$  and the rope is pulled with force  $F$ .

The block moves distance  $PR$  and is raised through height  $QR$ .

What is the equation for the work done on the block by the rope?

- A force  $F \times$  distance  $PR$
- B force  $F \times$  height  $QR$
- C weight  $W \times$  distance  $PQ$
- D weight  $W \times$  distance  $PR$

Candidate answer: A

Mark awarded = 1

## Examiner comment

Recall work done is given by the product of the force  $F$  and the distance moved in the direction of the force  $PR$ .

## Question 11

11 Which uses a non-renewable energy source?

- A a geothermal heating system
- B a nuclear power station
- C a solar panel
- D a wind turbine

Candidate answer: B

**Mark awarded = 1**

**Examiner comment**

Recall that geothermal, solar and wind are renewable sources of energy and that nuclear is non-renewable.

**Question 12**

**12** Which expression gives the efficiency of an a.c. generator?

- A  $\frac{\text{electrical energy output}}{\text{total energy input}}$
- B  $\frac{\text{electrical energy output}}{\text{thermal energy output}}$
- C  $\frac{\text{total energy output}}{\text{electrical energy input}}$
- D  $\frac{\text{thermal energy output}}{\text{total energy input}}$

**Candidate answer: A**

**Mark awarded = 1**

**Examiner comment**

Recall the equation

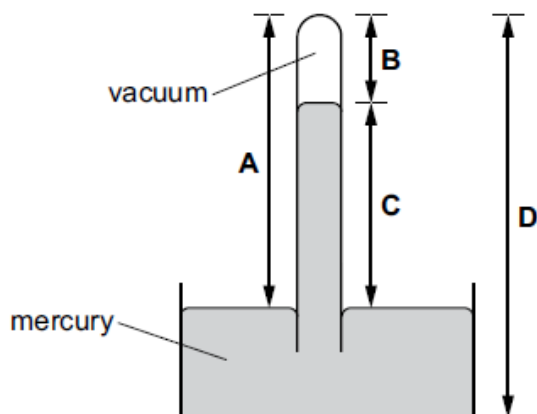
$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}}$$

and that an a.c. generator converts stored energy by electrical working.

**Question 13**

**13** Mercury is a liquid. The diagram shows a simple mercury barometer.

Which height is a measure of the atmospheric pressure?



**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

The height of a column of liquid in a barometer can be used to measure atmospheric pressure. Recall the relevant height is C.

### Question 14

**14** A gas is in a sealed container of constant volume. The gas is heated and the pressure of the gas on the walls of the container increases.

How do the particles of the gas cause this increase in pressure?

- A They expand.
- B They hit each other more frequently.
- C They hit the container walls more frequently.
- D They vibrate faster.

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

Pressure is caused by collisions of gas particles with the walls of a container. An increase in pressure is caused by particles hitting the walls of the container more frequently.

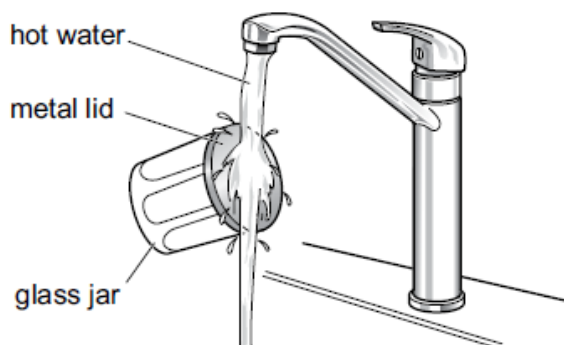
### Common mistakes

Pressure is not caused by particles colliding with each other.

### Question 15

15 A person cannot open a glass jar which has a metal lid.

After the lid is held under hot water for a few seconds, the jar opens easily.



What is the explanation for this?

- A The glass jar contracts.
- B The glass jar expands.
- C The metal lid contracts.
- D The metal lid expands.

**Candidate answer: D**

**Mark awarded = 1**

#### Examiner comment

Most materials expand when heated. Both the glass jar and metal lid will expand, but the metal will expand more than the glass. This means the lid can be unscrewed.

### Question 16

16 The more energetic particles escape from the surface of a liquid.

Which term describes this process?

