Cambridge
O Level

Cambridge Assessment International Education
Cambridge Ordinary Level

Candidate-2023
5054/12/O-2019
Date: 11/01/2023

PHYSICS **5054/12**

Paper 1 Multiple Choice **October/November 2019**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

8302161100

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **16** printed pages.

1 Which word is the name of a vector quantity?

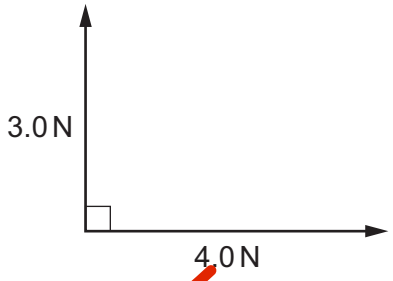
A density

B displacement

C energy

D speed

2 What is the size of the resultant of the two forces shown in the diagram?



A 1.0 N **B** 3.5 N **C** 5.0 N **D** 7.0 N

$R^2 = P^2 + Q^2$

$R = \sqrt{P^2 + Q^2}$

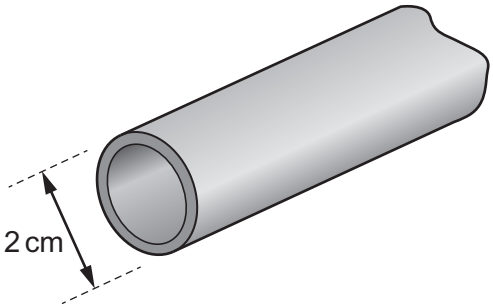
$= \sqrt{3^2 + 4^2}$

$= \sqrt{5^2} = 5$

3 What is the correct unit for the quantity shown?

	quantity	unit
A	electromotive force (e.m.f.)	N
B	latent heat	J
C	pressure	kg/m^3
D	weight	kg

4 A length of copper pipe, of uniform cross-section and several metres long, carries water to a tap.



Measurements are taken to determine accurately the volume of copper in the pipe.

Which instruments are used?

A micrometer and rule

B micrometer and calipers

C rule and tape

D tape and calipers

5 Part of a speed–time graph for two runners is shown. They are running along the same track.

Which statement **must** be correct?

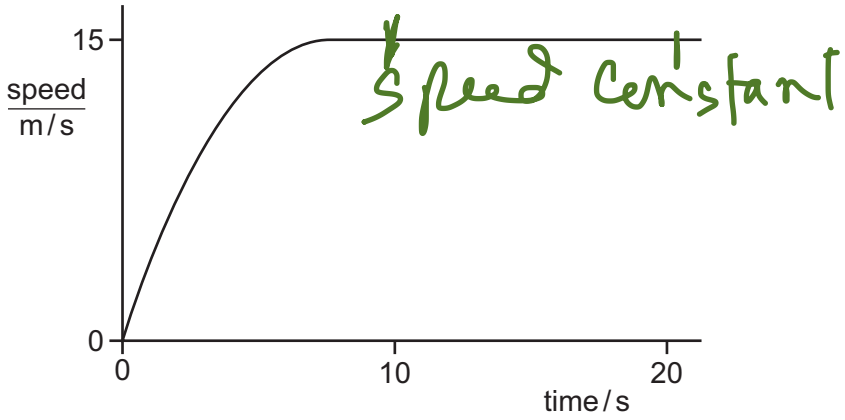
A Both runners started at the same moment.

B Runner 1 has a greater acceleration than runner 2.

C Runner 1 is moving faster than runner 2.

D The distance between the two runners stays constant.

6 The graph shows how the speed of a car varies with time.



Which statement about the acceleration of the car between the times 10 s and 20 s is correct?

A The acceleration decreases.

B The acceleration increases.

C The acceleration is constant, but not zero.

D The acceleration is zero.

7 In which descent is the acceleration equal to the acceleration of free fall g at all times?

A a bungee jumper leaping from a bridge

B a feather falling in a vertical tube that contains a vacuum

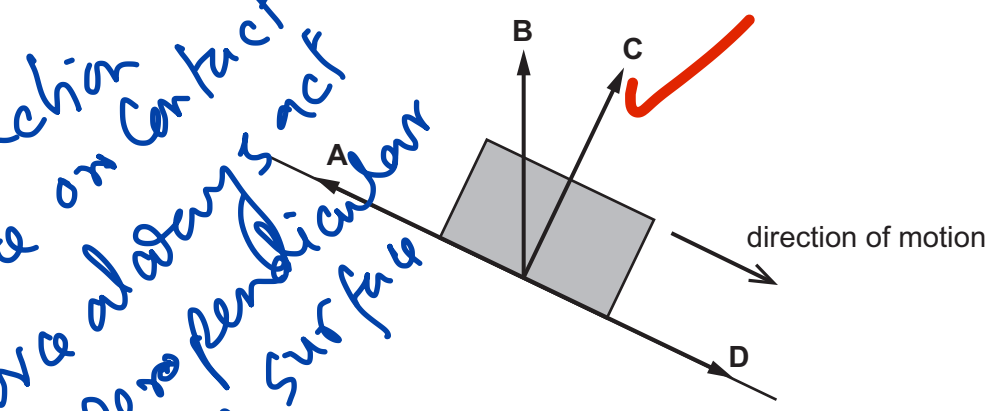
C a hailstone travelling to Earth at terminal velocity

D a sky-dive dropping from an aircraft towards the ground

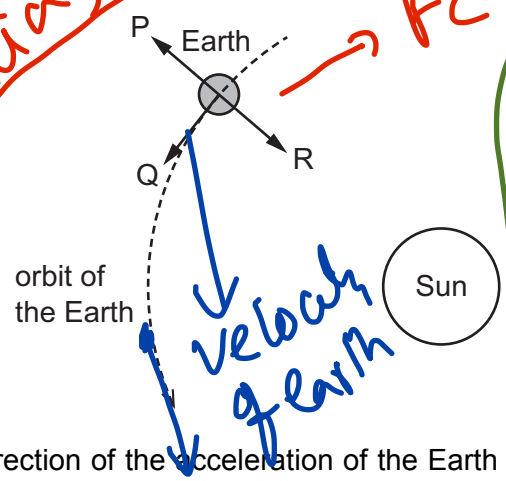
8 A body slides down a frictionless slope, as shown.

As the body presses on the surface, the surface pushes back on the body.

In which direction does the surface push back on the body?



9 The Earth travels at constant speed in a circular orbit around the Sun.

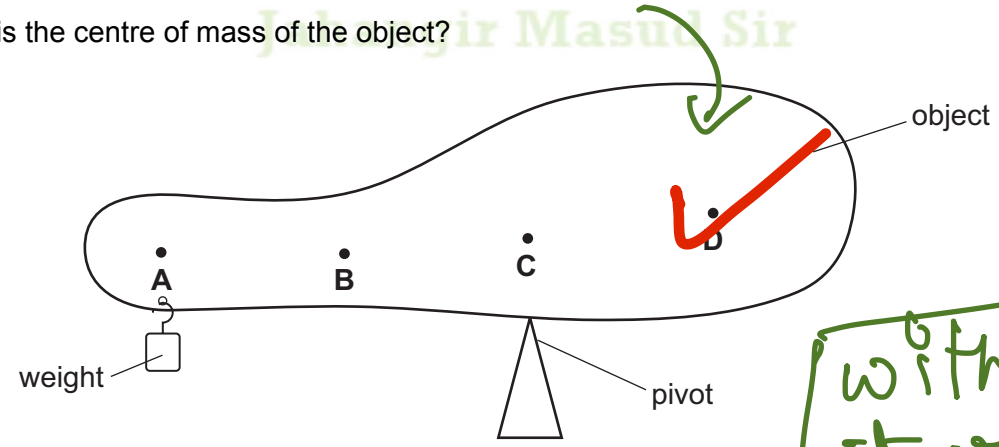


Which arrows show the direction of the acceleration of the Earth and the direction of the velocity of the Earth?

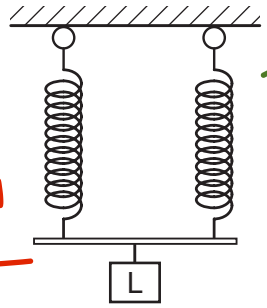
	direction of acceleration	direction of velocity
A	P	Q
B	Q	P
C	Q	R
D	R	Q

10 A student balances a non-uniform object on a pivot. To do this, a weight is suspended near the left-hand end of the object, as shown.

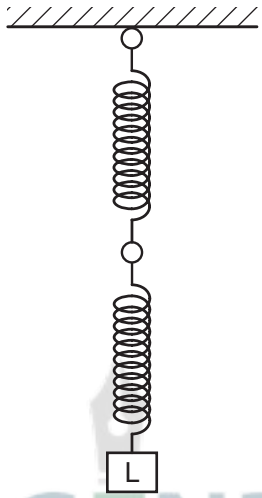
Where is the centre of mass of the object?



11 A load L is suspended from two springs that are in parallel. The extension of each spring is x.



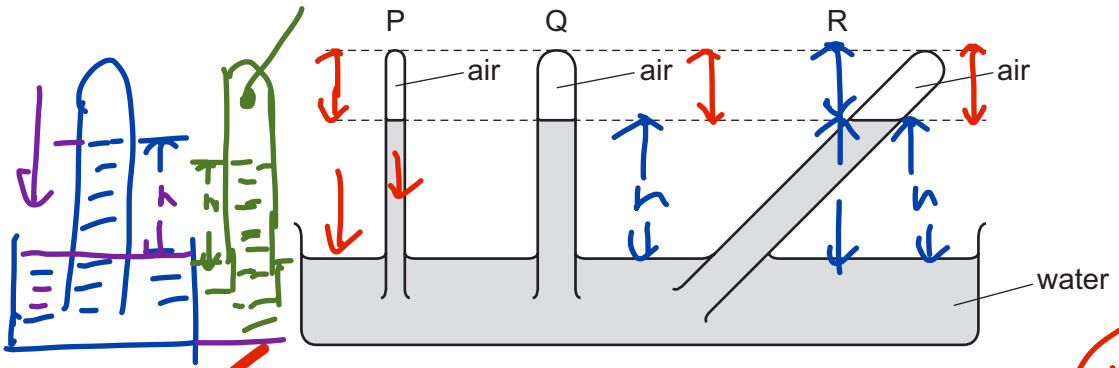
The springs are then arranged to hang vertically, one below the other.



In this new arrangement, what is the total extension of the two springs?

A $\frac{1}{2}x$ **B** x **C** $2x$ **D** $4x$

12 The diagram shows three tubes P, Q and R. Each tube contains air trapped by a water column.



Which statement is correct?

A The pressure of the trapped air is equal in tubes P, Q and R.

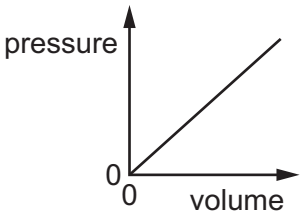
B The pressure of the trapped air is greatest in tube Q.

C The pressure of the trapped air is greatest in tube R.

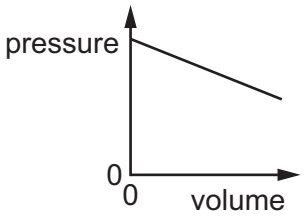
D The pressure of the trapped air is greatest in tube P.

13 Which graph shows the relationship between the pressure and the volume of a fixed mass of gas at constant temperature?

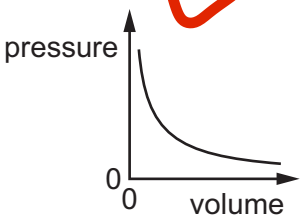
A



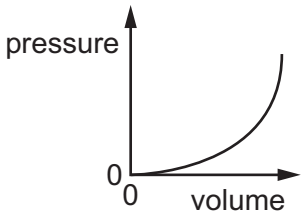
B



C



D



14 An object X has mass m and velocity v.

A second object Y has mass $2m$ and velocity $2v$.

What is the value of the ratio $\frac{\text{kinetic energy of Y}}{\text{kinetic energy of X}}$?

A 1 **B** 2 **C** 4 **D** 8

15 Where is energy released by the fusion of hydrogen nuclei to form helium?

A in a nuclear power station

B in a radioactive isotope emitting alpha-particles

C in the core of the Earth

D in the core of the Sun

16 A student uses a newton meter to pull an object a distance d horizontally along a flat surface in a time of t. The newton meter reading is F.

What is given by the expression $(F \times d)/t$?

A efficiency

B energy

C power

D work

17 A student is given a thermometer that reads 1 °C in pure melting ice and 101 °C in pure boiling water. She uses it to measure the temperature of some water before and after it is heated.

How does the rise in temperature of the water calculated from her results compare with the correct value?

A It is 1 °C lower.

B It is the same.

C It is 1 °C higher.

D It is 2 °C higher.

18 A student makes four statements about evaporation and boiling.

1 Both involve an increase in molecular separation.

2 Both occur only at a fixed temperature.

3 Both involve the absorption of thermal energy.

4 Both occur throughout the liquid.

Which two statements are correct?

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

19 How is *specific latent heat* defined?

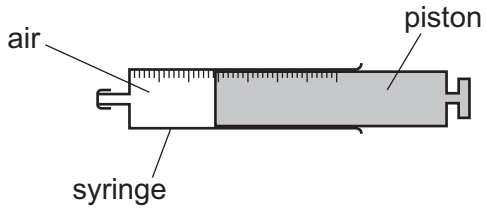
A the heat absorbed or emitted by unit mass during a change of a state without a temperature change

B the heat absorbed or emitted by unit mass during unit temperature change

C the heat absorbed or emitted during a change of a state without a temperature change

D the heat absorbed or emitted during unit temperature change

20 A syringe containing air is sealed at one end. The piston is free to move.



The air is heated.

What happens to the average distance between air molecules and the density of the air?

	average distance between air molecules	density of the air
A	increases	decreases
B	increases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

21 A metal disc is heated to 600 °C and then lowered into a beaker of water.

What happens to the mass of the metal disc and to the mass of the water in the beaker?

	mass of metal disc	mass of water in beaker
A	increases	decreases
B	increases	no change
C	no change	decreases
D	no change	increases

because of boiling of water

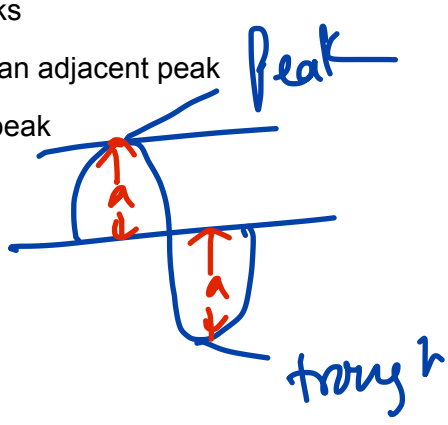
22 Which description defines the amplitude of a water wave in a ripple tank?

A half of the vertical distance between a trough and a peak

B the horizontal distance between adjacent peaks

C the horizontal distance between a trough and an adjacent peak

D the vertical distance between a trough and a peak



23 Here are four statements about wavefronts.

1 Wavefronts from a point source are straight lines.

2 Wavefronts from a point source are circular.

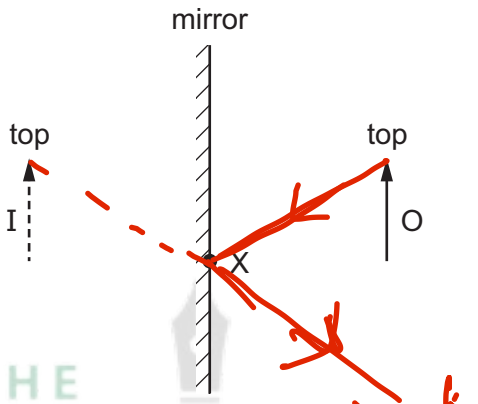
3 Wavefronts are parallel to the direction of energy movement.

4 Wavefronts are perpendicular to the direction of energy movement.

Which two statements are correct?

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

24 An object O is placed in front of a plane mirror. I is the image formed.



A ray from the top of the object is incident on the mirror at X.

What happens to this ray?

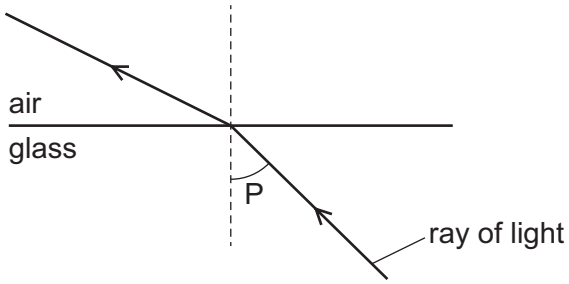
A It reflects and passes through the bottom of O.

B It reflects and passes through the top of O.

C It reflects as though it came from the bottom of I.

D It reflects as though it came from the top of I.

25 The diagram shows light passing from glass into air.



What is the name of angle P?

A the angle of incidence

B the angle of reflection

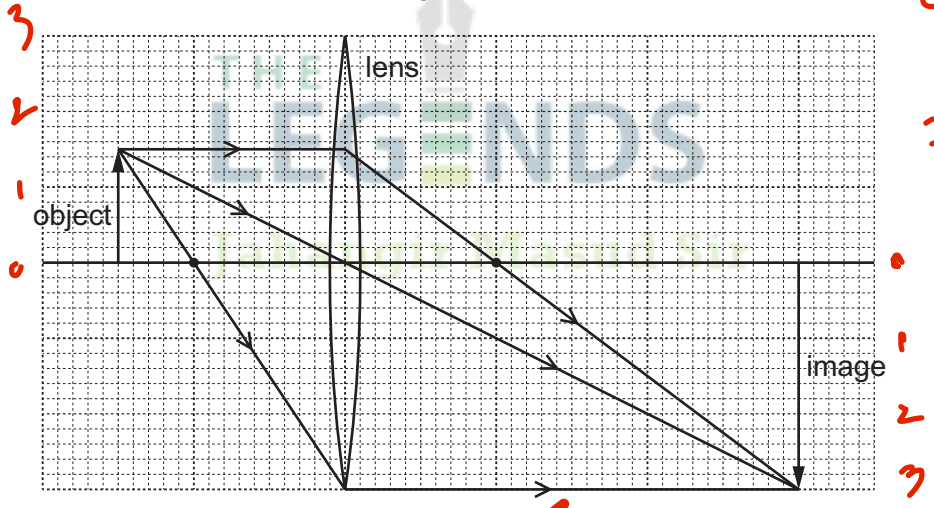
C the angle of refraction

D the critical angle

linear magnification = Image height / object height

26 An object is placed in front of a converging lens of focal length 4.0 cm. The height of the image is 6.0 cm.

The arrangement is shown on the scale diagram.



= Image distance / object distance

= 2.0

What is the linear magnification produced by the lens?

A 0.50 **B** 1.5 **C** 2.0 **D** 6.0

27 Which row shows the speed of sound in air (c_a), liquid (c_L) and solid (c_s) in order from slowest to fastest?

	slowest →		fastest
A	c_L	c_s	c_a
B	c_L	c_a	c_s
C	c_a	c_L	c_s
D	c_s	c_L	c_a

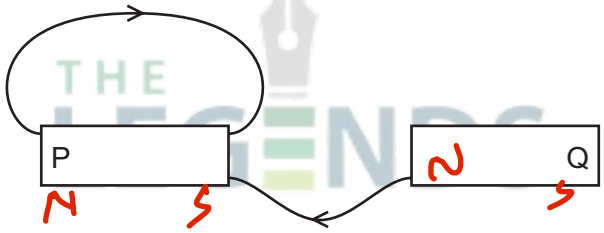
28 A man stands 80 m in front of a cliff face. He makes a loud bang and listens for the echo.

He makes a loud bang once every second. He hears an echo exactly halfway between the bang that caused it and the next bang.

What is the speed of sound?

A 40 m/s **B** 80 m/s **C** 160 m/s **D** 320 m/s

29 The diagram shows two magnetic field lines of the magnetic field around two bar magnets.

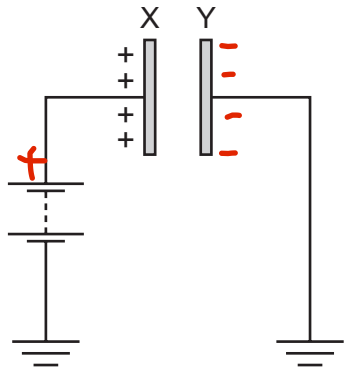


Which row shows the magnetic poles at end P and end Q of the two magnets?

	P	Q
A	N	N
B	N	S
C	S	N
D	S	S

30 A metal plate X is attached to earth by a battery. The plate has a positive charge.

A second metal plate Y is initially uncharged and connected to earth. This plate is positioned parallel to X.



What happens as Y is brought closer to X?

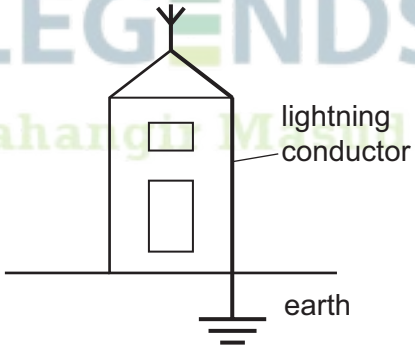
A Electrons flow from Y to earth only.

B Electrons flow to Y from earth only.

C Protons flow from Y to earth and electrons flow to Y from earth.

D Protons flow to Y from earth and electrons flow from Y to earth.

31 The diagram shows a metal lightning conductor attached to a building.



Why is the lightning conductor made of copper?