- A condensation
- B evaporation
- C melting
- D radiation

**Candidate answer: B**

**Mark awarded = 1**

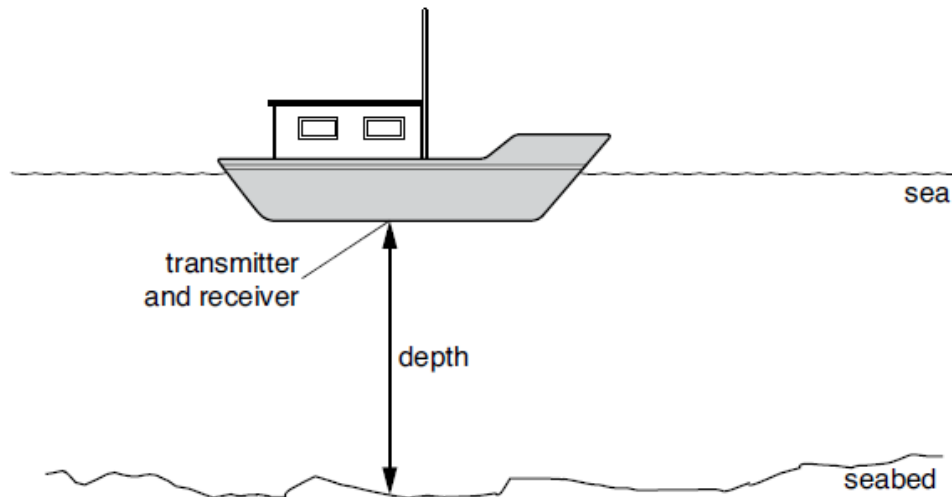
#### Examiner comment

Recall that evaporation is the escape of more-energetic molecules from the surface of a liquid.

## Question 17

- 17 The depth of the sea under a ship is determined by sending a pulse of sound with a frequency of 3000 Hz from a transmitter on the bottom of the ship to the seabed. The sound reflects from the seabed and returns to a receiver on the bottom of the ship.

The time between sending the pulse and receiving the reflected pulse is measured.



The depth of the sea beneath the ship is 600 m and the time measured is 0.80 s.

What is the wavelength of this sound in the sea?

- A 0.25 m
- B 0.32 m
- C 0.50 m
- D 2.0 m

**Candidate answer: C**

**Mark awarded = 1**

## Examiner comment

Calculate the speed of the sound waves in the water

$$v = \frac{d}{t} = \frac{600 \times 2}{0.80} = 1500 \text{ m / s}$$

Then the wavelength can be calculated

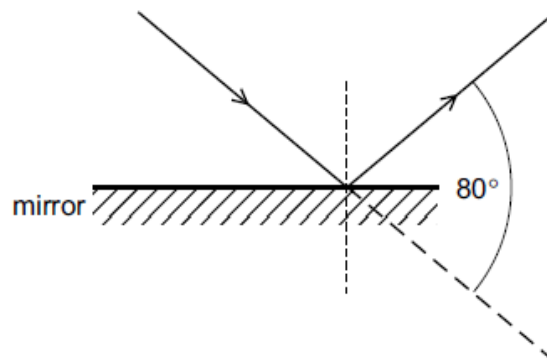
$$\lambda = \frac{v}{f} = \frac{1500}{3000} = 0.50 \text{ m}$$

## Common mistakes

The waves emitted from the ship travel down to the seabed and back to the ship so the depth must be multiplied by two.

## Question 18

18 Light is incident on a mirror and is reflected as shown.



What is the angle of incidence and what is the angle of reflection?

	angle of incidence	angle of reflection
<b>A</b>	40°	40°
<b>B</b>	40°	50°
<b>C</b>	50°	40°
<b>D</b>	50°	50°