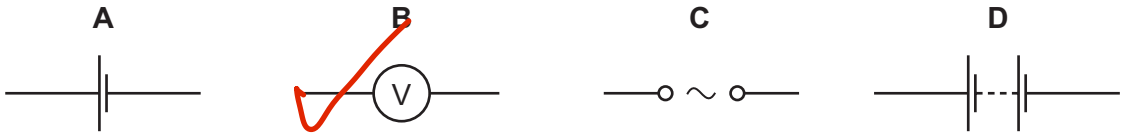
A Both positive and negative charges can flow through copper.

B Copper can be electrostatically charged.

C So the lightning conductor has a low electrical resistance.

D So the heat is conducted away quickly.

32 Which symbol does **not** represent a power source?



33 Resistors of different resistances are connected to a power supply in either a parallel circuit or a series circuit. Which statement is correct?

A The current is the same in all resistors connected in parallel.

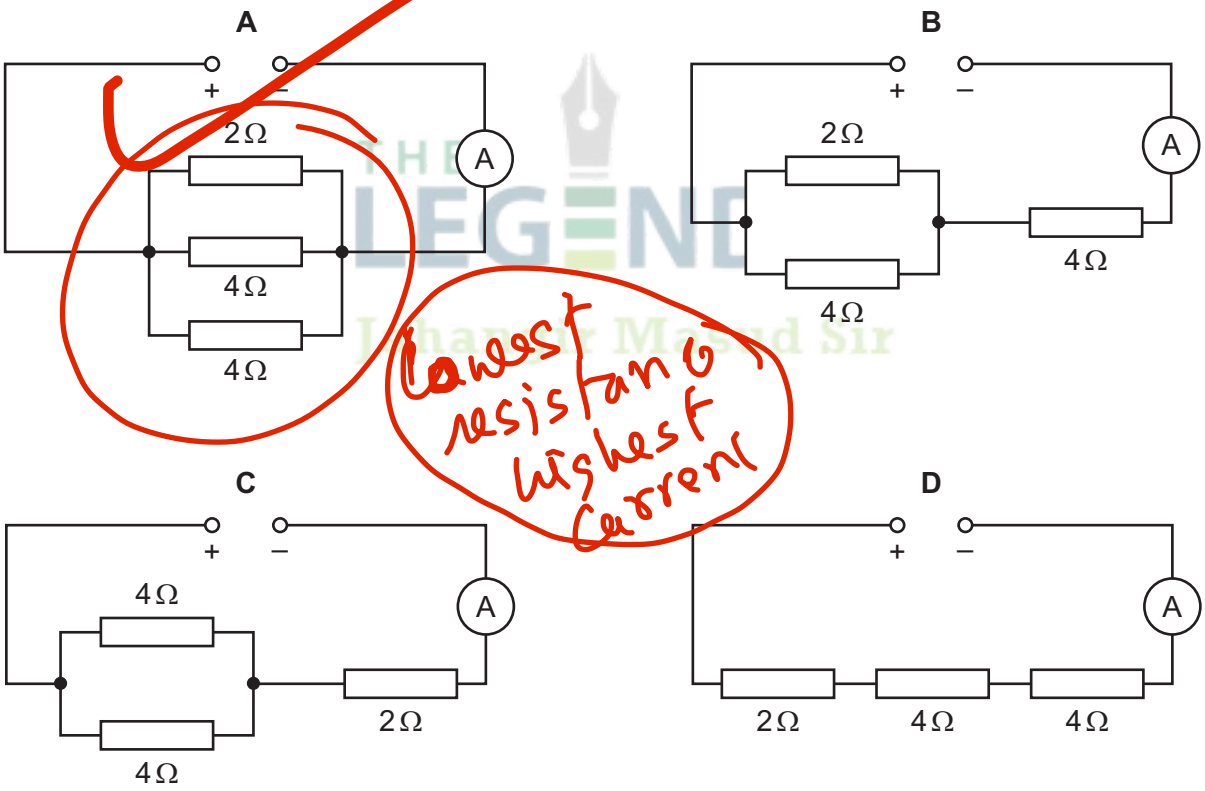
B The current is the same in all resistors connected in series.

C The voltage across each resistor is different for all resistors connected in parallel.

D The voltage across each resistor is the same for all resistors connected in series.

34 An ammeter is connected to three resistors and a power supply.

Which arrangement of resistors gives the greatest ammeter reading?



35 A hotplate on an electric cooker contains two identical resistors.

The switch has three positions.

position 1 The two resistors are connected in series to the mains supply.

position 2 The two resistors are connected in parallel to the mains supply.

position 3 Just one resistor is connected to the mains supply.

Which positions correspond to the low, the medium and the high power settings?

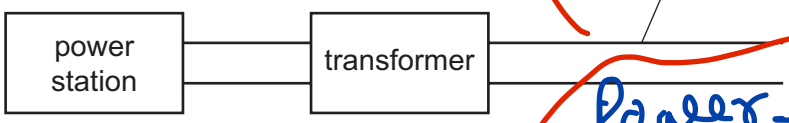
	low power	medium power	high power
A	1	2	3
B	1	3	2
C	3	1	2
D	3	2	1

36 A mains electric circuit is fitted with a circuit breaker rather than a fuse.

Where is the circuit breaker connected and what happens when the current is too large?

	A circuit breaker is connected in…	When the current is too large…
A	the live wire.	a thin wire melts and breaks the circuit.
B	the live wire.	an electromagnet opens a switch.
C	the neutral wire.	a thin wire melts and breaks the circuit.
D	the neutral wire.	an electromagnet opens a switch.

37 Transformers are used to transmit electrical energy between power stations and transmission cables, as shown.



What is the purpose of the transformer in the diagram?

A to decrease the current and the potential difference from the power station

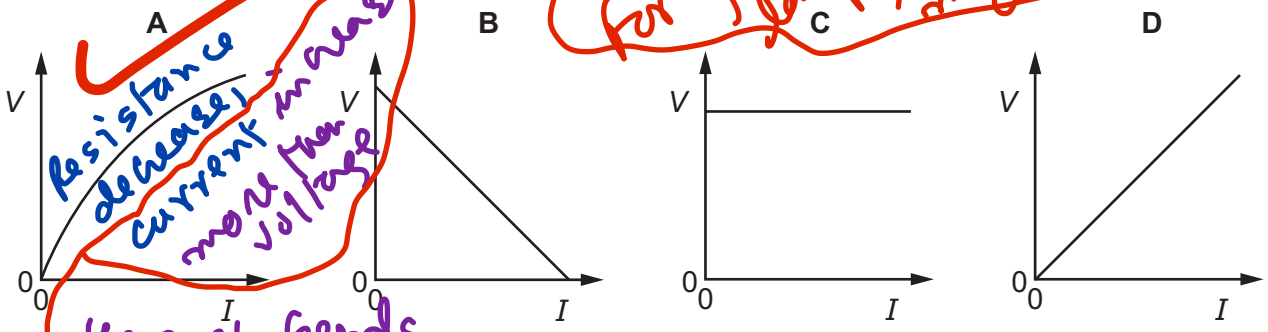
B to decrease the current and increase the potential difference from the power station

C to increase the current and the potential difference from the power station

D to increase the current and decrease the potential difference from the power station

38 A thermistor warms up as the current in it increases.

Which graph shows how the voltage V across the thermistor changes as the current I through it is increased?



39 Radioactive substances are used as tracers in medical examinations.

A liquid tracer is injected into a patient. A detector 20 cm above the patient shows where the radioactive substance is in the body.

What is the best radioactive substance to use?

A an alpha-particle emitter with a half-life of a few hours

B an alpha-particle emitter with a half-life of a few years

C a gamma ray emitter with a half-life of a few hours

D a gamma ray emitter with a half-life of a few years

40 An isotope of lead, $^{212}_{82}Pb$, is radioactive. After three decays, two beta-particles and an alpha-particle have been emitted. Another radioactive isotope of lead is formed.

What is the mass number (nucleon number) of the new isotope of lead?

A 200 **B** 208 **C** 212 **D** 216

Cambridge
O Level

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Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **5054/22**

Paper 2 Theory **October/November 2019**

1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **18** printed pages and **2** blank pages.

Cambridge Assessment International Education

Section A

Answer **all** the questions in this section. Answer in the spaces provided.

1 There is no atmosphere on the Moon.

An astronaut on the Moon drops a feather and a hammer from the same height at the same time. They both accelerate downwards at $1.6\,m/s^2$ and they hit the ground at the same time.

(a) The weight of the hammer is much larger than that of the feather.

Explain, in terms of their weights and masses, why their accelerations are equal.

weight is directly proportional to mass or $W = mg$.
More massive object is exerted by large force and less massive object is exerted by less force $a = \frac{F}{m}$, force mass ratio is same for falling body so acceleration is same. [3]

Rough work

$F = G\frac{Mm}{r^2}$ $F = \frac{GM}{r^2}$ $F = mg$

(b) Both the feather and the hammer take 1.5 s to fall to the ground from rest.

(i) Calculate the speed of the objects as they hit the ground.

$v = u + gt$

$v = 0 + gt = 1.6 \times 1.5 = 2.4\ m\,s^{-1}$

speed = ... [2]

(ii) On Fig. 1.1, draw the speed-time graph for the fall. At the correct position on the *y*-axis, write the value of the speed at time $t = 1.5$ s.

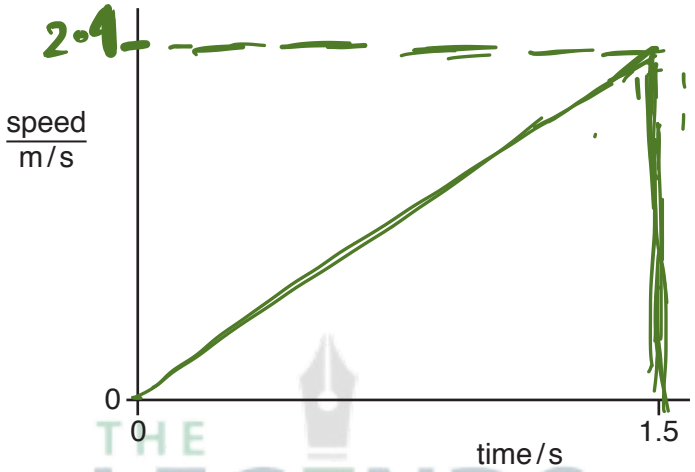


Fig. 1.1

[1]

(iii) Using the speed-time graph in **(b)(ii)**, determine the height from which the objects are dropped.

Area under the graph

$= \frac{1}{2} \times 1.5 \times 2.4$

$= 1.8$ m.

height = ... [2]

[Total: 8]

2 A student uses a pump to inflate a bicycle tyre.

Fig. 2.1 shows the pump and the tyre.

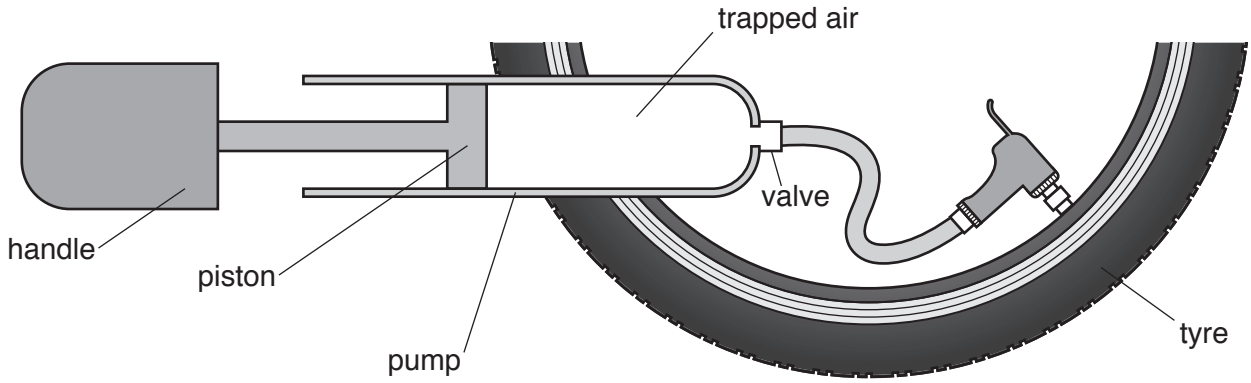


Fig. 2.1 (not to scale)

(a) The pressure of the trapped air in the pump is 3.8×10^5 Pa and the cross-sectional area of the piston is 6.1×10^{-4} m^2.

(i) Calculate the force exerted on the piston by the trapped air in the pump.

$F = PA$
$= 3.8 \times 10^5 \times 6.1 \times 10^{-4}$
$= 230$ N

force = ... [2]

(ii) The student pushes the handle to the right and the piston forces the trapped air into the tyre. The force exerted by the student is less than the value in **(a)(i)**.

Suggest one reason why.

pressure of trapped gas decreases as valve opens.

..... [1]

(b) The temperature of the air in the pump remains constant as the handle moves to the right.

Explain, in terms of its molecules, why the pressure of a gas increases when its volume is decreased at constant temperature.

Molecules collide each other and hit on the wall. As total volume decreases so the number of molecules per unit volume increases, therefore the frequency of collision increases and pressure increases

..... [3]

[Total: 6]

3 Solar panels are used to heat water.

(a) The energy absorbed by solar panels comes from the Sun.

(i) Describe how this energy is produced inside the Sun.

By nuclear fusion where small nuclei fuse together and produces a larger nucleus with the release of energy

[2]

(ii) State how this energy is transferred to Earth.

By infrared radiation

[1]

(b) Explain why solar panels are usually black.

Black surfaces are good absorbers of infrared radiation

[2]

[Total: 5]

4 In many countries, solid salt is produced by trapping sea-water in large, shallow ponds and letting the water evaporate.

Fig. 4.1 shows salt being produced in this way.

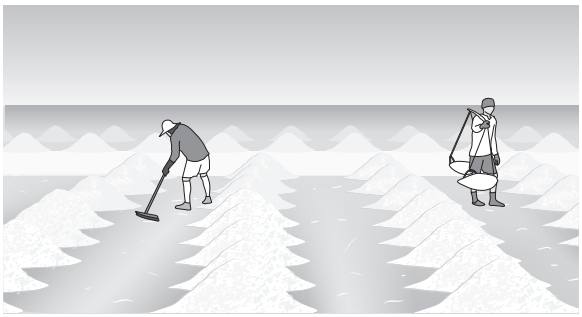


Fig. 4.1

(a) State two ways in which evaporation differs from boiling.

1. Evaporation occurs at surface
Boiling occurs at whole depth of liquid

2. Evaporation occurs at any temperature
Boiling occurs at fixed temperature

[2]

(b) Describe, in terms of water molecules, what is happening as the water evaporates.

High energetic molecules escape from the surface of liquid leaving behind low energetic molecules. Average kinetic energy of the remaining liquid decreases which decreases the temperature of the liquid.

[2]

(c) **(i)** State why the ponds used in this process have large surface areas.

Rate of evaporation increases with increasing surface area.

[1]

(ii) State why this method of salt production does not work well in a country with a cold climate.

Rate of evaporation decreases with decreasing temperature.

[1]

[Total: 6]

5 Both sound and ultrasound are longitudinal waves.

(a) Describe what is meant by *longitudinal*.

Particles

Direction of vibrations of medium are parallel to direction of energy travel

[2]

(b) Fig. 5.1 shows an ultrasound cleaner being used to clean jewellery.

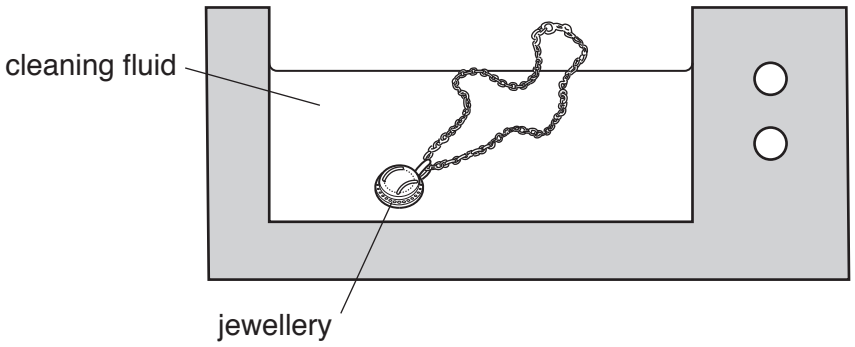


Fig. 5.1

The jewellery is lowered into the cleaning fluid and ultrasound waves of frequency 42 000 Hz are produced in the fluid.

(i) The speed of ultrasound in the fluid is 1500 m/s.

Calculate the wavelength of the ultrasound in the fluid.

$\lambda = \frac{v}{f} = \frac{1500}{42000} = 0.036\,m$

wavelength = ... [2]

(ii) Describe how the ultrasound cleans the jewellery.

Ultrasound and cleaning fluid jointly vibrates and create bubbles that cling to foreign particles. Dirts are taken off by the fluid.

[2]

[Total: 6]

6 An electric circuit contains a 700 Ω resistor and a light-dependent resistor (LDR). Fig. 6.1 is the circuit diagram.

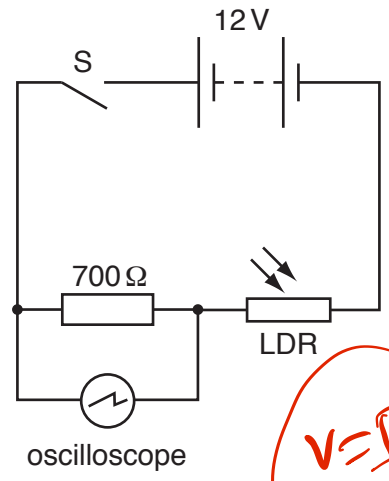


Fig. 6.1

The electromotive force (e.m.f.) of the battery is 12 V.

An oscilloscope is connected across the fixed resistor. Fig. 6.2 shows the oscilloscope, including the settings of the timebase and the Y-gain controls. Line Q shows the position of the trace on the oscilloscope when the switch S is open.

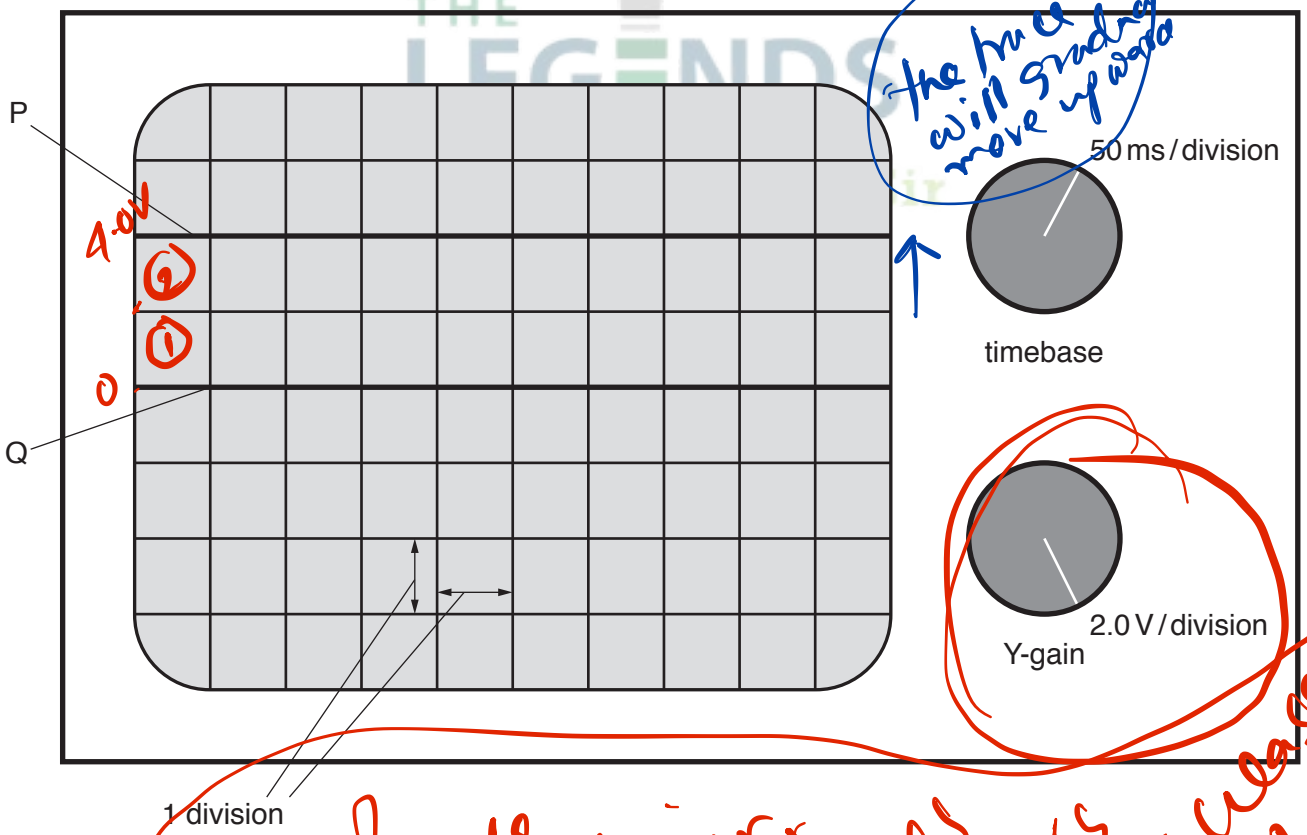


Fig. 6.2

The switch S is closed and the trace on the oscilloscope moves to the position shown by line P in Fig. 6.2.

(a) **(i)** Determine the potential difference (p.d.) across the 700 Ω resistor.

p.d. = 4.0 V. ..... [1]

(ii) Determine the resistance of the LDR.

pd across LDR = 12 − 4 = 8 V.

$V = IR$

or, $R = \frac{V}{I} = \frac{8}{\frac{4}{700}} = 1400\ \Omega$.

resistance = ... [3]

(b) The intensity of the light incident on the LDR gradually increases.

State and explain how the trace on the oscilloscope screen moves.