**Candidate answer: D**

**Mark awarded = 1**

### Examiner comment

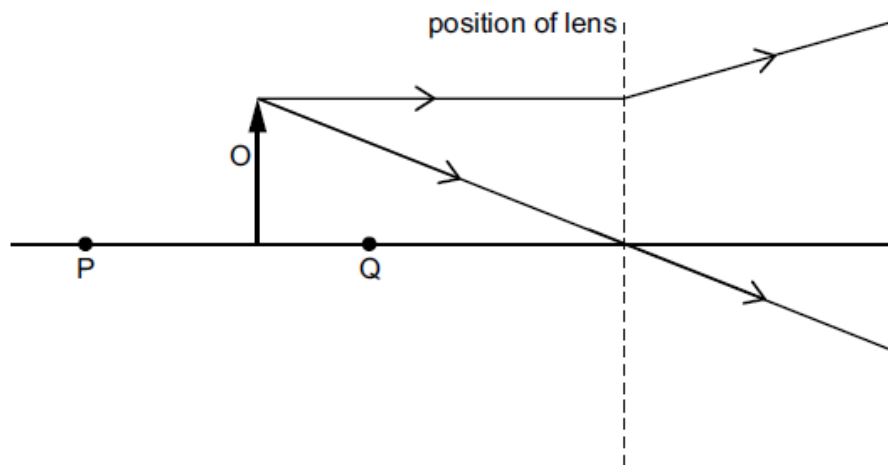
The incident light ray and the extrapolated dashed line form a straight line. Angles on a straight line add to 180°. So the angle between the incident and reflected ray is  $180 - 80 = 100^\circ$ . Since angle of incidence and angle of reflection are equal, they must both be 50°.



## Question 19

19 An object O is placed in front of a lens.

The ray diagram shows the paths of two light rays that start at the tip of the object.



Which point P or Q is a principal focus and what type of image is formed?

	principal focus	type of image formed
A	point P	real
B	point P	virtual
C	point Q	real
D	point Q	virtual

Candidate answer: B

Mark awarded = 1

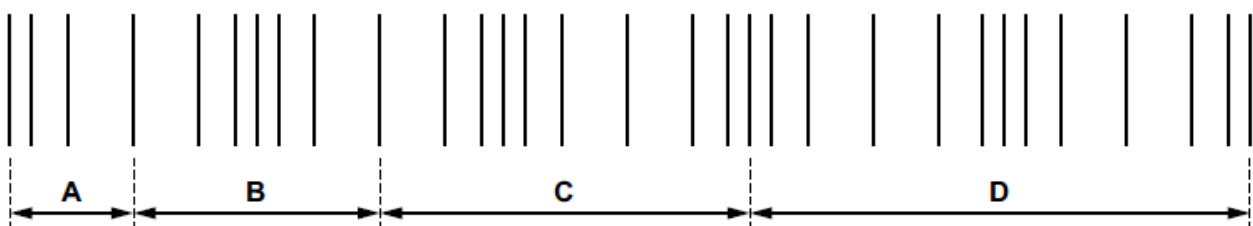
## Examiner comment

The ray drawn horizontally from the top of the object refracts away from the principal axis indicating this is a diverging ray. Recall that virtual images are formed by diverging rays. The top ray diverges as if it had originated at the principal focus – this is point P.

## Question 20

20 A sound wave travels through air. The lines in the diagram show the positions of particles of air at one particular time.

Which distance is the wavelength of the wave?



Candidate answer: B

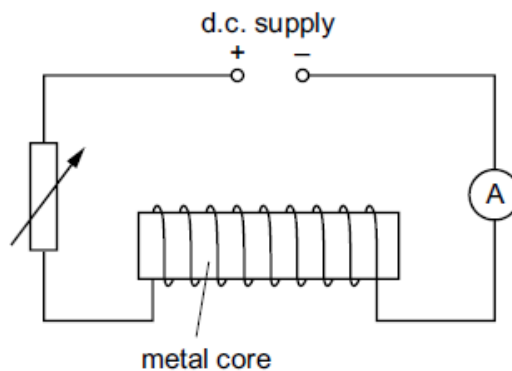
**Mark awarded = 1**

**Examiner comment**

The wavelength is the shortest distance between two identical points.

**Question 21**

**21** The diagram shows an electromagnet.



How can the strength of the magnetic field around the electromagnet be increased?

- A Remove the metal core and decrease the current in the circuit
- B Remove the metal core and keep the current in the circuit constant
- C Reverse the d.c. supply and decrease the current in the circuit
- D Reverse the d.c. supply and increase the current in the circuit

**Candidate answer: D**

**Mark awarded = 1**

**Examiner comment**

Recall “core turns current”. That is, the strength of an electromagnet can be increased by inserting a soft iron core, winding more turns on the coil or increasing the current. It does not matter if the d.c. supply is reversed.