Resistance of LDR decreases
Current increases, pd across 700Ω resistor increases. trace moves up the screen.

..... [3]

[Total: 7]

7 Fig. 7.1 shows a horizontal, rectangular coil ABCD placed between a magnetic N-pole and an S-pole.

There is a current in the coil.

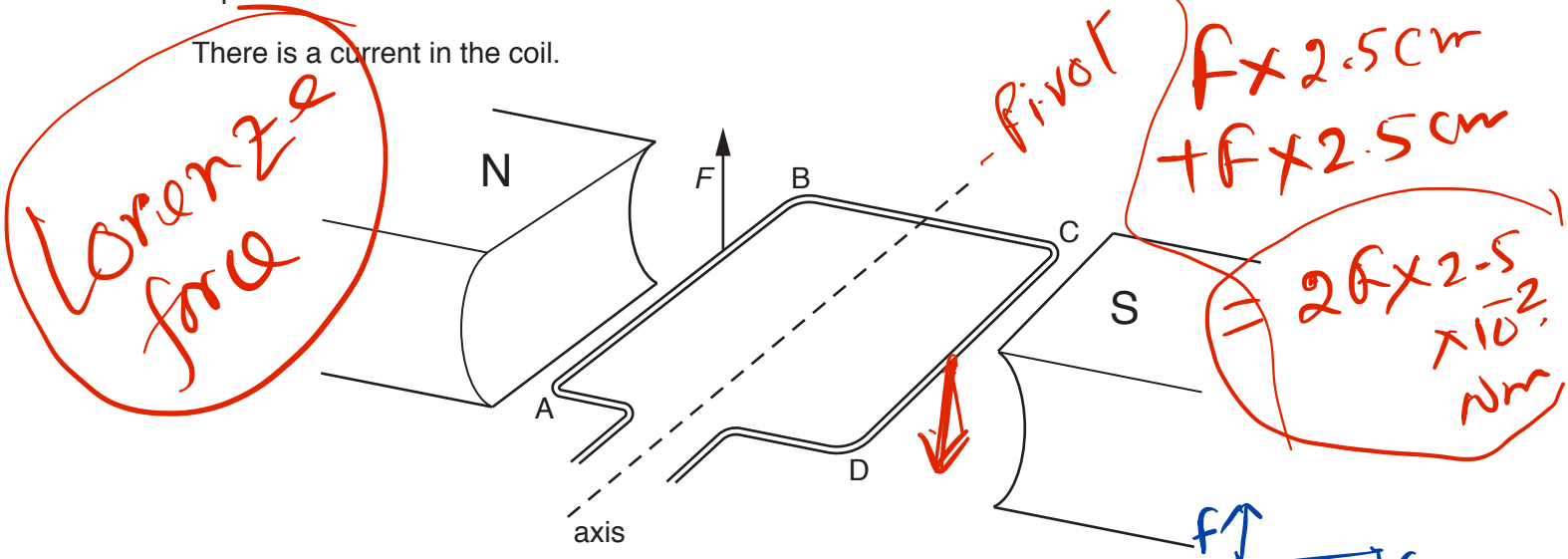


Fig. 7.1

An upward force F of size 9.6×10^{-3} N acts on side AB of the coil.

(a) **(i)** Explain why there is a force on side AB.

magnetic field and current interact each other produces this force.

..... [1]

(ii) Determine the direction of the current in AB and state how the direction is deduced.

According to Fleming's left hand rule fore finger → magnetic field (N to S) thumb → motion upwards, second finger current flow B to A.

..... [2]

(b) Both side AB and side CD of the coil are 2.5 cm from the axis.

Determine the total moment acting on the coil.

$2 \times 9.6 \times 10^{-3} \times 2.5 \times 10^{-2}$

moment = 4.8×10^{-4} Nm [2]

(c) The coil in Fig. 7.1 is part of a direct current (d.c.) motor.

(i) State the name of the device that connects the coil of a d.c. motor to the electricity supply.

split ring commutator.

..... [1]

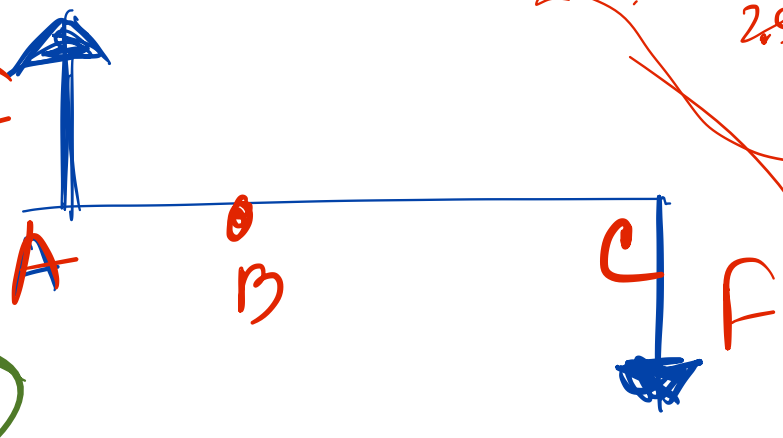
(ii) State **one** change to the arrangement in Fig. 7.1 that produces a greater turning effect in coil ABCD.

using stronger magnet.

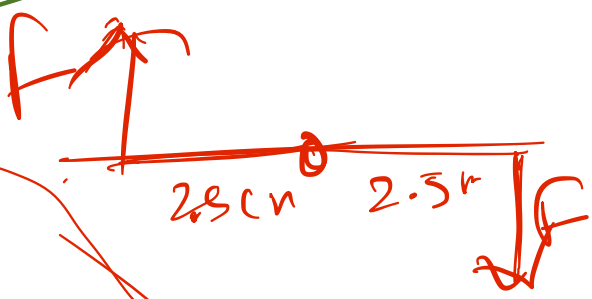
..... [1]

[Total: 7]

AC Generator
Rotating coil ⇒ alternating force (−)
slip rings
Direct (+)
Process



Alternator
(−)



$F \times AB + F \cdot BC$

$= F(AB + BC)$

$= F \times AC$

= one force × the perpendicular distance between two forces

(−)
Rotating coil ⇒ Alternating (−) process
split rings reverses Alternating process

$9.6 \times 10^{-3} \times 2 \times 2.5$

Direct current motor
(+) DC motor

Section B

Answer **two** questions from this section. Answer in the spaces provided.

8 Fig. 8.1 shows an elastic rope (bungee).

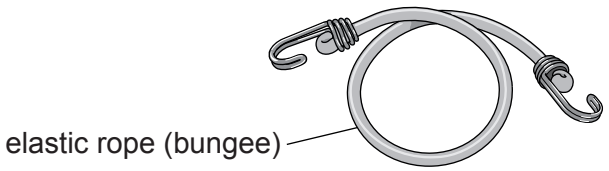


Fig. 8.1

The unstretched length of the rope is 0.80 m.

A student uses the hook at one end to suspend the rope from a shelf and hangs an empty paint can of mass 0.70 kg from the other end. The rope stretches to a length of 0.97 m but does not exceed its limit of proportionality.

(a) Explain what is meant by *limit of proportionality*.

limit of proportionality is a point above where the extension is no longer proportional to load.

[2]

(b) State what is meant by:

(i) *mass* Amount of matter in a body [1]

(ii) *weight.* force of attraction in a gravitational field. [2]

(c) The gravitational field strength is 10 N/kg.

(i) Calculate the weight of the empty paint can.

$W = mg$
$= 0.7 \times 10\,N$

weight = 7.0 N. [1]

(ii) For the rope, calculate a value for $\frac{\text{load}}{\text{extension}}$.

$F = kx$
$\Rightarrow \frac{F}{x} = k$

$\frac{7.0}{(0.97 - 0.80)} =$

$\frac{\text{load}}{\text{extension}}$ = 0.41 N/cm [1]

(d) The student repeatedly pours small volumes of paint into the can.

When there is $2.5 \times 10^{-3}\,m^3$ of paint in the can, the total length of the rope is 1.70 m. This is where the rope reaches the limit of proportionality.

(i) Determine the mass of the paint in the can.

$W = mg$

extension $= 1.70 - 0.80 = 0.90\,m$

$F = kx$

or, $F = 41 \times 0.90 = 36.9\,N$

paint $= (36.9\,N - 7.0\,N) = 29.9\,N$

$\text{Mass} = \frac{W}{g} = \frac{29.9}{10} = 2.99 \approx 3.0\,kg$

mass = ... [3]

(ii) The student continues to pour paint into the can until there is a volume of $5.0 \times 10^{-3}\,m^3$ in it. He notices that the elastic rope becomes harder to stretch after the limit of proportionality.

He plots a graph of the total length of the rope against the volume of paint added.

On Fig. 8.2, sketch the length-volume graph for the range 0 to $5.0 \times 10^{-3}\,m^3$.

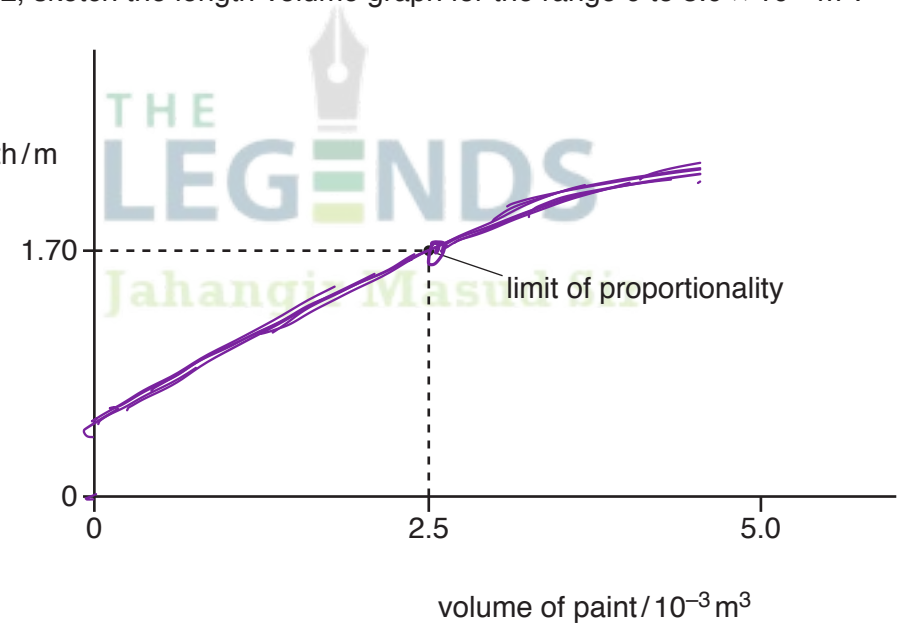


Fig. 8.2

[3]

(e) The student suddenly removes the can from the end of the stretched rope and, as it contracts, the rope jumps into the air.

State the energy change that is taking place in the rope as it contracts and jumps into the air.

Elastic potential energy to kinetic energy.

..... [2]

[Total: 15]

9 Fig. 9.1 shows a boiling liquid at its boiling point, trapped in a cylinder by a piston.

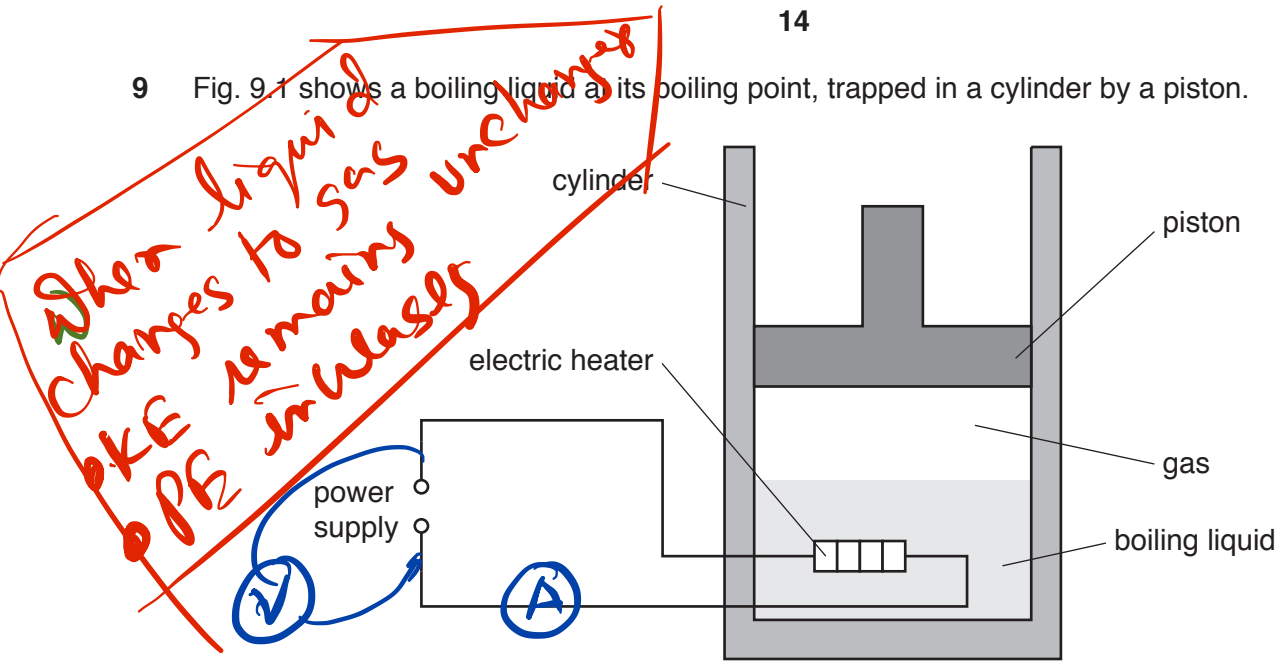


Fig. 9.1

There is an electric heater in the liquid which is connected to a power supply. The thermal energy produced by the heater gradually turns the boiling liquid into a gas.

(a) State what is meant by *boiling point*.

The fixed temperature at which a liquid converts into a gas.

[2]

(b) Explain, in terms of molecules, why it is necessary to supply energy in order to turn a liquid at its boiling point into a gas.

Work must be done to break the bonds of liquid and to separate molecules that is to increase the potential energy

[3]

(c) In order to determine the power of the electric heater, two meters are connected into the circuit. One meter measures the current in the heater and the other meter measures the potential difference (p.d.) across it.

On the circuit in Fig. 9.1, draw symbols to show the two meters used and where they are connected. [2]

(d) The current in the heater is 2.0 A and the p.d. across it is 6.0 V.

(i) Calculate the power of the heater.

$P = VI$

$= 6.0 \times 2.0\,A$

power = 12 W [2]

(ii) Calculate the thermal energy supplied to the liquid by the heater in 1.0 minute.

12 W → 12 J in 1 second

energy = $P \times t$ $= 12 \times 60$

$= 720$ J

energy = ... [2]

(iii) The specific latent heat of vaporisation of the liquid is 9.0×10^5 J/kg.

Calculate the mass of liquid that vaporises every minute.

$Q = mL_V \Rightarrow m = \frac{Q}{L_V} = \frac{720}{9.0 \times 10^5}$

mass = 8.0×10^{-4} kg [2]

(e) The piston is free to move in the cylinder. As the liquid boils, the piston is pushed upwards in the cylinder at a constant speed. The volume occupied by the gas just above the liquid increases.

Discuss whether the upward force on the piston changes as the piston moves upwards at constant speed.

Resultant force is zero as the weight of piston plus force due to atmospheric pressure equal to upward force

[2]

[Total: 15]

When constant speed Resultant force is zero the object is in equilibrium

10 All the isotopes of the gas radon are radioactive.

(a) State **one** similarity and **one** difference between the nuclei of two different isotopes of radon.

similarity ..... Same number of proton .....

difference ..... different no. of neutrons .....

[2]

(b) The isotope radon-222 decays by alpha-particle emission to an isotope of polonium (Po). The proton number (atomic number) of polonium is 84.

(i) Determine the number of neutrons in an atom of the polonium isotope.

mass no of (Po) 222 − 4 = 218

neutron no. = 218 − 84 = 134

number of neutrons = ... [2]

(ii) Determine the number of protons in an atom of radon-222.

$Rn \rightarrow {}^{4}_{2}He + Po$

86 → 2 + 84

84 + 2 = 86

number of protrons = ... [2]

(iii) Describe how a neutral atom of helium ($^{4}_{2}He$) differs from an alpha-particle.

$({}^{4}_{2}He)$ Helium atom has two electrons

.....

Alpha particle doesn't have electrons $({}^{4}_{2}He^{++})$ [1]

(c) In an experiment to collect a small quantity of helium, a sample of radon-222 is enclosed in an inner glass tube which has a very thin wall. Fig. 10.1 shows that this tube is placed inside a container that is initially evacuated.

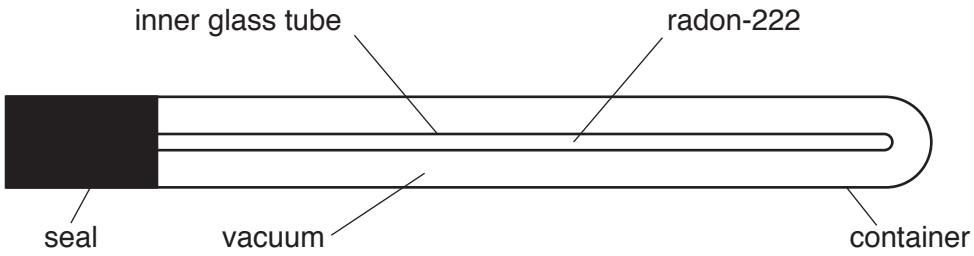


Fig. 10.1

Both the container and the inner glass tube are sealed.

As the radon-222 decays, alpha-particles pass through the thin wall of the inner glass tube.

Fig. 10.2 shows how the total number of alpha-particles produced by the radioactive decay of the radon-222 changes as time passes.

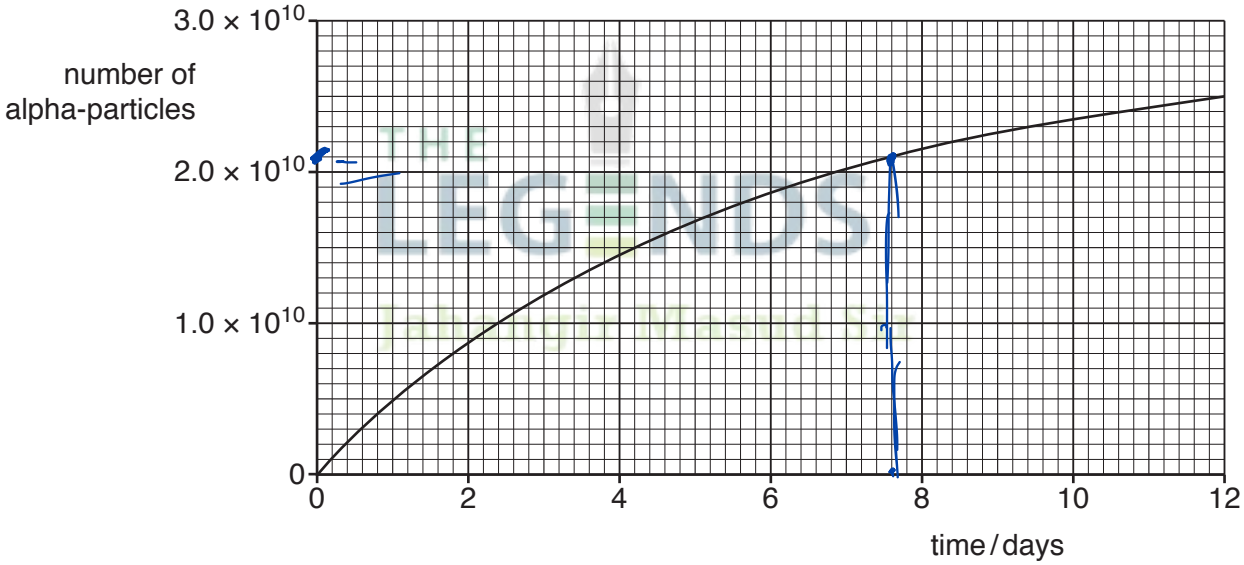


Fig. 10.2

(i) Use Fig. 10.2 to determine the number of alpha-particles produced in 7.6 days.

2.1×10^{10} ..... [1]

(ii) Initially, there are 2.8×10^{10} atoms of radon-222 in the inner glass tube. As each radon-222 atom decays, it produces an alpha-particle.

Calculate the number of radon-222 atoms that remain after 7.6 days.

$2.8 \times 10^{10} - 2.1 \times 10^{10} = 0.7 \times 10^{10} = 7.0 \times 10^{9}$

number of atoms remaining = ... [1]

(iii) Using the number of radon-222 atoms present initially and the number present after 7.6 days, calculate the half-life of radon-222.

$\frac{7.0\times10^{9}}{2.8\times10^{10}} = \frac{1}{4}$

= 2 half lives

$\frac{2.8\times10^{10}}{7.0\times10^{9}} = 4$

2 half lives → 7.6 days

half-life = $T_{\frac{1}{2}} = \frac{7.6}{2} = 3.8$ days ..... [3]

(d) The alpha-particles become helium atoms which are collected in the vacuum shown in Fig. 10.1.

Explain, in terms of the properties of alpha-particles, why the wall of the inner glass tube must be extremely thin.

The penetrating power of alpha particle is very less

..... [1]

(e) In some parts of the world, radon-222 accumulates in the air in buildings and is breathed in by people.

Explain why the presence of an alpha-emitter in the lungs is particularly hazardous.

alpha particle is strongly ionising which causes cell mutation or cancers

..... [2]

[Total: 15]

$\frac{2}{8} = \frac{1}{4}$

8 → 4 → 1 half life

4 → 2 → 2 half life

Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

Candidate 2023
May/June 2018
Date: 30/03/2023

PHYSICS **5054/12**

Paper 1 Multiple Choice **May/June 2018**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BAR CODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **15** printed pages and **1** blank page.

1 Which is a vector quantity?

A a mass of 2.0 kg

B a temperature of –10 °C

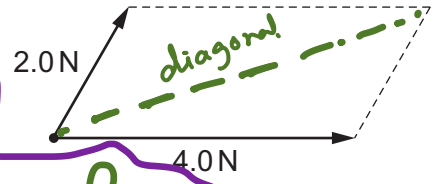
C a weight of 15 N

D an average speed of 20 m / s

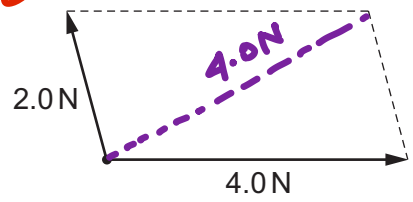
2 Forces of 4.0 N and 2.0 N act at a point.

Which scale diagram shows the forces that have a resultant of 4.0 N?

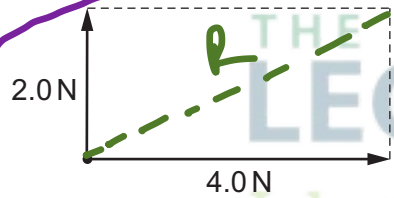
A



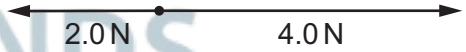
B



C



D



3 What is the name and value of the unit of power written as mW?

	name	value
A	megawatt	10^{-3} W
B	megawatt	10^{6} W
C	milliwatt	10^{-3} W
D	milliwatt	10^{6} W

4 Micrometers, metre rules, tapes and calipers are used for measuring lengths.

Which row identifies the most suitable device for accurately measuring the stated length?

	length	measuring device
A	0.15 mm	micrometer
B	0.50 mm	metre rule
C	0.15 m	tape
D	0.50 m	calipers

5 The planets in the Solar System orbit the Sun.

Which statement is correct?

A There is a force on each planet away from the Sun.

B There is a force on each planet in the direction in which it travels.

C There is a force on each planet opposite to the direction in which it travels.

D There is a force on each planet towards the Sun.

6 Which forces act on a skydiver who is falling at terminal velocity?

A air resistance and weight

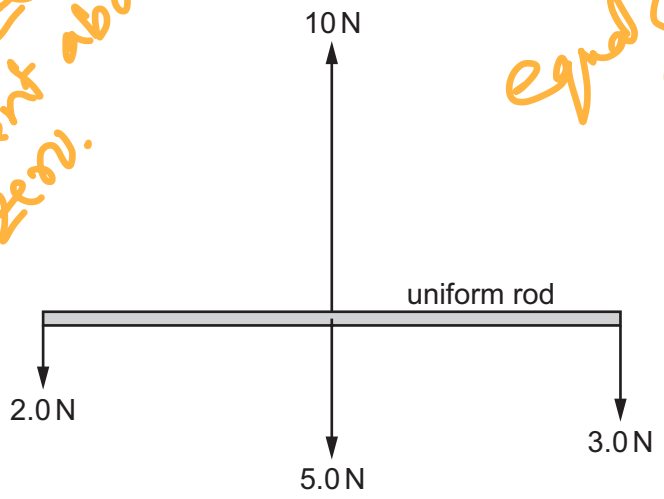
B air resistance only

C weight only

D no forces act

7 A uniform rod of weight 5.0 N is held initially at rest.

The diagram shows the forces acting on the rod when it is released.



What happens to the rod when it is released?

A It does not move.

B It moves to the right.

C It moves upwards.

D It starts to rotate.

8 A block of metal is placed on an electronic balance to record its mass.

What is the unit of the reading on the electronic balance and what is the unit of weight?

	unit on electronic balance	unit of weight
A	g	g
B	g	N
C	N	g
D	N	N

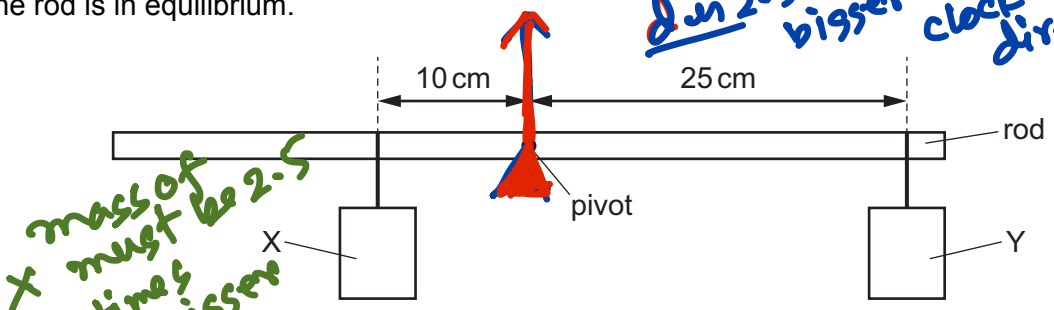
9 A body of mass 10 kg falling freely in the gravitational field close to the Moon's surface has an acceleration of 1.6 m/s^2.

What is the gravitational field strength on the Moon?

A 0 N/kg **B** 1.6 N/kg **C** 10 N/kg **D** 16 N/kg

10 Two objects X and Y are suspended from a uniform rod, pivoted at its centre.

The rod is in equilibrium.



Which statement about X and Y is correct?

A The mass of X is 0.4 times the mass of Y.

B The mass of X is 2.5 times the mass of Y.

C The mass of X is 3.5 times the mass of Y.

D The mass of X is equal to the mass of Y.

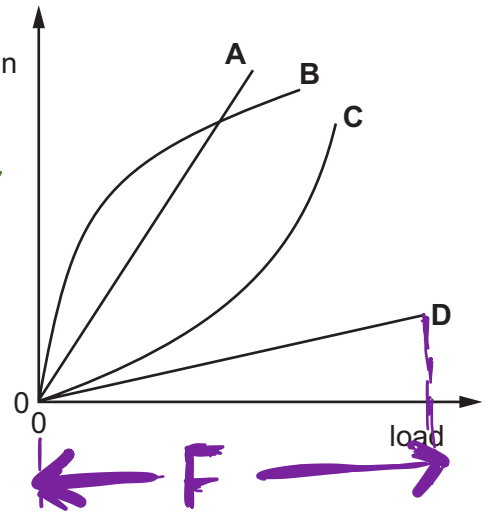
11 A force of 1600 N accelerates a car, of mass 800 kg, from rest.

What is the car's acceleration and its velocity after 4.0 s?

	acceleration m/s^2	velocity m/s
A	0.50	0.13
B	0.50	0.50
C	2.0	2.0
D	2.0	8.0

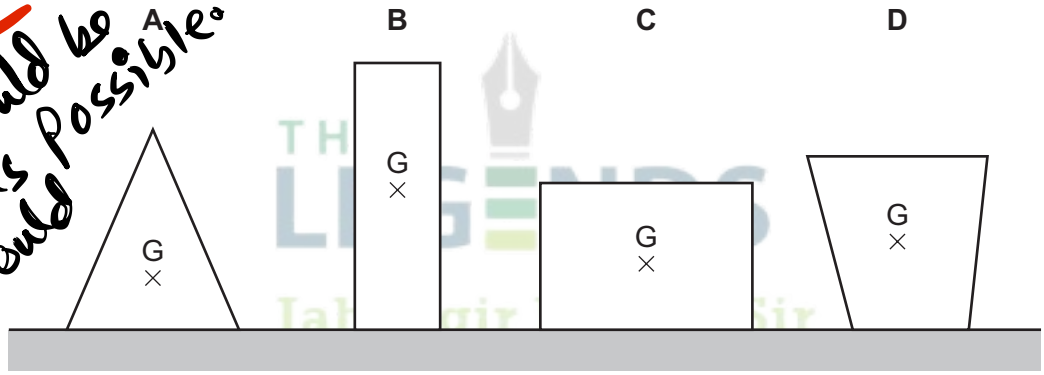
12 The graph shows extension-load curves for four fibres.

Which fibre is the most difficult to stretch over the range of loads shown?



13 Four objects of equal mass rest on a table. The centre of mass of each object is labelled G.

Which object is the least stable?



14 Which power station produces carbon dioxide when operating?

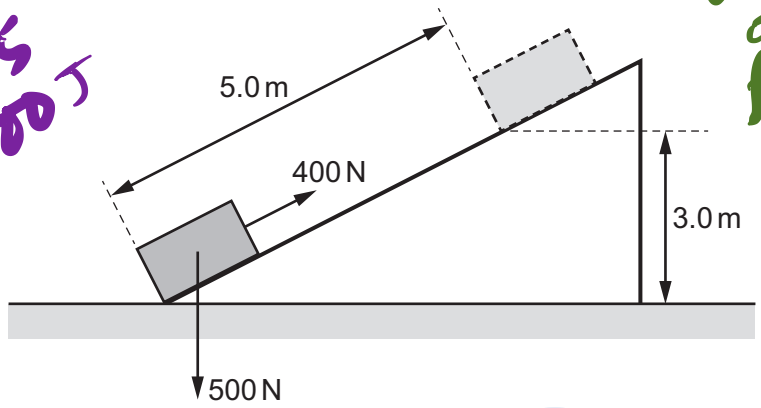
A gas-fired power station

B geothermal power station

C nuclear power station

D wind power station

15 Work is done when a force of 400 N pulls a crate of weight 500 N at a constant speed along a ramp, as shown.

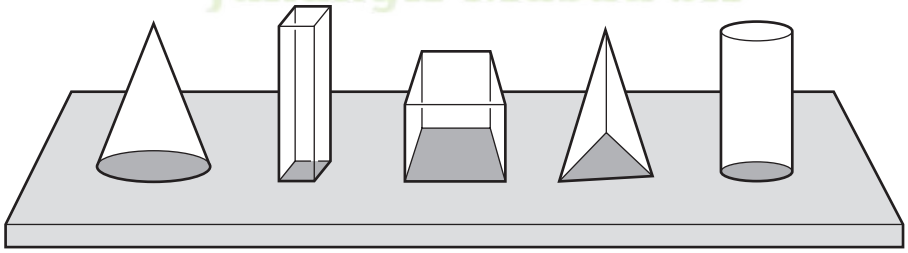


Part of the work done increases the gravitational potential energy E of the crate and the rest is work done W against friction.

What are the values of E and W?

	E / J	W / J
A	1500	500
B	1500	2000
C	2000	2500
D	3500	500

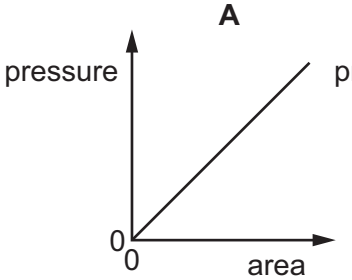
16 Five blocks have the same mass but different base areas. They all rest on a horizontal table.



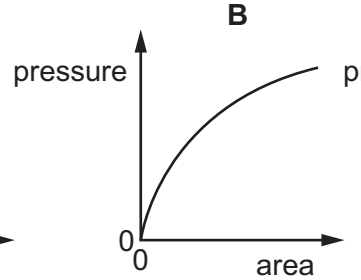
A graph is plotted to show the relationship between the pressure exerted on the table and the base area of the block.

Which graph shows this relationship?

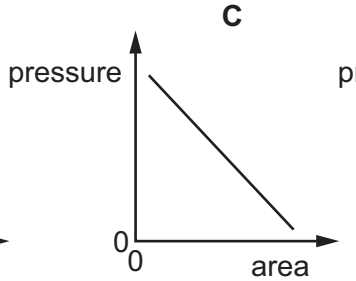
A



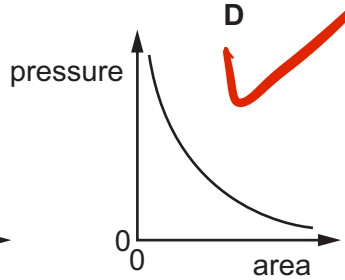
B



C

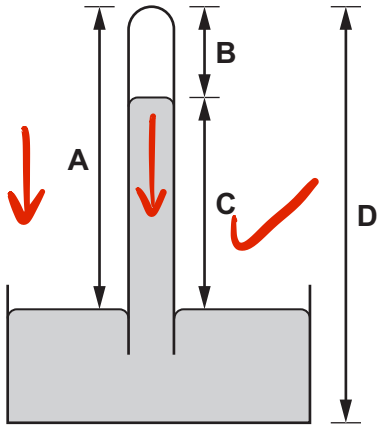


D



17 The diagram shows a simple mercury barometer.

Which height is a measure of the atmospheric pressure?



18 A sealed packet containing air and a snack is purchased at an airport. The sealed packet is taken on board an aircraft. During the flight the packet becomes larger.

What causes the packet to become larger?

A The density of the air inside the packet increases.

B The mass of the packet increases.

C The pressure of the air outside the packet decreases.

D The volume of the air inside the packet decreases.

19 A sealed container of gas is heated and the pressure inside increases.

What happens to the molecules of the gas to cause this increase in pressure?

A Their kinetic energy decreases.

B They become heavier.

C They expand.

D They hit the container more frequently.

20 Equal masses of copper and water are heated to the same temperature. As they cool down, the copper and the water lose thermal energy at the same rate.

The temperature of the copper falls faster.

Why is this?

A Copper has a larger specific heat capacity.

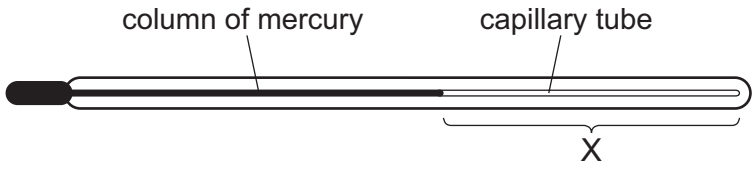
B Copper has a larger specific latent heat.

C Copper has a smaller specific heat capacity.

D Copper has a smaller specific latent heat.

The object cools faster and become hot faster if its specific heat capacity is low

21 The diagram shows a thermometer.



What is in region X of the capillary tube?

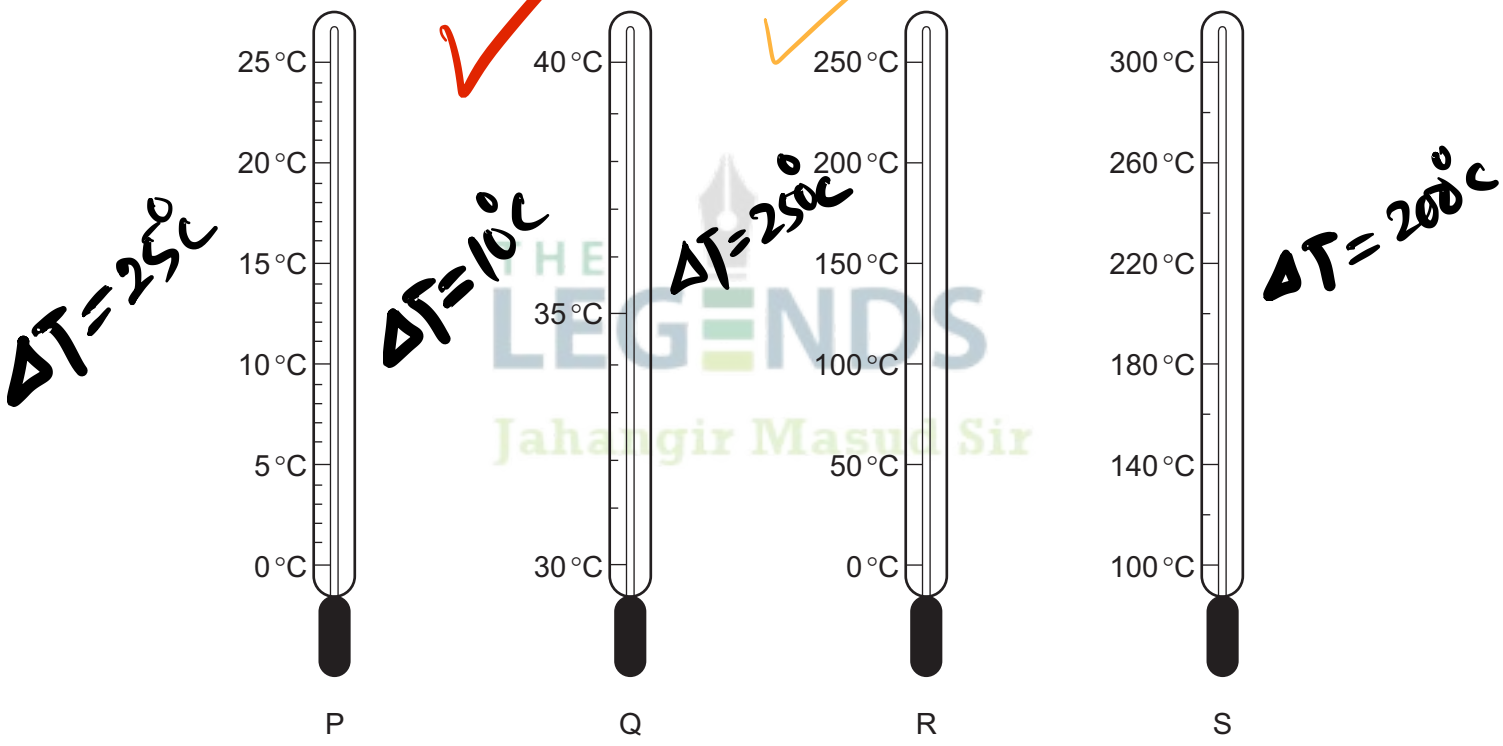
A a vacuum

B alcohol

C steam

D water

22 The diagrams represent four thermometers.



Which thermometer has the greatest sensitivity and which thermometer has the greatest range?

	greatest sensitivity	greatest range
A	P	R
B	P	S
C	Q	R
D	Q	S

23 The resistance R of a wire increases uniformly with temperature. The values of R at the fixed points are shown in the table.

	0 °C	100 °C
R/Ω	100	250

What is the temperature when $R = 160\,\Omega$?

A 24 °C **B** 40 °C **C** 60 °C **D** 64 °C

24 Samples of four different materials at room temperature are heated from below and heat is transferred upwards.

In which material is all of the heat transferred by the vibration of molecules?

A air

B mercury

C rubber

D water

25 The diagrams show four identical cans with their outside surfaces either polished silver or painted dull black. Each can contains the same volume of water, initially at 80 °C.

After five minutes in a cool room, which can contains the coolest water?

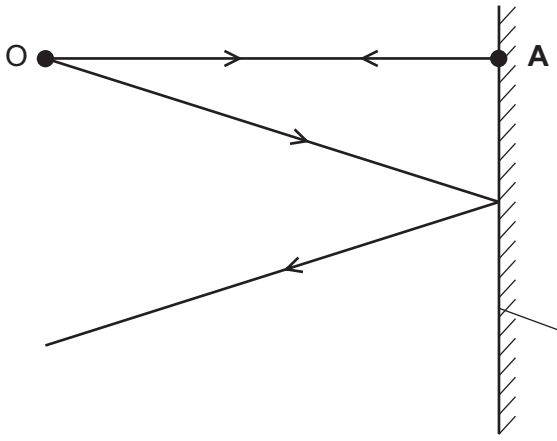
26 A communications system uses microwaves with a wavelength of 15 cm. The speed of light is 3.0×10^8 m/s.

What is the frequency of the microwaves?

A 2.0×10^7 Hz **B** 4.5×10^7 Hz **C** 2.0×10^9 Hz **D** 4.5×10^9 Hz

27 The diagram shows two divergent rays of light from an object O being reflected from a plane mirror.

At which position is the image formed?



- B
- C
- D

more bending
less bending
VIBGYOR

① Locate the image
② Draw reflected rays to eye.
③ Draw incident rays

28 Which statement about blue light is correct?

A Blue light has a smaller frequency than red light.

B Blue light has a longer wavelength than red light.

C Blue light has the same speed in glass as red light.

D Blue light is refracted more by a glass prism than red light.

29 Which device uses total internal reflection?

A magnifying glass

B optical fibre

C photographic enlarger

D projector

30 A television controller emits an infra-red beam.

Which statement about infra-red radiation is correct?

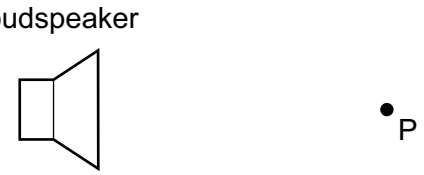
A It causes ionisation.

B It consists of longitudinal waves.

C It has a higher frequency than ultra-violet light.

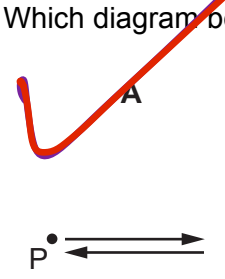
D It travels at the speed of light.

31 The diagram shows a loudspeaker that is producing a continuous sound wave of frequency 200 Hz in air.

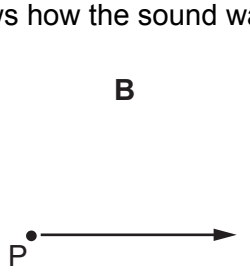


Which diagram best shows how the sound wave causes a molecule at P to move during $\frac{1}{200}$ s ?