**Question 22**

**22** What material can a temporary magnet be made from?

- A plastic
- B soft iron
- C steel
- D wood

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

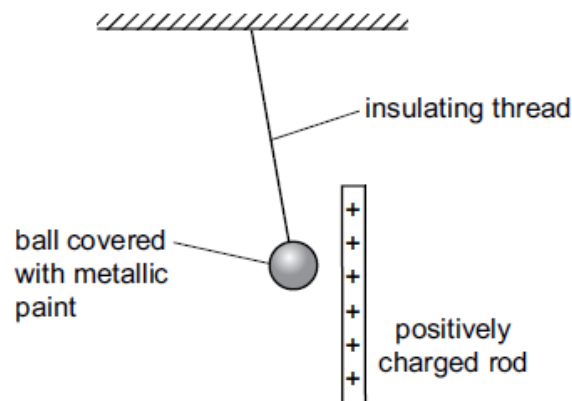
A temporary magnet can be made from soft iron since it is easy to magnetise and demagnetise.

**Common mistakes**

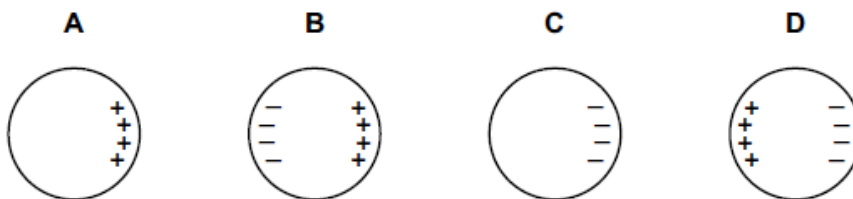
Steel is used to make permanent magnets since it is difficult to demagnetise.

**Question 23**

- 23** The diagram shows an uncharged ball covered with metallic paint. The ball is suspended from an insulating thread. It is placed near a positively charged rod.



Which diagram shows the charge distribution on the ball?



**Candidate answer: D**

**Mark awarded = 1**

**Examiner comment**

As the positively charged rod is moved near the ball, it attracts negative electrons in the metallic paint towards the right-hand side of the ball. Because the ball was initially uncharged, this leaves a deficit of negative charges on the left-hand side of the ball i.e. this region has a positive charge.

**Common mistakes**

Only negative charges in the metallic paint can move.

## Question 24

24 A charge of 45 C flows through an electric appliance in 3.0 minutes.

What is the average current in the appliance?

- A 0.25A      B 4.0A      C 15A      D 135A

Candidate answer: A

Mark awarded = 1

## Examiner comment

Recall equation  $I = \frac{Q}{t}$

$$I = \frac{Q}{t} = \frac{45}{3.0 \times 60} = 0.25 \text{ A}$$

## Common mistakes

Ensure time is converted into seconds.

## Question 25

25 A wire of length 0.50 m and cross-sectional area  $1.0 \times 10^{-6} \text{ m}^2$  has a resistance of 0.75  $\Omega$ .

Another wire of the same material has a length of 2.0 m and a cross-sectional area of  $0.50 \times 10^{-6} \text{ m}^2$ .

What is the resistance of the longer wire?

- A 0.094  $\Omega$       B 0.38  $\Omega$       C 1.5  $\Omega$       D 6.0  $\Omega$

Candidate answer: D

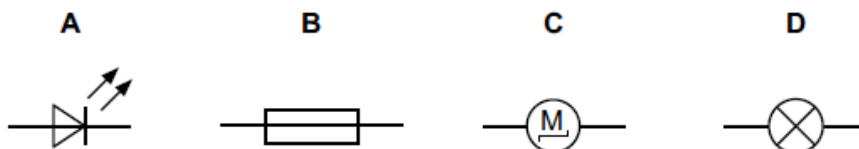
Mark awarded = 1

## Examiner comment

Increasing the length by a factor of 4, increases the resistance by a factor of 4. Halving the cross-sectional area, increases the resistance by a factor of 2. Together, these increase the resistance by a factor of 8.  $8 \times 0.75 = 6.0 \Omega$

## Question 26

26 Which electrical symbol represents a fuse?



Candidate answer: B

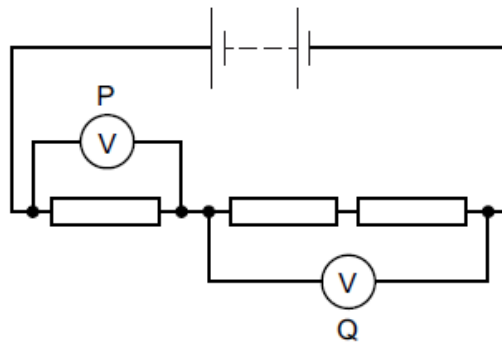
Mark awarded = 1

## Examiner comment

Recall of the circuit symbol.

## Question 27

27 Three identical resistors are joined in series to a battery.



Voltmeter Q reads 8.0 V.

What is the reading on voltmeter P and what is the e.m.f. of the battery?

	reading on P/V	e.m.f. of battery/V
<b>A</b>	4.0	8.0
<b>B</b>	4.0	12
<b>C</b>	8.0	8.0
<b>D</b>	8.0	12

**Candidate answer: B**

**Mark awarded = 1**

**Examiner comment**

The sum of the p.d. across components in series is equal to the e.m.f. of the battery. Voltmeter Q connected across 2 resistors reads 8 V. Therefore the p.d. across a single resistor is 4 V. The reading on voltmeter P is 4 V. The e.m.f. of the battery is then the sum of the readings on voltmeters P and Q = 4+8 = 12 V.

## Question 28

28 The e.m.f. of the battery in a radio is 3.0 V.

The resistance of the circuit in the radio is 6.0  $\Omega$ .

The radio is switched on.

How much energy is transferred from the battery in 30 minutes?

- A** 45 J
- B** 900 J
- C** 2700 J
- D** 32400 J

**Candidate answer: C**

**Mark awarded = 1**

### Examiner comment

Recall  $E=VIt$  and  $I=\frac{V}{R}$

Calculate the current in the circuit:

$$I = \frac{V}{R} = \frac{3.0}{6.0} = 0.50 \text{ A}$$

and then the energy transferred

$$E = VIt = 3.0 \times 0.50 \times 30 \times 60 = 2700 \text{ J}$$

### Common mistakes

Ensure time is converted into seconds.

### Question 29

**29** What is the unit for the energy used by an electrical appliance?

- A ampere
- B kilowatt-hour
- C volt
- D watt

**Candidate answer:** B

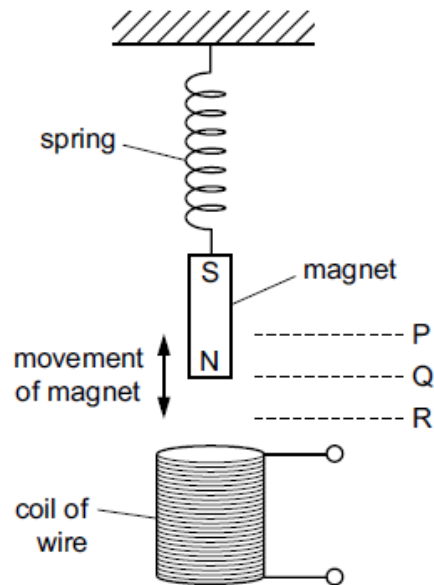
**Mark awarded = 1**

### Examiner comment

Recall that the kilowatt-hour is a unit of energy. The ampere is the unit of current. The volt is the unit of p.d. and e.m.f. The watt is the unit of power.

## Question 30

30 A magnet oscillates vertically above a coil of wire.



As the lower end of the magnet oscillates between P and R, a varying e.m.f. is induced across the coil.

When this e.m.f. is 0V, where could the lower end of the magnet be?

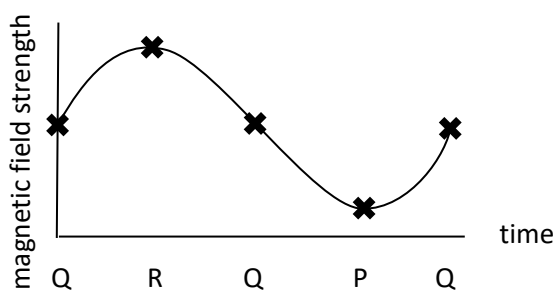
- A at R only
- B at Q only
- C at P or at R
- D at P or at Q