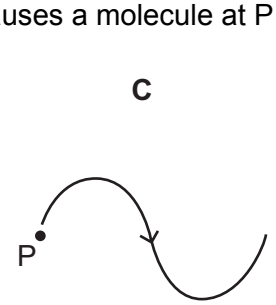
A



B



C



D

32 Which frequency is in the range heard by a healthy human ear?

A 12 mHz **B** 12 Hz **C** 12 kHz **D** 12 MHz

33 What is one of the uses of ultrasound?

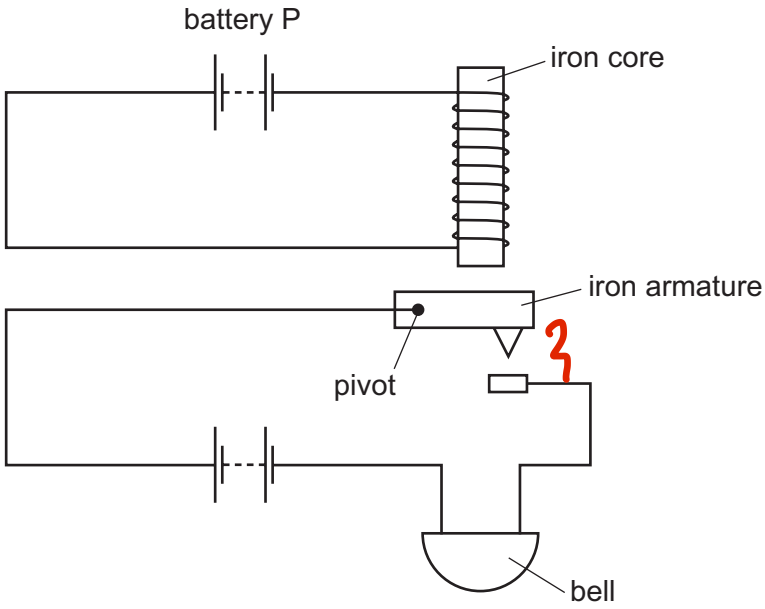
A cleaning jewellery

B satellite communication

C fluorescent tubes

D optical fibres

34 The diagram shows an alarm system.



What happens when battery P is disconnected?

	iron armature	bell
A	falls	rings
B	falls	stops ringing
C	moves up	rings
D	moves up	stops ringing

35 V is a potential difference, I is a current, R is a resistance, and t is a time.

Which expression has units of energy?

A It **B** I^2R **C** VIt **D** $\frac{V^2}{R}$

36 A step-down transformer has a primary coil and a secondary coil wound on a soft-iron core.

The primary coil is connected to a 6.0 V direct current (d.c.) supply.

Which statement about the transformer is correct?

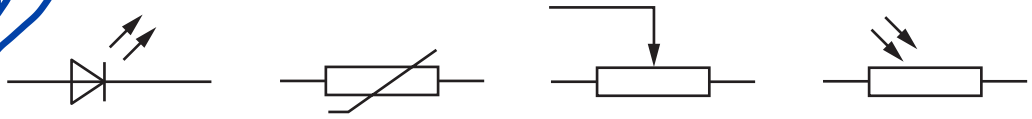
A The output voltage is equal to 6.0 V.

B The output voltage is greater than 6.0 V.

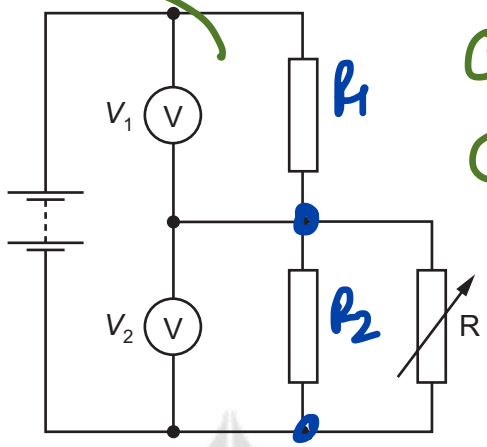
C The output voltage is less than 6.0 V but more than zero.

D There is no output voltage.

37 Which symbol is used for a light-dependent resistor?



38 The circuit diagram shows a variable resistor R connected in parallel to the lower half of a potential divider.

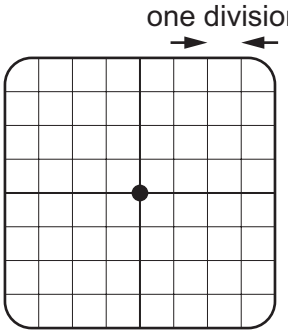


The resistance of R increases.

What happens to the two voltmeter readings?

	V_1	V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

39 An oscilloscope is used to measure potential difference (p.d.). The trace with no input connected is shown.

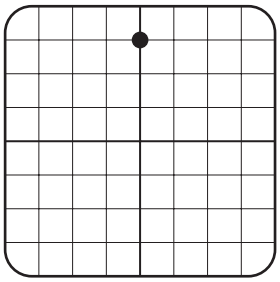


A 1.5 V d.c. supply is connected to the oscilloscope.

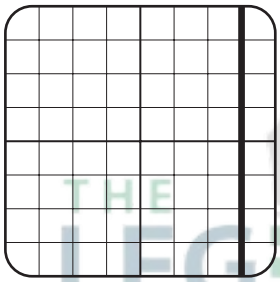
The Y-gain is set at 0.5 V / div. The time-base is set at 0.5 ms / div.

Which trace shows a supply of 1.5 V d.c.?

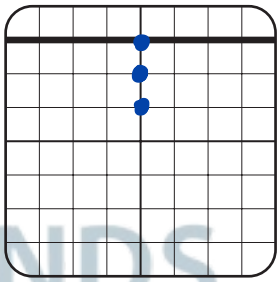
A



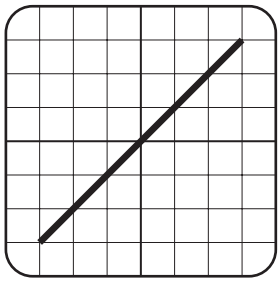
B



C



D



40 How many nucleons are in one neutral atom of the krypton isotope $^{84}_{36}Kr$?

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

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Cambridge
O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6032081406

PHYSICS **5054/22**

Paper 2 Theory **May/June 2018**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

CAMBRIDGE International Examinations

Section A

Answer **all** the questions in this section. Answer in the spaces provided.

1 A student drops a small metal object into a cylinder of oil. The object falls alongside a vertical ruler and a camera records its position at 1.0 s intervals, as shown in Fig. 1.1.

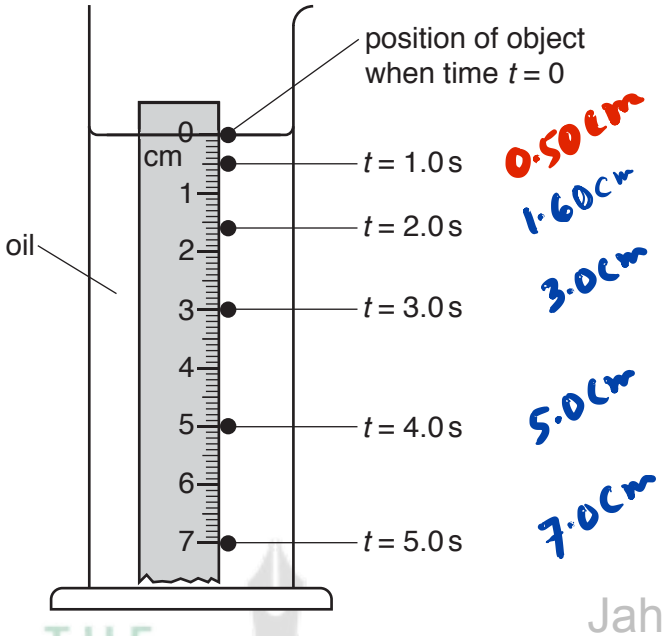

Fig. 1.1

(a) On the grid in Fig. 1.2, plot a distance-time graph for the object.

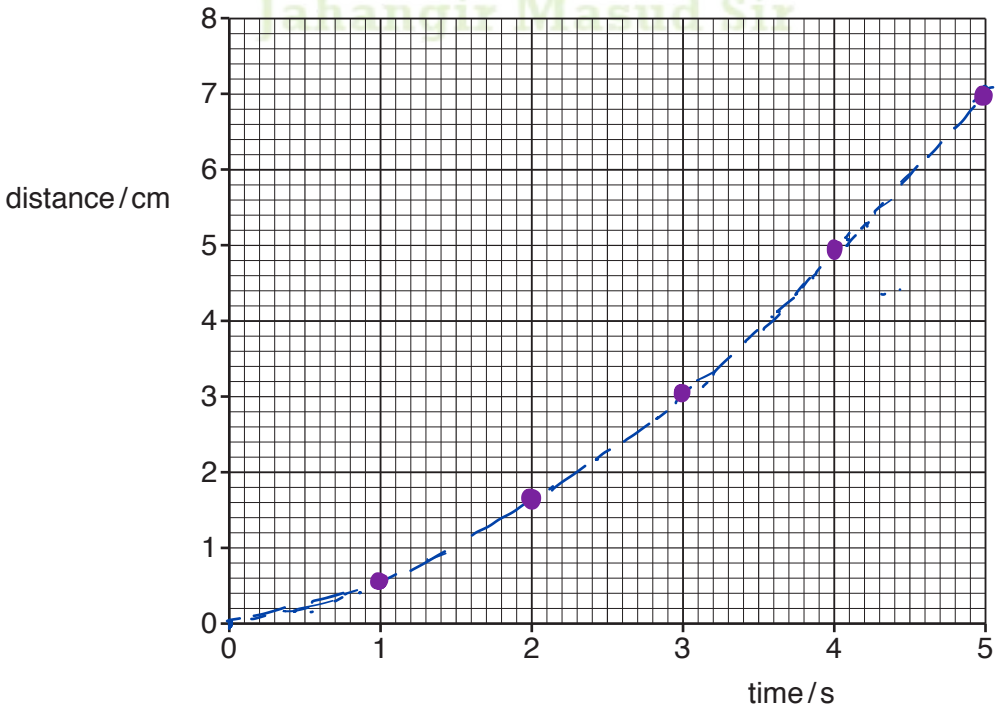

Fig. 1.2

[2]

(b) The object has a constant speed for some of the time.

(i) State and explain how a distance-time graph shows that speed is constant.

Gradient of distance–time graph is speed as it is a straight line so gradient is constant and speed is constant.

.....[2]

(ii) Explain, in terms of the forces acting on the object, how it is able to fall at a constant speed.

weight and upward force by oil is equal therefore the forces are balanced and resultant force is zero. The object gains constant speed.

.....[2]

2 In an experiment, a student takes measurements and determines the extension of a spring for different loads. The apparatus is shown in Fig. 2.1.

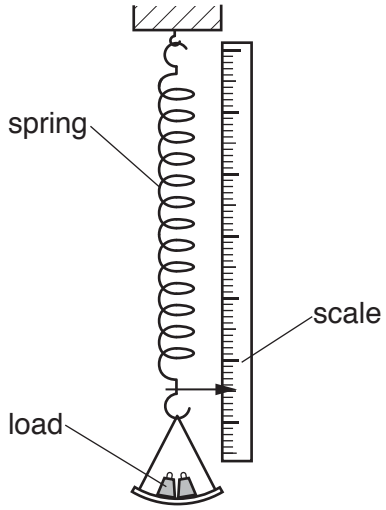

Fig. 2.1

The table in Fig. 2.2 shows the results.

load / N	0	1.0	2.0	3.0	4.0	5.0
length of spring / mm	200	235	270	305	350	420
extension / mm	0	35	70	105	150	220

Fig. 2.2

(a) Only some of the extensions are shown in the table.

Complete the table to show all of the extensions. [1]

(b) Calculate the load that produces an extension of 49 mm.

$F = kx$

$\therefore 2.0 = k \times 70$

$\therefore k = \frac{2.0}{70}$

$= \frac{1}{35}$

$F = kx$

$\therefore F = \frac{1}{35} \times 49$

$= 1.4\,N$

load = 1.4N [2]

(c) The student pulls a load downwards from position A to position B and holds it fixed at position B, as shown in Fig. 2.3.

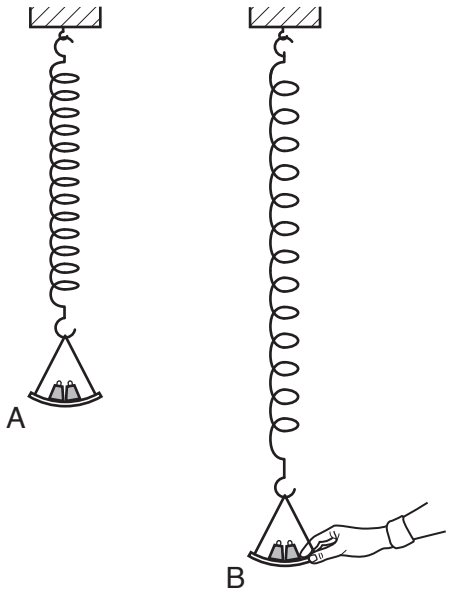

Fig. 2.3

The load is stationary at A and at B. The load has no kinetic energy at either point.

(i) Place ticks (✓) in the boxes to show how the value of each of the forms of energy compares at A and B.

	equal at A and B	larger at A	larger at B
energy stored in spring	☐	☐	✓
gravitational potential energy of load	☐	✓	☐

[1]

(ii) Work is done by the student to pull the load down. The law of conservation of energy states that energy cannot be created and cannot be destroyed.

Explain how this principle applies in this case.

student loses chemical energy that increases elastic potential energy of spring.

.....

.....

.....

.....[2]

3 Equal volumes of metal, water and air are heated from 20 °C to 80 °C.

(a) State whether the metal, the water or the air expands the most.

the air.

.....[1]

(b) Fig. 3.1 is a diagram of the metal at 20 °C. The metal is a large, square sheet with a square hole at its centre. The sheet lies flat on a table.

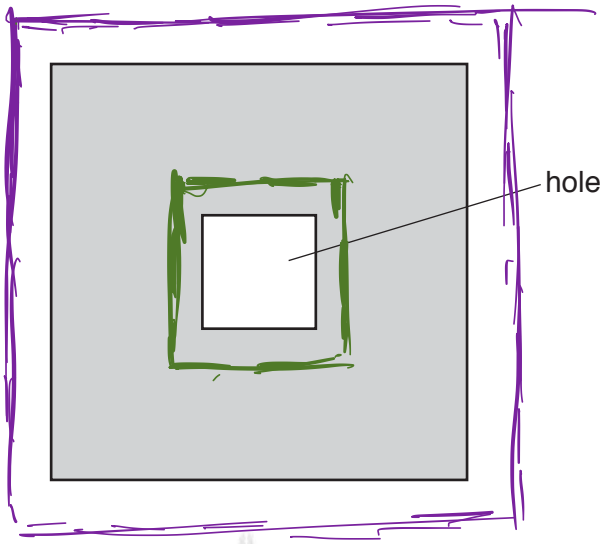

Fig. 3.1

On Fig. 3.1, draw the outline of the sheet and of the hole after the metal is heated. Make sure that the expansion is noticeable. [2]

(c) The metal has a mass of 5.0 kg and a density of 7.5×10^3 kg/m^3.

(i) Define *density*.

Density is defined as mass per unit volume.

.....[1]

(ii) Calculate the volume of the metal.

Give your answer to a suitable number of significant figures.

$\rho = \frac{m}{V}$ or, $V = \frac{m}{\rho} = \frac{5.0}{7.5 \times 10^3}$

$= 6.7 \times 10^{-4}\ m^3$

volume = ... [2]

4 One form of latent heat is the thermal energy needed to melt a solid.

(a) Define *specific latent heat*.

The amount of heat in required to change the state of 1 kg mass without change in temperature is specific latent heat [2]

(b) Fig. 4.1 shows one method of measuring the thermal energy needed to melt ice. The ice is contained in a glass funnel and covered with an insulator.

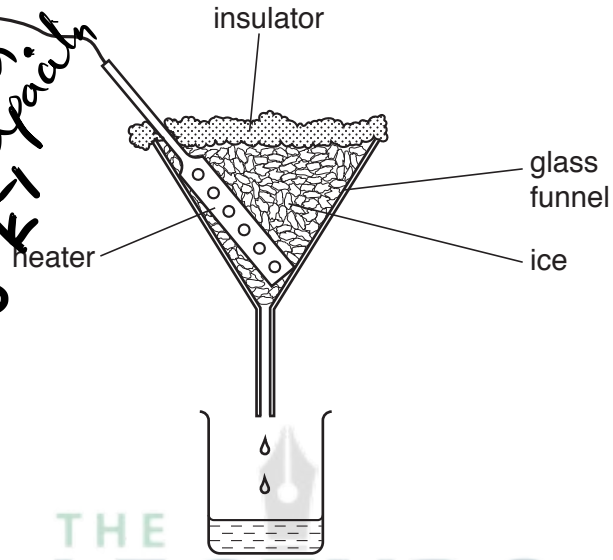

Fig. 4.1

(i) The heater is switched on and the ice melts.

The specific latent heat of fusion of ice is 3.3×10^5 J/kg.

Calculate the energy needed to melt 5.0 g of ice.

$Q = ml$
$= 5.0 \times 10^{-3} \times 3.3 \times 10^5$
$= 1650$ J

energy = ... [2]

(ii) Before the heater is switched on, thermal energy from the room causes some of the ice to melt.

Describe the process by which the ice gains thermal energy from the air.

Glass is a conductor so heat may conduct to ice through glass funnel. [1]

5 A microwave signal from a transmitter on the Earth's surface is sent up to a satellite in orbit and is then immediately transmitted back to Earth.

(a) A pulse of microwaves from the transmitter is received back at the transmitter 0.24 s later.

The speed of microwaves is 3.0×10^8 m/s.

Calculate the distance from the transmitter on the Earth to the satellite.

distance = ... [2]

(b) The microwave signal is used in a telephone system that produces sound.

Waves are described as longitudinal or transverse. Some waves are also electromagnetic.

(i) Place ticks (✓) in the table in Fig. 5.1 to show whether microwaves and sound waves are longitudinal or transverse and to show whether they are electromagnetic.

	longitudinal	transverse	electromagnetic
microwaves			
sound			

[2]

Fig. 5.1

(ii) A longitudinal wave contains a compression.

Describe what is meant by a *compression*.

.....

.....

.....[1]

6 A converging lens has a focal length of 3.0 cm. An object of height 2.0 cm is placed 5.0 cm from the centre of the lens. Fig. 6.1 shows the arrangement of the object and the lens.

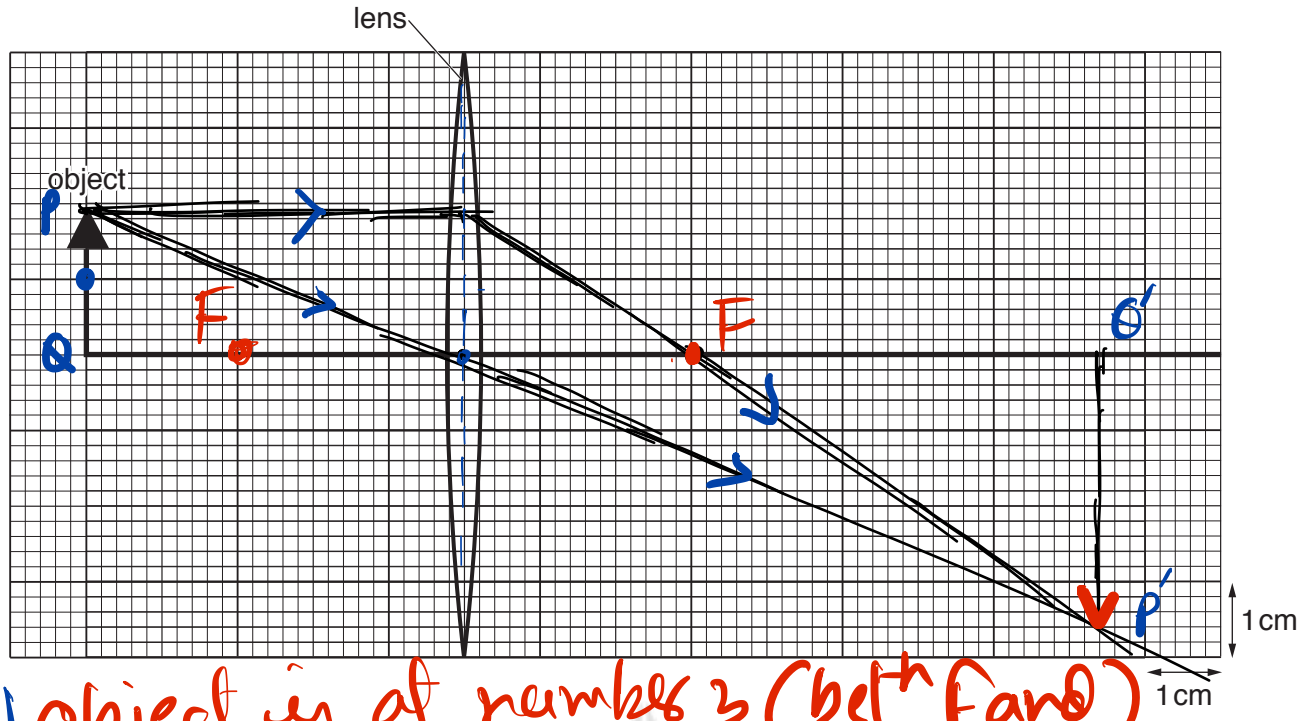

Fig. 6.1 (to scale)

object in at number 3 (bet^n F and 2F)
Image will be at no. 5 (beyond 2F)

(a) On Fig. 6.1, draw rays from the top of the object to show how the lens forms an image of the object. Mark the image clearly. [2]

(b) The image is magnified. State **one** other feature of the image.

Real and inverted.

.....[1]

(c) Calculate the linear magnification produced by the lens in this case.

linear magnification = Image distance / object distance

magnification = (1.3 − 1.7) [2]

(d) State the name of **one** optical device that produces a magnified image as shown by Fig. 6.1.

Projector.