**Candidate answer: C**

**Mark awarded = 1**

**Examiner comment**

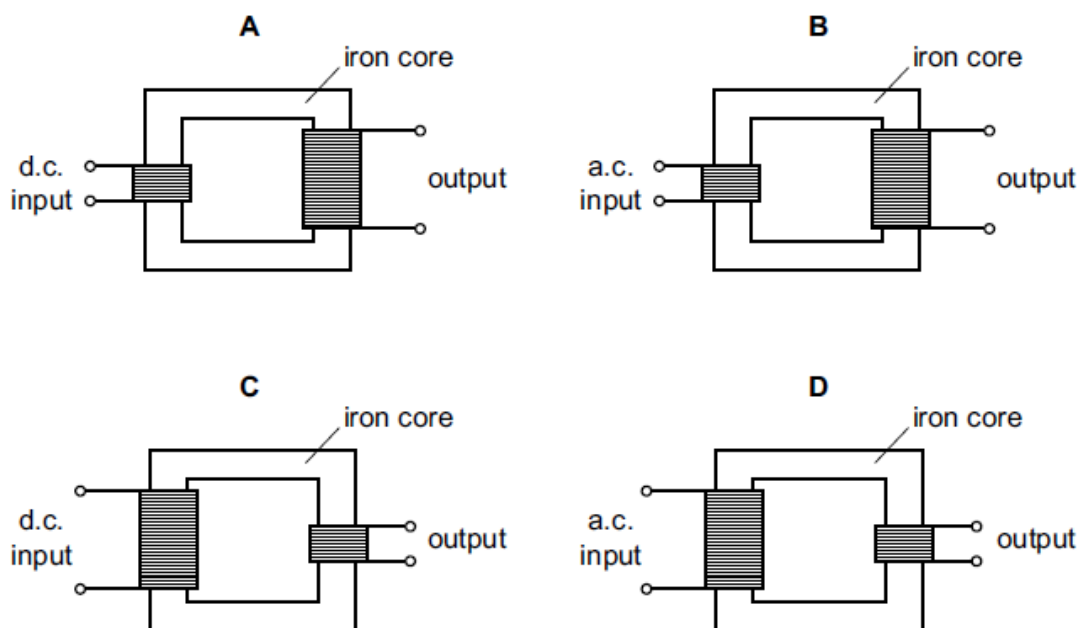
Sketch a graph showing the magnetic field in the coil as the position of the magnet changes.



The e.m.f. is zero when the rate of change of the magnetic field is zero. This is when the gradient of the graph is zero.

## Question 31

31 Which transformer arrangement produces an output e.m.f. that is larger than the input p.d.?



Candidate answer: B

Mark awarded = 1

## Examiner comment

A transformer only produces a continuous output with an a.c. input. The output e.m.f. is larger if there are more turns on the secondary output coil than on the primary input coil.

## Question 32

32 Why is a relay used in a switching circuit?

- A to switch on a small current using a small current
- B to switch on a small current using a large current
- C to switch on a large current using a small current
- D to switch on a large current using a large current

Candidate answer: C

Mark awarded = 1

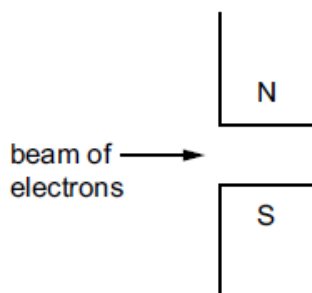
## Examiner comment

Recall a relay is used to switch on a large current using a small current.



## Question 33

33 A horizontal beam of electrons passes between the two poles of a magnet in a vacuum.



In which direction is the beam deflected?

- A into the page
- B out of the page
- C towards the north pole
- D towards the south pole

**Candidate answer: B**

**Mark awarded = 1**

## Examiner comment

Use Fleming's left-hand rule with the index finger pointing downwards (north to south) and the second finger pointing to the left. The thumb points out of the page.

## Common mistakes

The direction of the current is the direction of flow of positive charge. In this question there is a beam of electrons moving left to right, so the current is right to left.

## Question 34

34 How many neutrons are in one neutral atom of the krypton isotope  ${}_{36}^{84}\text{Kr}$ ?

- A 36
- B 48
- C 84
- D 120

**Candidate answer: B**

**Mark awarded = 1**

## Examiner comment

The number of neutrons is found by subtracting the proton number (36) from the mass number (84).  $84 - 36 = 48$ .