.....[1]

7 A computer hard disk contains a layer of a magnetic material.

(a) Describe how a magnet is used to find out if a sample of material is magnetic or non-magnetic.

magnetic materials are always attracted by magnet.

.....[1]

(b) Data is stored on the disk as a series of N-poles and S-poles.

Fig. 7.1 shows part of the hard disk. The thin layer of magnetic material contains small regions. Each region has an N-pole and an S-pole. Some magnetic field lines are shown on Fig. 7.1.

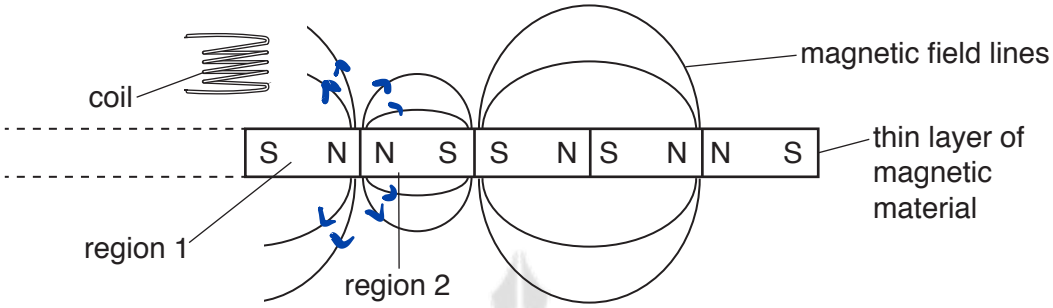

Fig. 7.1 (not to scale)

(i) Region 2 causes a magnetic force on region 1.

State the direction of the magnetic force on region 1 and explain why it acts.

Away from region-2 because like poles repel

.....[2]

(ii) On Fig. 7.1, draw arrows on the field lines to show the direction of the magnetic field near the boundary between region 1 and region 2. [1]

(iii) The coil shown in Fig. 7.1 is fixed in position. The layer of magnetic material passes quickly under the coil.

A voltage is induced in the coil as some of the boundaries between the regions pass under the coil.

1. Explain why a voltage is induced in the coil.

Coil cuts magnetic field lines
Magnetic flux changes

.....[1]

2. Suggest why the coil must be close to the layer.

Magnetic field lines will be closme to the coil. there will be a good magnetic flux linkage.

.....[1]

8 A fuse is one form of protection in an electrical circuit.

(a) State **two other** forms of protection that are included in household electrical circuits.

These may protect the consumer, the circuit or an electrical appliance.

1. .....

2. .....

[2]

(b) Fig. 8.1 shows a fusebox connected to part of a lighting circuit in a house.

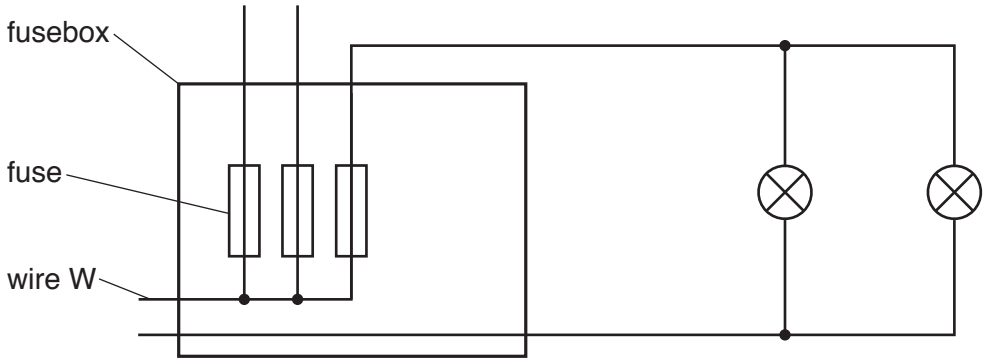

Fig. 8.1

(i) State how Fig. 8.1 shows that wire W is the live wire.

.....

.....[1]

(ii) On Fig. 8.1, mark with a letter s, the correct position for a switch that controls both lamps. [1]

(iii) The rating of the fuse in the lighting circuit is 5A.

Explain what this means.

.....

.....

.....[1]

Section B

Answer **two** questions from this section. Answer in the spaces provided.

9 Wind energy is a renewable energy source. A wind turbine and generator convert energy in the wind to electrical energy in a generator. Fig. 9.1 shows some wind turbines.

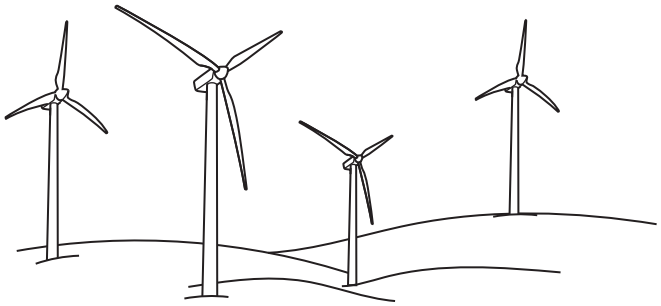

Fig. 9.1

(a) (i) State what is meant by a *renewable energy source*.

.....

.....

.....[1]

(ii) State the name of **one other** renewable energy source.

.....

.....[1]

(iii) Some methods of generating electricity cause much more global warming than wind energy.

1. State **one** method of generating electricity that causes a large amount of global warming.

.....[1]

2. Describe, in outline, how the method you have chosen causes a significant amount of global warming.

.....

.....

.....[1]

(b) During a 30 minute period, a mass of 4.2×10^7 kg of air enters the turbine with a speed of 15 m/s.

(i) Calculate the kinetic energy of the air that enters the turbine in 30 minutes.

energy = ...[2]

(ii) The electrical power output of the generator connected to the turbine is 8.4×10^5 W.

Calculate the electrical energy output from the turbine in 30 minutes.

energy output = ...[2]

(iii) Calculate the efficiency of the turbine and generator in converting the kinetic energy of the air to electrical energy.

efficiency = ...[2]

(c) The generator contains a coil that rotates between the poles of a magnet.

The coil rotates 50 times in one second and produces an alternating voltage output with a maximum value of 500 V.

(i) On the grid in Fig. 9.2, sketch a voltage–time graph showing the output voltage.

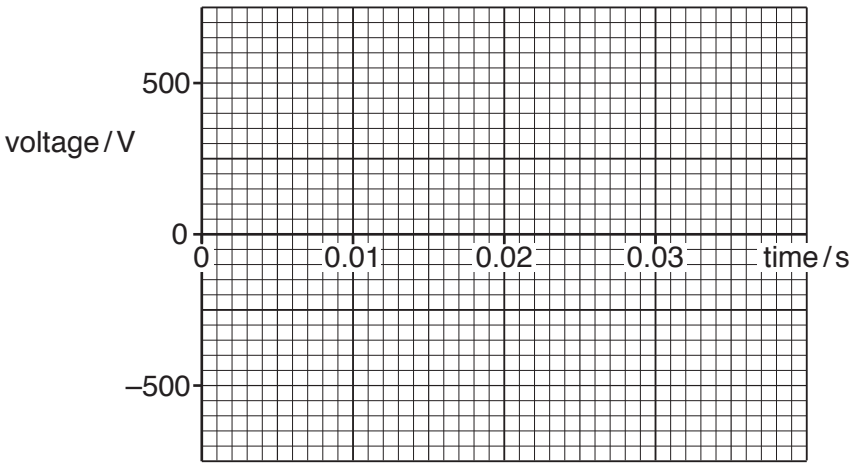

Fig. 9.2

[2]

(ii) The output voltage from the generator is stepped up by a transformer. The electrical energy then passes along a transmission line to a distant house.

Explain why

1. a high voltage is used for the transmission of electrical energy,

.....

.....

.....

.....[2]

2. a transformer is used to connect the transmission line to the house.

.....

.....

.....[1]

10 A student connects a battery to two resistors. The circuit diagram is shown in Fig. 10.1.

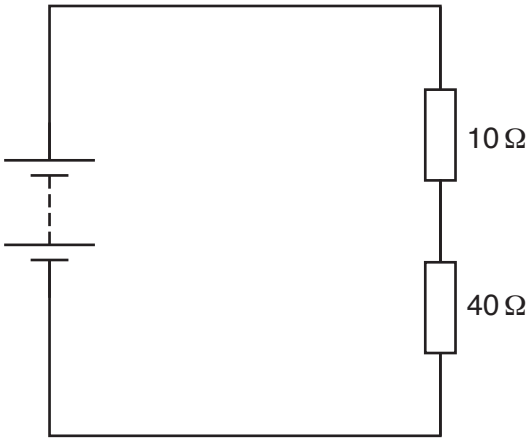

Fig. 10.1

The potential difference (p.d.) across the 40 Ω resistor is 9.6 V.

(a) State what is meant by the *potential difference* across a resistor.

.....

.....[2]

(b) **(i)** Calculate the current in the 40 Ω resistor.

current = ...[2]

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

e.m.f. = ...[2]

(c) The student has three different voltmeters to measure the p.d. across the 40 Ω resistor. These are labelled 0–2 V, 0–20 V and 0–200 V. Each has a pointer that shows the p.d. on a scale.

State and explain which of the three voltmeters is best to measure this p.d.

.....

.....

.....

.....[2]

(d) (i) Calculate the power P produced in the 10 Ω resistor.

P = ...[2]

(ii) The student has available two 10 Ω resistors, with power ratings of $\frac{1}{2}P$ and $2P$.

Suggest why a resistor with a power rating of $\frac{1}{2}P$ is not suitable for the circuit in Fig. 10.1.

.....

.....[1]

(e) The student adds a resistor R to the circuit, to make the circuit shown in Fig. 10.2.

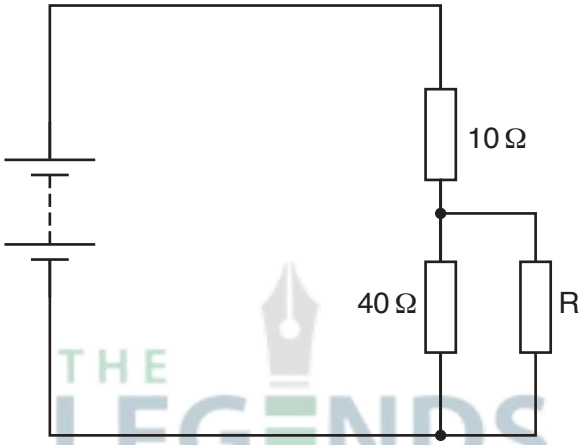

Fig. 10.2

Complete the table in Fig. 10.3 to show what happens as resistor R is connected.

You should state whether each quantity increases, decreases or stays the same and give a brief explanation of why any change occurs. Calculations are not required.

quantity	increases, decreases or stays the same as resistor R is added	brief explanation of why the change occurs
current in 10 Ω resistor	increases	
p.d. across 10 Ω resistor		
p.d. across 40 Ω resistor		

[4]

Fig. 10.3

11 A smoke detector contains a small radioactive source of americium-241. The source emits alpha-particles.

(a) **(i)** In the space below, draw a diagram of an apparatus that can be used to show that the source emits alpha-particles.

[2]

(ii) Describe how this apparatus is used.

.....

.....

.....

.....[2]

(iii) Explain how the results of the test show that the source emits alpha-particles.

.....

.....

.....

.....[2]

(b) The smoke detector works because alpha-particles from the source ionise the air.

Compare the relative ionising effects and penetrating powers of alpha-particles, beta-particles and gamma rays.

ionising effects .....

.....

penetration effects .....

.....
[2]

(c) Americium-241 has a half-life of 430 years.

(i) Radium-224 is another element that emits alpha-particles. It has a half-life of 3.6 days.

Explain why americium-241 is more suitable as the radioactive source in a smoke detector than radium-224.

.....

.....

.....[1]

(ii) A smoke detector contains 8.0×10^{11} atoms of americium-241.

Calculate the time taken for the number of atoms of americium-241 to fall to 1.0×10^{11}.

time = ...[3]

(d) When used correctly, the radioactive source in the smoke detector is less harmful than background radiation.

(i) State one harmful effect of background radiation.

.....[1]

(ii) A radioactive source is picked up using a long-handled tool. Explain why this is safer than using a short-handled tool.

.....

.....

.....

.....[2]

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Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

PHYSICS **5054/12**

Paper 1 Multiple Choice **October/November 2018**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and candidate number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
Electronic calculators may be used.

This document consists of **15** printed pages and **1** blank page.

CAMBRIDGE International Examinations

1 An apple falls from a tree.

Which row describes the forces acting on the apple and the motion of the apple as it falls?

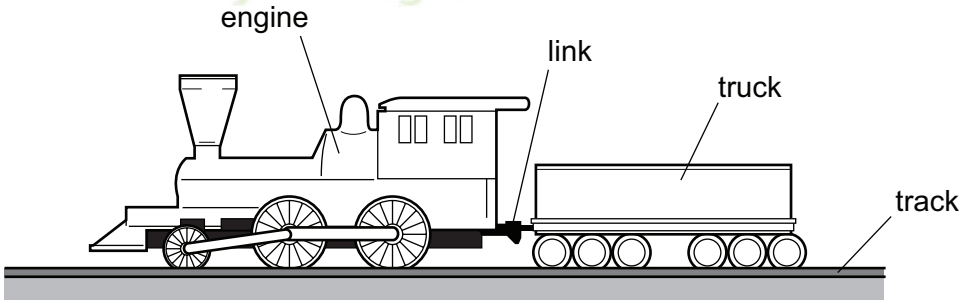
	forces acting on the apple	motion of the apple
A	balanced	acceleration
B	balanced	constant speed
C	unbalanced	acceleration
D	unbalanced	constant speed

2 The table shows how the speeds of four bodies, **A**, **B**, **C** and **D**, change with time.

Which body has an acceleration that is **not** constant?

time / s	speed of **A** / m/s	speed of **B** / m/s	speed of **C** / m/s	speed of **D** / m/s
0	0	0	0	5.5
1	1.0	2.0	3.0	6.5
2	3.0	4.0	6.0	7.5
3	6.0	6.0	9.0	8.5

3 An engine pulls a truck at constant speed on a level track.



The link between the engine and the truck breaks. The driving force on the engine remains constant.

What effect does this have on the engine and on the truck?

	engine	truck
A	speed stays constant	slows down
B	speeds up	slows down
C	speed stays constant	stops immediately
D	speeds up	stops immediately

4 On which car is there a resultant force?

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 uphill at constant velocity

D a car that is stationary

5 Which piece of apparatus may be used to compare the masses of two objects?

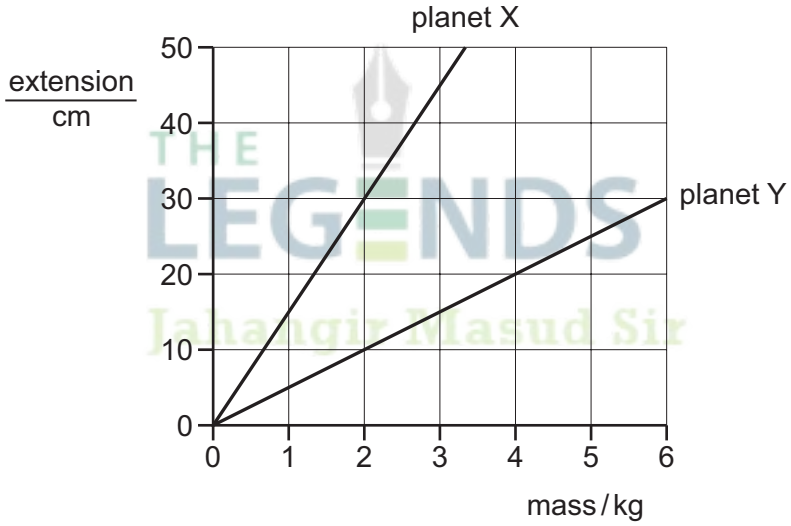
A balance

B manometer

C measuring cylinder

D micrometer

6 The graph shows how the extension of a spring changes with the masses suspended from it when the spring is on planet X and when the spring is on planet Y.



Which conclusion can be drawn from these graphs?

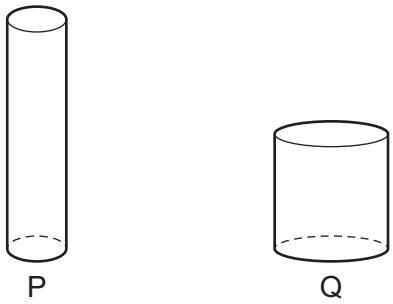
A It is not possible to compare the gravitational field strengths on planets X and Y.

B The gravitational field strength on planet X is equal to the gravitational field strength on planet Y.

C The gravitational field strength on planet X is one third of the gravitational field strength on planet Y.

D The gravitational field strength on planet X is three times the gravitational field strength on planet Y.

7 Two cylinders P and Q are made of copper.



The height of P is twice the height of Q. The diameter of P is half the diameter of Q.

Which statement is correct?

A The density of cylinder P is four times that of cylinder Q.

B The density of cylinder P is twice that of cylinder Q.

C The density of cylinder P is equal to that of cylinder Q.

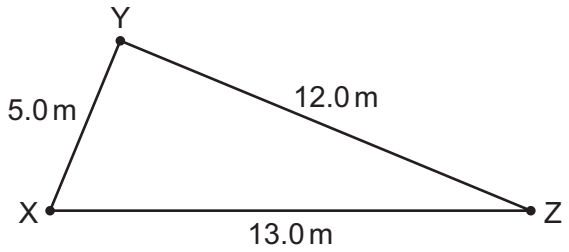
D The density of cylinder P is half that of cylinder Q.

8 A tennis ball is compressed. Work is done and energy is transferred to the molecules of air inside the ball, and also to the rubber from which the ball is made.

Which row is correct?

	kinetic energy of air molecules inside the ball	temperature of ball
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

9 Paths are laid as shown between points X, Y and Z.



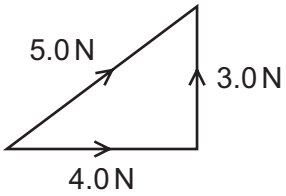
A person walks along the paths from X to Y to Z and then back to X.

What is the value of the total displacement and of the total distance travelled?

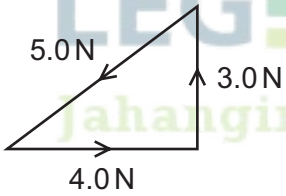
	total displacement / m	total distance travelled / m
A	0	0
B	0	30
C	30	0
D	30	30

10 Which diagram shows the addition of the 4.0 N and the 3.0 N forces?

A



B



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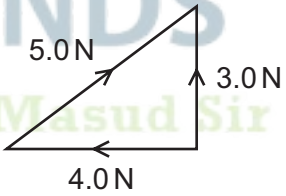
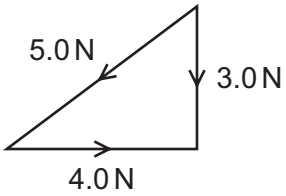
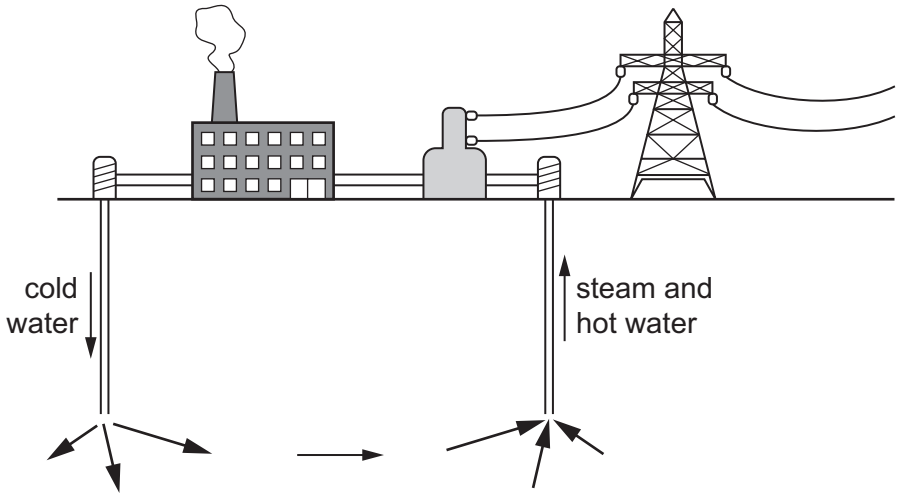


D



11 The diagram represents a geothermal power station.



Which useful energy transformation is taking place?

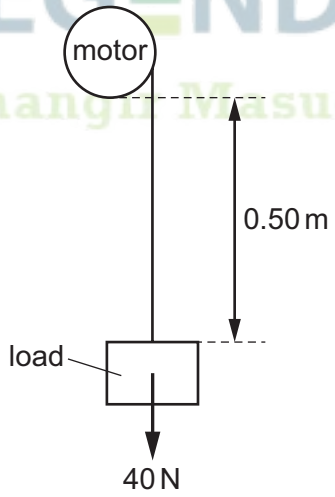
A electrical energy → potential energy

B electrical energy → thermal energy

C potential energy → electrical energy

D thermal energy → electrical energy

12 A motor is used to lift a load 0.50 m vertically, as shown.



The load weighs 40 N. The power of the motor is 20 W and the system is 25% efficient.

How long does it take to raise the load?

A 0.040 s **B** 0.25 s **C** 4.0 s **D** 40 s

13 Different liquids are poured into four different containers.

In which container does the liquid produce the greatest pressure at the bottom of the container?

	area of base / cm^2	density of liquid / g/cm^3	depth of liquid / cm
A	10	1.3	50
B	20	0.80	80
C	40	1.0	60
D	50	0.92	75

14 A rectangular block of metal has weight 6.0 N and measures 3.0 cm × 4.0 cm × 5.0 cm.

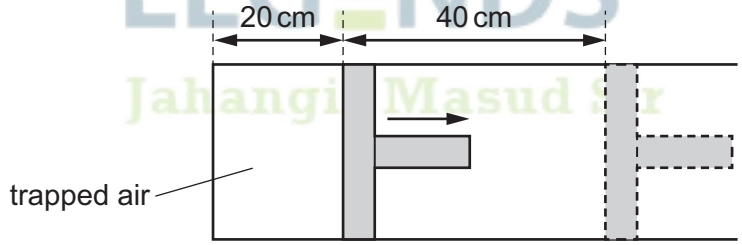
What is the smallest pressure that it can exert when resting on a horizontal surface?

A 0.10 N/cm^2 **B** 0.30 N/cm^2 **C** 0.40 N/cm^2 **D** 0.50 N/cm^2

15 Air is trapped in a cylinder by a piston. The pressure of the air is p and the length of the air column is 20 cm.

The piston is moved outwards until the length of the air column has increased by 40 cm.

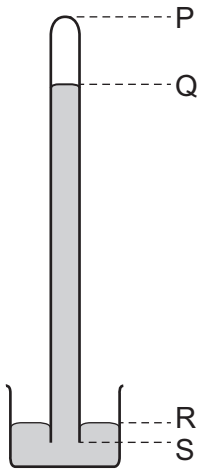
The temperature of the air remains constant.



What is the new air pressure?

A $\frac{p}{2}$ **B** $\frac{p}{3}$ **C** $2p$ **D** $3p$

16 A long tube, full of mercury, is inverted in a small dish of mercury.



The mercury level in the tube falls, leaving a vacuum at the top.

When the atmospheric pressure decreases, which length decreases?

A PQ **B** PS **C** QR **D** RS

17 A cold bottle containing a drink is placed on a table on a warm day. Drops of water form on the outside of the bottle.

Which process causes the drops to form?

A condensation

B conduction

C convection

D evaporation

18 Some gas is trapped in a closed container. The gas is cooled and the volume of the container is kept constant.

What happens to the gas molecules?

A They collide with the walls more often.

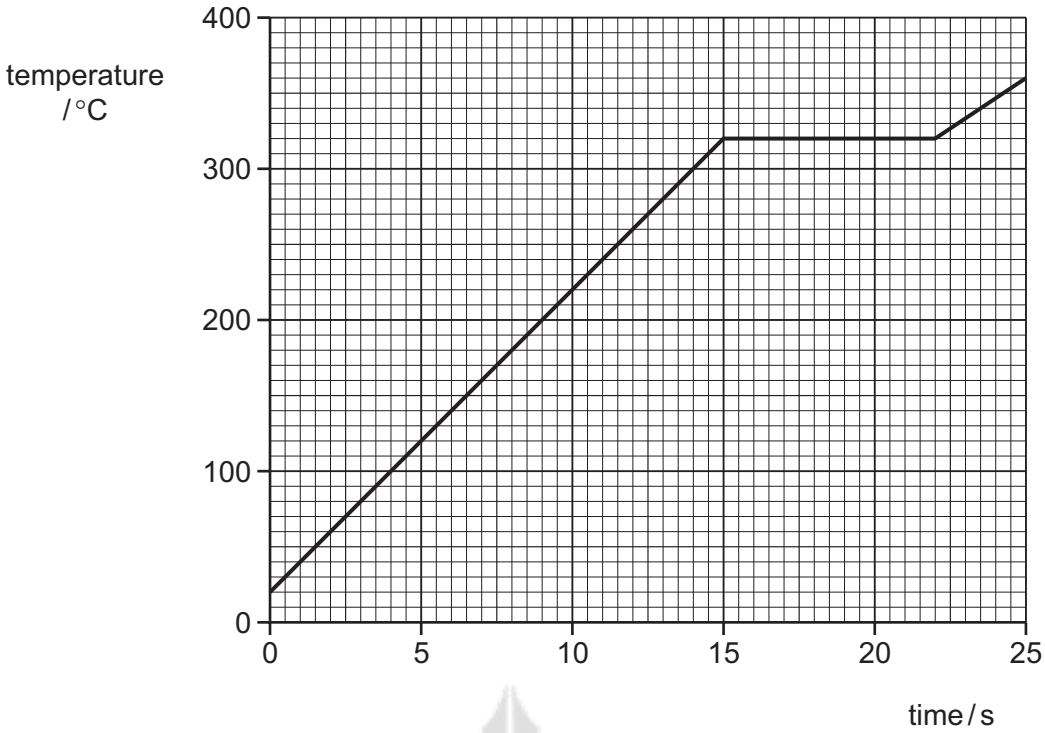
B They contract.

C They get closer together.

D They move more slowly.

19 A 100 g piece of solid lead at room temperature is heated. After 22 s, it has all become liquid.

The graph shows how its temperature varies with time.



The power of the heater is 320 W.

Which expression gives the specific latent heat, in J / kg, of the lead?

A $\frac{7.0 \times 320}{0.10 \times 300}$ **B** $\frac{22 \times 320}{0.10 \times 300}$ **C** $\frac{7.0 \times 320}{0.10}$ **D** $\frac{22 \times 320}{0.10}$

20 What increases when a liquid becomes a gas at its boiling point?

A the average kinetic energy of the molecules

B the molecular size

C the molecular spacing

D the total number of molecules

[Turn over

21 Two liquid-in-glass thermometers are almost identical. They contain the same quantity of the same liquid and the diameters of their capillary tubes are the same.

The only difference is that one thermometer is longer than the other.

Which row shows how the ranges and the sensitivities of the thermometers compare?

	ranges	sensitivities
A	different	different
B	different	same
C	same	different
D	same	same

22 Which statement about a water wave is correct?

A The amplitude is the vertical distance between a trough and a peak.

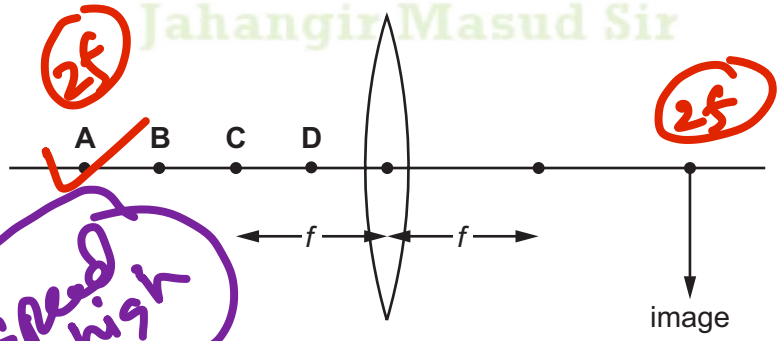
B The frequency is the number of troughs passing a point in one second added to the number of peaks passing a point in one second.

C The speed is the horizontal distance travelled per second by a peak.

D The wavelength is the horizontal distance between a trough and a peak.

23 The diagram shows a thin converging lens of focal length *f*.

Where must an object be placed to produce a real image in the position shown?



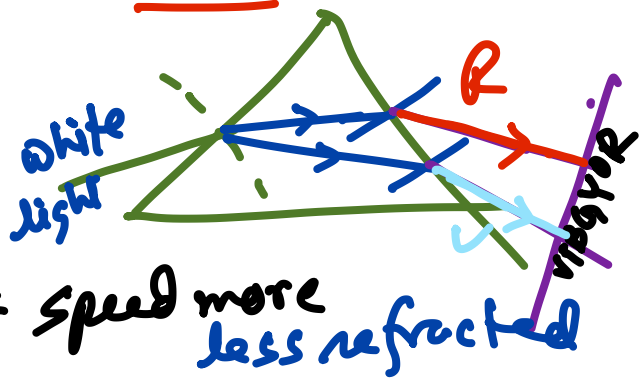
24 White light is dispersed by a prism. Compared with blue light, the **red** light is

A slowed down less and refracted less.

B slowed down less and refracted more.

C slowed down more and refracted less.

D slowed down more and refracted more.



25 A student reads the following in her physics book.

'The incident angle is greater than 42° which is the critical angle for glass in air.'

What is the student reading about?

A focal length of a glass lens

B reflection in a plane mirror

C refraction as light enters glass

D total internal reflection

26 Which statement about radio waves is correct?

A Radio waves are sound waves.

B Radio waves are used to kill cancerous cells.

C Radio waves are used in television communications.

D Radio waves have frequencies higher than those of visible light.

27 Ultrasound is used to map the ocean floor.

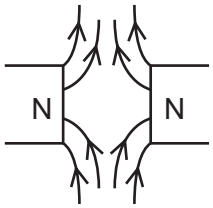
During one survey, the depth of water is 1200 m. An ultrasound pulse is sent from the surface and when it returns to the ship, another pulse is sent immediately. In any period of 8.0 s, five pulses are sent down from the surface.

What is the speed of the ultrasound in water?

A 150 m/s **B** 300 m/s **C** 750 m/s **D** 1500 m/s

28 Which diagram shows the magnetic field pattern in the region between the N-poles of the two bar magnets?

A



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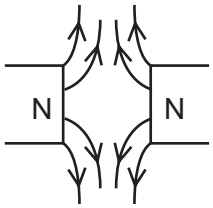

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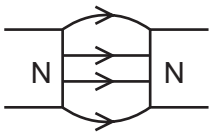

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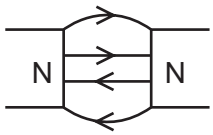


29 Students are asked to describe an experiment to measure the resistance of a metallic conductor.

Which description is correct?

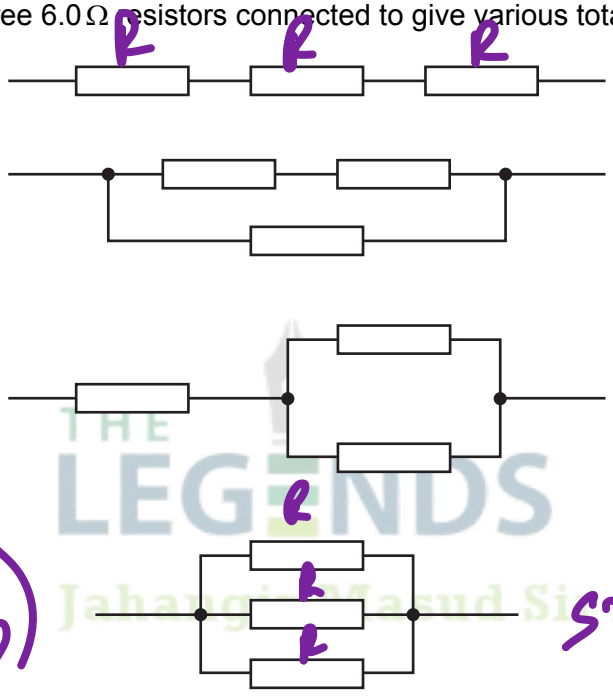
A Connect an ammeter in parallel and a voltmeter in series with the conductor then use $R = \frac{I}{V}$.

B Connect an ammeter in parallel and a voltmeter in series with the conductor then use $R = \frac{V}{I}$.

C Connect a voltmeter in parallel and an ammeter in series with the conductor then use $R = \frac{I}{V}$.

D Connect a voltmeter in parallel and an ammeter in series with the conductor then use $R = \frac{V}{I}$.

30 The diagram shows three 6.0 Ω resistors connected to give various total resistances.



What is the difference between the smallest total resistance and the largest total resistance?

A 7.0 Ω **B** 9.0 Ω **C** 12 Ω **D** 16 Ω

31 A wire of length 0.50 m and cross-sectional area 1.0×10^{-6} m^2 has a resistance of 0.75 Ω.

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

What is the resistance of the longer wire?

A 0.094 Ω **B** 0.38 Ω **C** 1.5 Ω **D** 6.0 Ω

32 A defibrillator is a device that is used to give an electric shock to a patient's heart.

It supplies an electric shock with energy 240 J at an average voltage of 2000 V for 10 ms.

What is the average current it supplies?

A 0.012 A **B** 1.2 A **C** 12 A **D** 120 A

$W = P \times t$
$W = V \times I \times t$
$\Rightarrow 240 = 2000 \times I \times 10 \times 10^{-3}$
$I = \frac{240 \times 10^{2}}{2000} = 12\,A$

33 In a lighting circuit, the switch is placed in the live wire.

Why is this?

A A lamp in the circuit can be isolated from the supply.

B The fuse is in the neutral wire.

C The switch does not work in the neutral wire.

D Too much current flows in the earth wire.

live wire is dangerous should be disconnected when not necessary to use.

34 Which cable transmits electrical energy at the highest voltage?

A a cable from a bicycle dynamo to a lamp

B a household lighting cable

C a power cable between towns

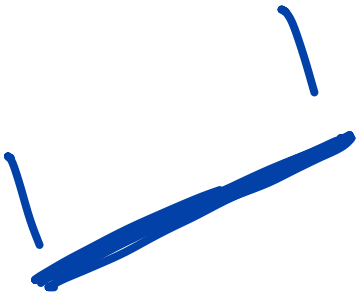
D an electric cooker cable

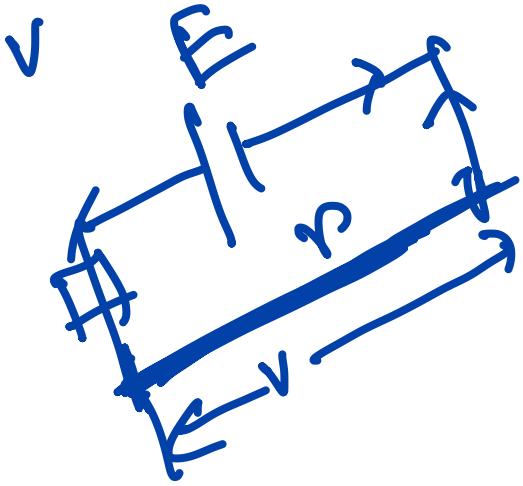
→ to minimize the power loss.

$P = I^2 R$
loss
(Power transmission)
$P = (\pm I)^2 R$

$P = VI$
high/low low/high

Current (I) as minimum as possible during transmission

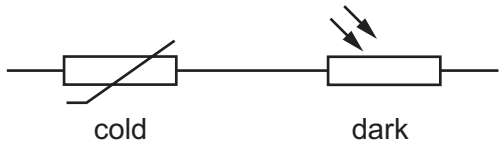


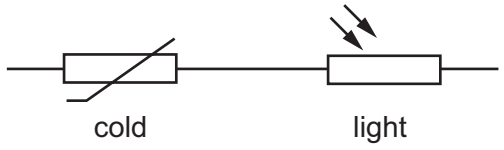


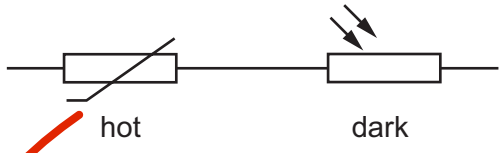
R low means thicker wire but it is very expensive

35 A thermistor and a light-dependent resistor are connected in series.

Which conditions give the least resistance?

A 

B 

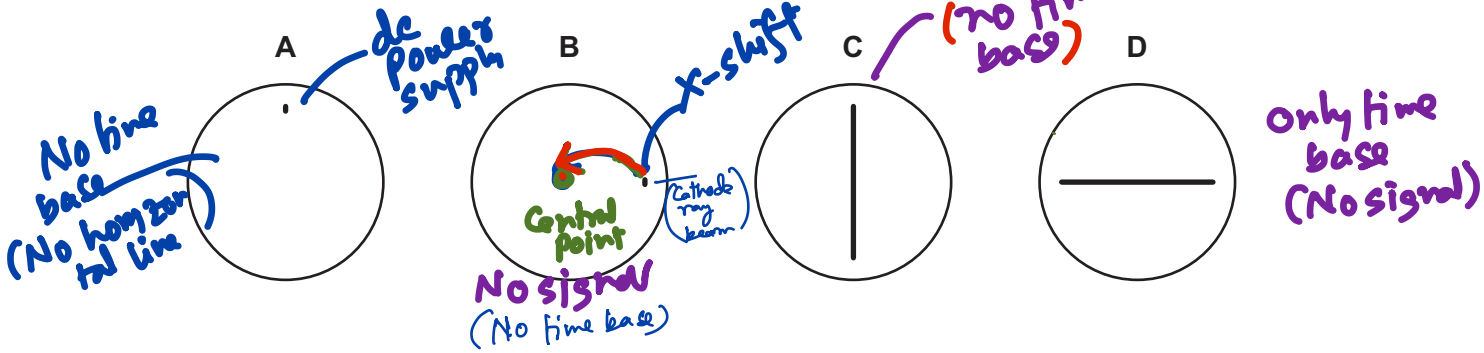
C 

D 

36 An oscilloscope is connected to a d.c. power supply.

The time-base on the oscilloscope is switched off.

What is seen on the screen of the oscilloscope?



37 What does the alpha-radiation given off by radioactive nuclei consist of?

A fast-moving protons

B helium nuclei

C microwaves

D radio waves

38 Which statement about the reactor in a nuclear power station is correct?

A In the reactor, the main reaction occurs when protons hit uranium nuclei.

B The process taking place in the reactor is called nuclear fusion.

C The reactor produces energy to boil water and to produce steam.

D Carbon dioxide is the major waste product from the reactor.

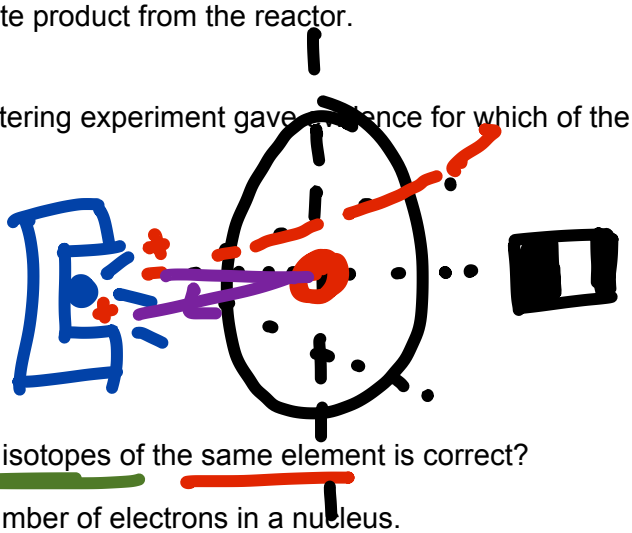
39 The results of the alpha-particle scattering experiment gave evidence for which of the following?

A nuclear fusion

B radioactive decay

C the existence of isotopes

D the nuclear atom



40 Which statement about two different isotopes of the same element is correct?

A Both isotopes have the same number of electrons in a nucleus.

B Both isotopes have the same number of protons in a nucleus.

C Both isotopes have the same number of neutrons in a nucleus.

D Both isotopes have the same number of nucleons in a nucleus.

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Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

PHYSICS **5054/22**

Paper 2 Theory **October/November 2018**

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer all questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer any two questions.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **17** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

[Turn over

Section A

Answer **all** the questions in this section. Answer in the spaces provided.

1 Fig. 1.1 shows a satellite travelling at a constant speed in a circular orbit around the Earth.

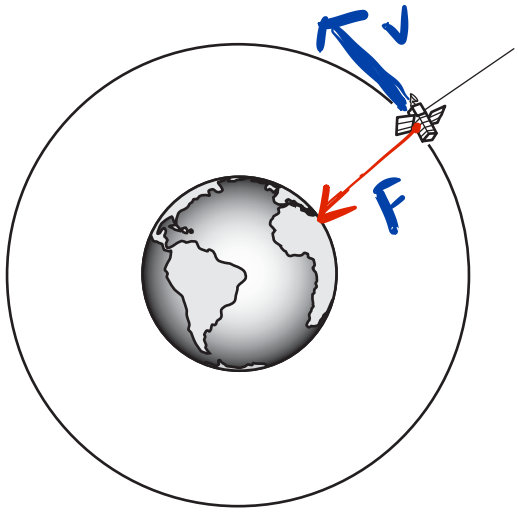

Fig. 1.1 (not to scale)

(a) State how *speed* differs from *velocity*.

speed is a scalar quantity and velocity is a vector quantity means it has particular direction.

[1]

(b) As it orbits the Earth, the satellite is experiencing an acceleration.

(i) Explain, in terms of its velocity, why the satellite is accelerating.

the direction of motion changes so that its velocity changes with time.

[2]

(ii) On Fig. 1.1, draw an arrow, starting on the satellite, to show the direction of the satellite's acceleration. [1]

(c) As the satellite orbits the Earth, it experiences a force due to gravitational attraction.

State and explain whether this force does work on the satellite and state whether the energy of the satellite is affected.

No work is done because no movement of satellite along the direction of force. The height and speed of satellite remains same it means their total energy remains same.

[2]

2 A sports car is designed to be very stable when turning a corner at high speed.

Fig. 2.1 shows the position of the centre of mass of the car.

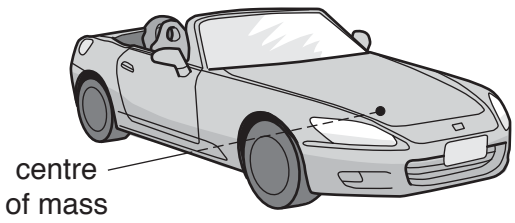

Fig. 2.1

(a) State what is meant by *centre of mass*.

.....

..... [1]

(b) State two features of the design that make the car in Fig. 2.1 stable.

1. .....

2. .....
[2]

(c) Fig. 2.2 shows an irregularly shaped piece of card.

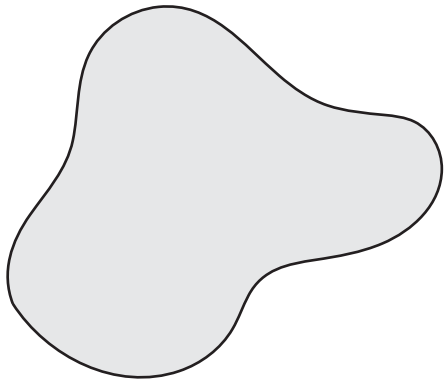

Fig. 2.2

Describe how to determine the position of the centre of mass of the piece of card.