### Question 35

- 35  $^{14}_6\text{C}$  represents a nuclide of the element carbon and  $^{14}_7\text{N}$  represents a nuclide of the element nitrogen.

How is a neutral atom of  $^{14}_7\text{N}$  different to a neutral atom of  $^{14}_6\text{C}$ ?

- A The nitrogen atom has one electron fewer than the carbon atom.
- B The nitrogen atom has one neutron more than the carbon atom.
- C The nitrogen atom has one proton fewer than the carbon atom.
- D The nitrogen atom has one proton more than the carbon atom.

**Candidate answer: D**

**Mark awarded = 1**

#### Examiner comment

The lower number to the left of an element symbol is the number of protons. Nitrogen has 7 protons and Carbon has 6.

### Question 36

- 36 Radioactive isotopes emit three types of radiation.

Which list gives the types of radiation in order of their ionising effect from greatest to least?

- A alpha-particles, beta-particles, gamma rays
- B alpha-particles, gamma rays, beta-particles
- C beta-particles, gamma rays, alpha-particles
- D gamma rays, beta-particles, alpha-particles

**Candidate answer: A**

**Mark awarded = 1**

#### Examiner comment

Recall, the most ionising nuclear radiation are alpha particles (due to having the highest charge) and the least are gamma rays (with no charge).

### Question 37

- 37 Which statement about the half-life of a radioactive isotope is correct?

- A Half-life is half the time it takes for the mass of the isotope to decrease to zero.
- B Half-life is half the time it takes for the number of nuclei of the isotope to decrease to zero.
- C Half-life is the time taken for the nucleon number of the isotope to halve.
- D Half-life is the time taken for the number of nuclei of the isotope to halve.

**Candidate answer: D**

**Mark awarded = 1**

**Examiner comment**

Recall the definition of half-life: time taken for half the nuclei of that isotope in any sample to decay.

**Question 38**

**38** Light from the Sun travels to the Earth at a speed of  $3.0 \times 10^8$  m/s.

The time for the complete journey is 500 s.

What is the average orbital speed of the Earth in its orbit around the Sun?

- A 60 m/s
- B  $4.8 \times 10^3$  m/s
- C  $3.0 \times 10^4$  m/s
- D  $1.8 \times 10^6$  m/s

**Candidate answer: C**

**Mark awarded = 1**

**Examiner comment**

Calculate the distance from the Earth to the Sun. This is the radius of the orbit.

$$r = v \times t = 3.0 \times 10^8 \times 500 = 1.5 \times 10^{11} \text{ m}$$

Calculate the orbital speed

$$v = \frac{2\pi r}{T} = \frac{2\pi \times 1.5 \times 10^{11}}{365 \times 24 \times 60 \times 60} = 3.0 \times 10^4 \text{ m/s}$$

**Common mistakes**

The time taken for the Earth to complete one orbit is one year. This needs to be converted into seconds i.e.  $365 \times 24 \times 60 \times 60$

## Question 39

39 In the Sun, energy is transferred from an energy store.

Which energy is being released and what is the name of the reaction that releases this energy inside the Sun?

	energy	reaction
A	chemical	burning
B	chemical	radiation
C	nuclear	fission
D	nuclear	fusion

Candidate answer: D

Mark awarded = 1

## Examiner comment

Recall that the sun releases nuclear energy as it joins small nuclei to build larger nuclei. This process is called fusion.

## Question 40

40 The light emitted from a galaxy is redshifted when detected on Earth.

How does the frequency of the light when detected on Earth compare with its frequency when emitted and in what direction is the galaxy moving?

	frequency of light when detected on Earth	direction of movement of galaxy
A	less than frequency of emission	away from Earth
B	less than frequency of emission	towards Earth
C	greater than frequency of emission	away from Earth
D	greater than frequency of emission	towards Earth

Candidate answer: A

Mark awarded = 1

## Examiner comment

Red shift refers to an increase in the wavelength of light emitted by a galaxy moving away from Earth. Since  $\lambda = \frac{v}{f}$ , an increase in wavelength means a decrease in frequency. Therefore, on Earth the frequency observed is less than the frequency emitted.

Cambridge Assessment International Education  
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom  
t: +44 1223 553554  
e: [info@cambridgeinternational.org](mailto:info@cambridgeinternational.org) [www.cambridgeinternational.org](http://www.cambridgeinternational.org)

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