You may draw on Fig. 2.2 or in the blank space.

.....

.....

.....

.....

.....

.....

.....

..... [3]

3 Fig. 3.1 shows a cylindrical copper kettle that contains cold water.

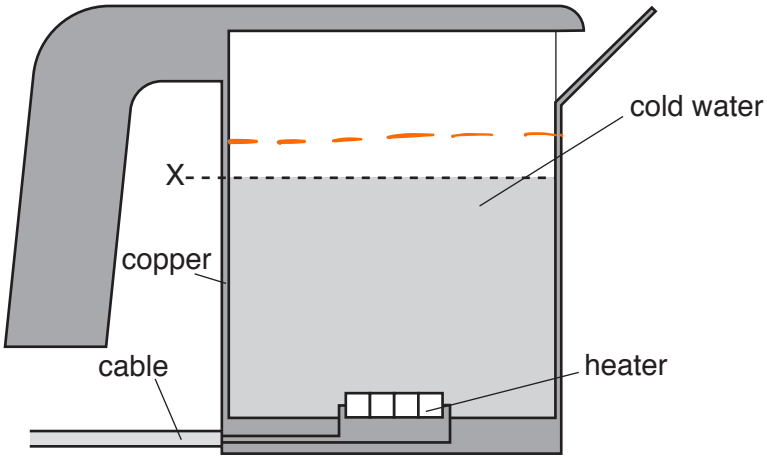

Fig. 3.1

The kettle is used to heat water and there is an electric heater at the base.

(a) State and explain the advantage of heating the water from below.

Heated water rises and cold water sinks by this way convection current can be set up and water mixed up properly.

[2]

(b) As the water is heated, it expands.

(i) Explain, in terms of molecules, why water expands when it is heated.

Molecules move with more kinetic energy, they push each other apart so the distance between molecules increase

[2]

(ii) Copper also expands when heated.

State what happens to level X of the water in the kettle. Explain your answer in terms of the expansion of the copper and the water.

The level will be rised. liquid expands more than solid.

[1]

4 A house has several solar panels on the roof.

These panels use energy from the Sun both to generate electricity and to raise the temperature of water that passes through tubes inside the panels.

(a) The panels on the roof of the house have a black surface.

(i) State how energy from the Sun travels through space before it reaches the Earth.

.....

..... [1]

(ii) Explain the advantage of using panels that have a black surface.

.....

.....

.....

..... [2]

(b) On one occasion, the panels are supplying an electric current of 15 A at a voltage of 24 V.

(i) Calculate the electrical energy generated by the panels in one hour.

electrical energy = ... [2]

(ii) In the same time, 51 kg of cold water is pumped through the panels. The temperature of the water increases from 16 °C to 45 °C.

The specific heat capacity of water is 4200 J/(kg °C).

Calculate the increase in thermal energy of the water.

thermal energy increase = ... [3]

5 Two uncharged conducting spheres, K and L, are mounted on insulating stands.

(a) State how the structure of an insulator differs from that of a conductor and give one example of an insulator.

.....

.....

..... [2]

(b) The two spheres are in contact.

Fig. 5.1 shows a positively-charged insulating rod held next to K.

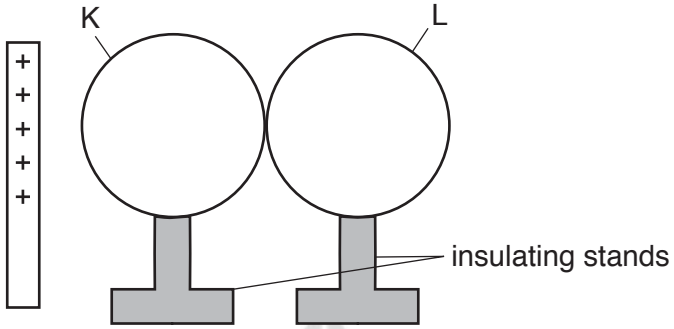

Fig. 5.1

(i) On Fig. 5.1, draw the charges on K and on L. [2]

(ii) Sphere L is moved to the right, a long way from sphere K.

1. The positively charged rod is moved away.

State what happens to the charge on K.

.....

..... [1]

2. An earthing wire is connected to sphere L.

State what happens to the charge on L.

.....

..... [1]

6 Fig. 6.1 shows a radiation detector placed on a laboratory bench.

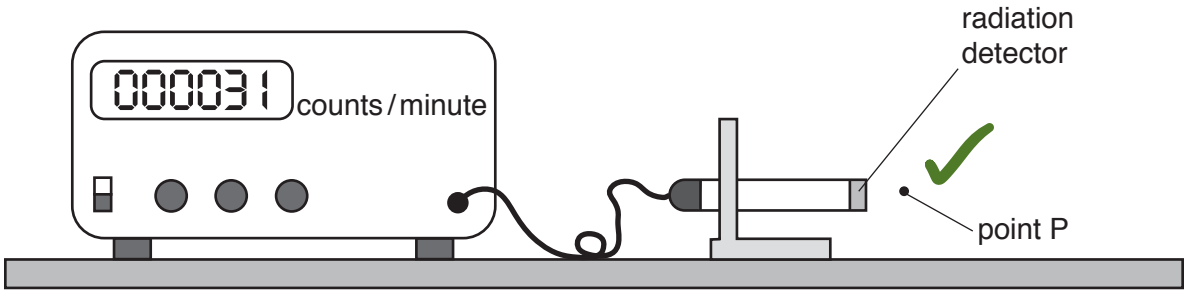

Fig. 6.1

The detector is switched on and six readings of the count rate are recorded.

The table in Fig. 6.2 shows the readings obtained.

reading number	1	2	3	4	5	6
count rate / counts/minute	31	36	29	32	31	33

Fig. 6.2

(a) Using all the readings obtained, determine an average value for the background count rate.

31 + 36 + 29 + 32 + 31 + 33
= 32

background count rate = ... 32 counts/min ..... [1]

(b) Fig. 6.1 shows a point P which is a very short distance from the end of the radiation detector. A sample of the radioactive isotope cobalt-60 is placed at P. The average value of the count rate obtained is now 975 counts / minute.

The average count rate is determined with different objects between the radiation detector and the sample. The table in Fig. 6.3 shows the results obtained.

object	average count rate / counts/minute
no object	975
four sheets of paper	976
0.50 mm thickness sheet of aluminium	117
2.0 cm thickness sheet of lead	52

β particle

Fig. 6.3

(i) Indicate, by placing ticks (✓) in the appropriate boxes, the radiation emitted by cobalt-60.

☐ alpha-particles ☑ beta-particles ☑ gamma rays

[1]

(ii) This radiation is produced when a nucleus of cobalt-60 ($^{60}_{27}Co$) decays into a nucleus of the daughter product X. Product X is not radioactive.

Determine

1. the number of protons in a nucleus of X,

number of protons = 28 [1]

2. the number of neutrons in a nucleus of X.

number of neutrons = 32 [1]

(c) The half-life of cobalt-60 is 5.3 years.

(i) State what is meant by *half-life*.

Time is taken to become the number of unstable nuclei to half.

[2]

(ii) When there is a lead sheet between the detector and the sample, the average count rate is obtained from six readings taken at one-minute intervals. The six readings are given in the table in Fig. 6.4.

reading number	1	2	3	4	5	6
count rate / counts / minute	61	46	43	56	49	57

Fig. 6.4

There are reasons for suggesting that the variation in these readings is random and not because the number of cobalt-60 atoms in the sample is decreasing.

State two of these reasons.

1. Reading is fluctuating and same cases count rate is increased

2. The measured time is too short compared to the half life of Cobalt-60 [2]

7 Fig. 7.1 shows the structure of a transformer.

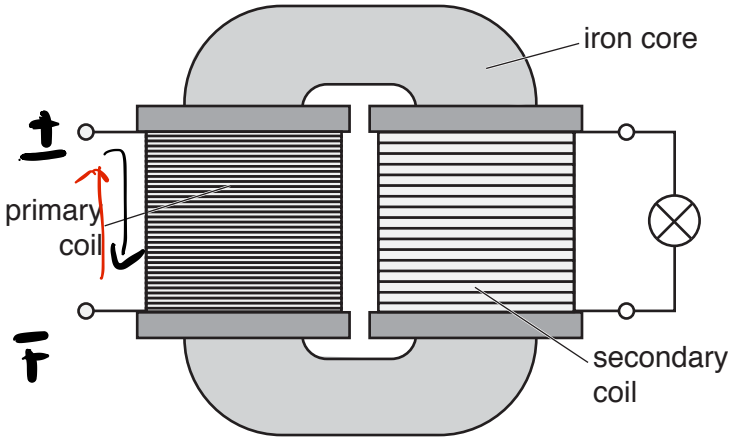

Fig. 7.1

A lamp is connected to the secondary coil.

(a) Explain why the core of the transformer is made from iron.

It is a soft magnetic material. It magnetises and demagnetises rapidly. It increases the magnetic flux linkage between primary and secondary coil

[2]

(b) When there is an alternating current (a.c.) in the primary coil, the lamp is lit.

When there is a direct current (d.c.) in the primary coil, the lamp is **not** lit.

(i) State two ways in which an alternating current differs from a direct current.

1. for AC current the direction change

2. And magnitude also changes so sinusoidal graph.

[2]

(ii) Explain why the lamp is **not** lit when there is a direct current in the primary coil.

There won't be any magnetic flux change therefore no electromagnetic induction takes place at secondary coil.

[2]

Section B

Answer **two** questions from this section. Answer in the spaces provided.

8 During a game of cricket, a player hits a ball with a bat. The ball then travels vertically upwards, as shown in Fig. 8.1.

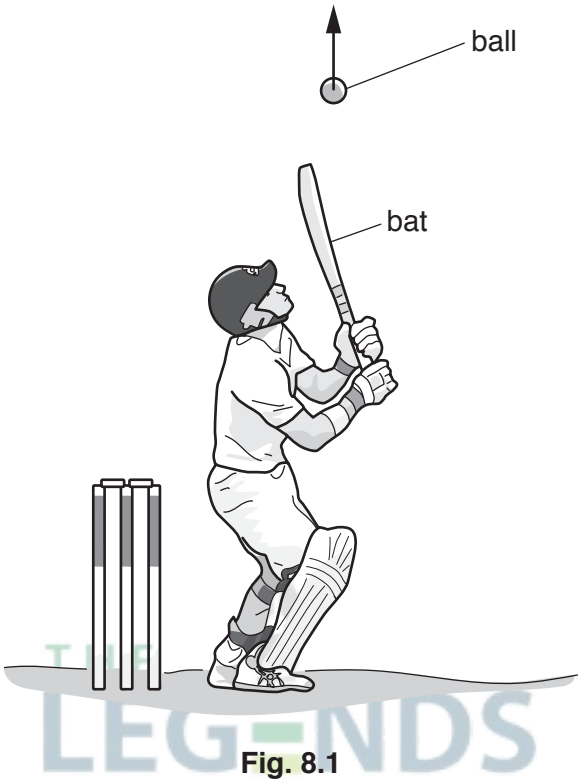

Fig. 8.1

The speed of the ball as it leaves the bat is 8.7 m/s.

(a) The mass of the ball is 0.16 kg.

(i) **1.** State what is meant by *mass*.

.....

..... [1]

2. State the name of a measuring instrument that is used to determine mass.

.....

..... [1]

(ii) Calculate the kinetic energy of the ball as it leaves the bat.

kinetic energy = ... [3]

(b) Fig. 8.2 is the velocity-time graph for the ball.

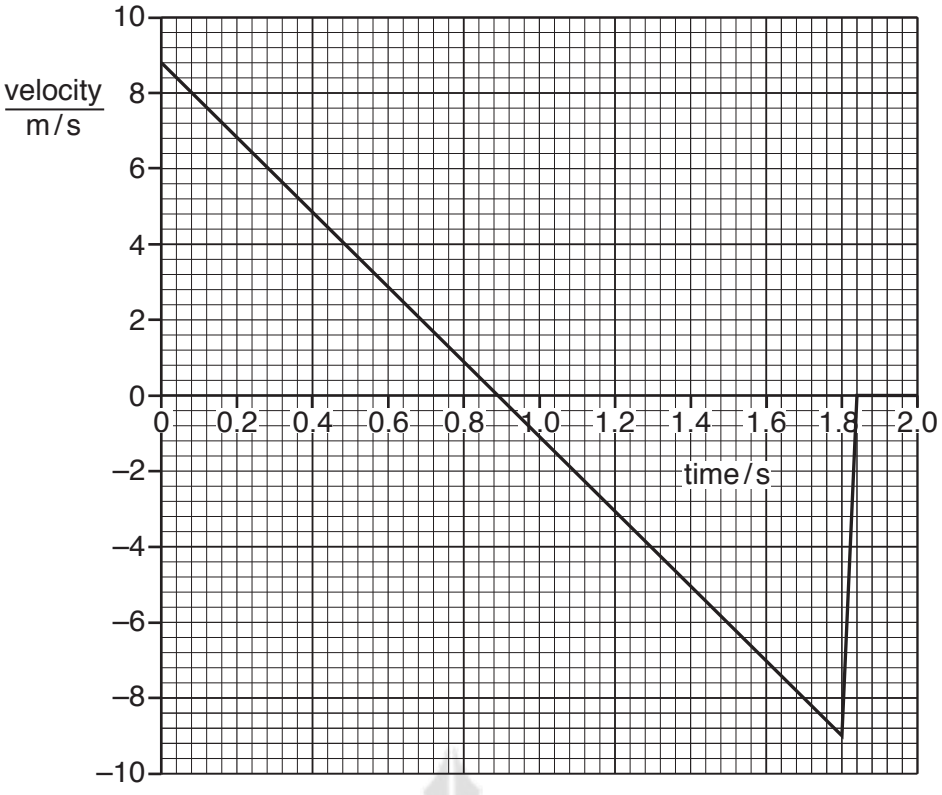

Fig. 8.2

(i) Fig. 8.2 shows that immediately after being hit, the ball has a negative acceleration.

1. State the name given to a negative acceleration.

..... [1]

2. State how the graph shows that the ball has a negative acceleration.

.....

..... [1]

(ii) Using Fig. 8.2, determine

1. the time at which the ball stops moving upwards,

time = ... [1]

2. the distance travelled before the ball stops moving upwards.

distance = ... [2]

(iii) Suggest why the graph, in Fig. 8.2, is almost vertical when time = 1.84 s.

.....

..... [1]

(iv) Fig. 8.2 shows that the ball remains stationary after a time of 1.84 s.

Describe the energy change that is occurring at a time of 1.84 s.

.....

.....

..... [2]

(c) For this ball moving in the way shown, the effect of air resistance is negligible.

When a ball with a much smaller mass is hit vertically upwards at the same speed, air resistance produces a noticeable effect on its motion.

Suggest two ways in which the velocity-time graph for the ball with a smaller mass differs from Fig. 8.2.

1. .....

.....

2. .....

.....

[2]

9 Both sound and ultrasound are waves that travel in solids, liquids and gases.

(a) State how sound differs from ultrasound.

.....

..... [1]

(b) Sound and ultrasound are longitudinal waves that consist of compressions and rarefactions.

(i) Explain what is meant by a wave and describe how a longitudinal wave differs from a transverse wave.

.....

.....

.....

.....

..... [3]

(ii) Fig. 9.1 represents a longitudinal wave of frequency 25 000 Hz travelling in oil.

Fig. 9.1 (full scale)

1. On Fig. 9.1, mark two points at the centre of two different rarefactions and label each one R. [1]

2. On Fig. 9.1, draw a double-headed arrow to indicate a distance that is equal to one wavelength of the wave. [1]

3. Measure the length of the arrow drawn on Fig. 9.1 and use it to determine the speed of the wave in oil.

speed = ... [2]

(c) A sound wave travelling in a liquid, passes into air.

(i) State what happens to the speed of the sound wave as it enters the air.

..... [1]

(ii) The wave in the liquid travels towards the surface at an angle. Fig. 9.2 shows the centres of the compressions of the sound wave in the liquid.

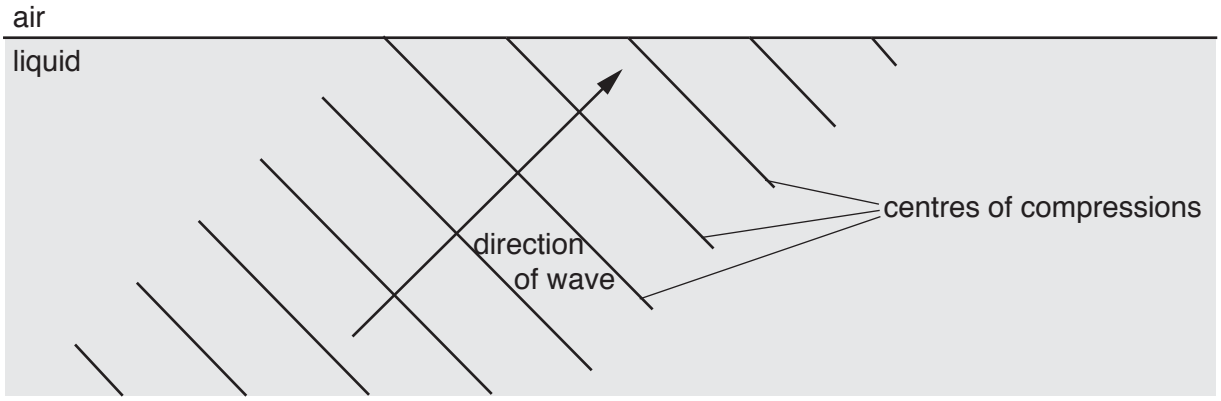

Fig. 9.2

Some compressions shown have reached the liquid-air boundary. The parts of these compressions in the air are not shown on Fig. 9.2.

On Fig. 9.2, draw the parts of these compressions that are in the air. [3]

(d) Describe, in outline, how ultrasound is used in cleaning.

.....

.....

.....

.....

..... [3]

10 A student sets up the circuit shown in Fig. 10.1 in a laboratory at room temperature.

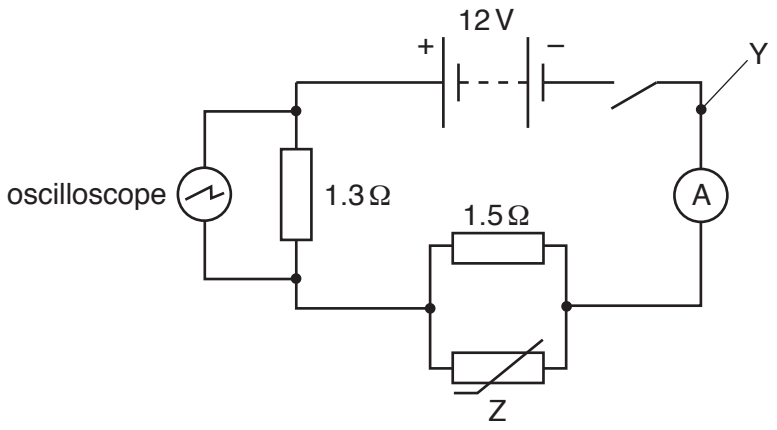

Fig. 10.1

The electromotive force (e.m.f.) of the battery is 12 V.

The switch is closed.

(a) The connecting wires in the circuit are made from copper covered by insulating plastic.

State the name of the particles that flow in the copper and state the direction in which they are flowing at point Y in the circuit.

.....

.....

..... [2]

(b) At room temperature, the resistance of component Z is 6.0 Ω.

(i) State the name of component Z.

..... [1]

(ii) Calculate the resistance of the whole circuit.

resistance = ... [3]

(iii) Calculate the current measured by the ammeter.

current = ... [2]

(iv) The current in the ammeter is I_A, the current in the 1.5 Ω resistor is I_R and the current in component Z is I_Z.

Write down an equation that relates I_A, I_R and I_Z.

..... [1]

(c) Fig. 10.2 shows the screen of the oscilloscope.

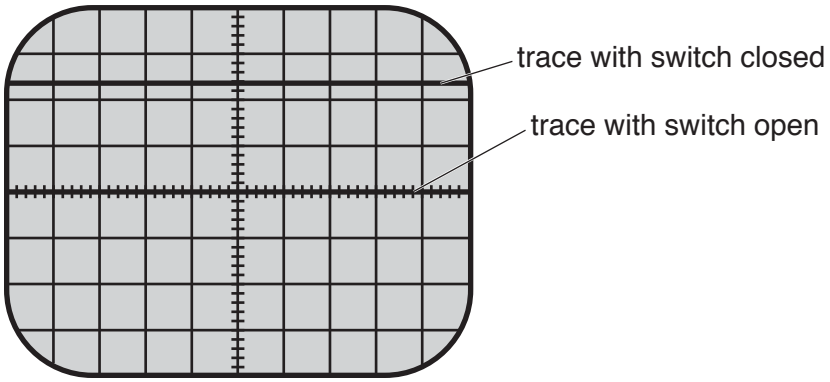

Fig. 10.2

Before the switch is closed, the trace is a horizontal line across the middle of the screen, as shown in Fig. 10.2. When the switch is closed, the trace remains horizontal and moves up the screen.

Component Z is heated.

State and explain what is observed on the oscilloscope screen as the temperature of Z increases.

.....

.....

.....

.....

.....

..... [4]

(d) The 12 V battery is made from cells of electromotive force (e.m.f.) 1.5 V which are all in series.

(i) Calculate the number of 1.5 V cells that make up the battery.

number = ... [1]

(ii) State the e.m.f. of a battery made by connecting all of these cells in parallel.

e.m.f. = ... [1]

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