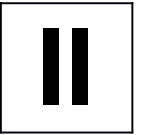


[Pure] Physics O Level Exam Paper
Preliminary Examination Set [II]
Secondary Four Express



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

(Updated 2024)

6091/01

PHYSICS

1 hour

Paper 1 Multiple Choice

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid/tape.

Write your name, class and index number on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** or **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

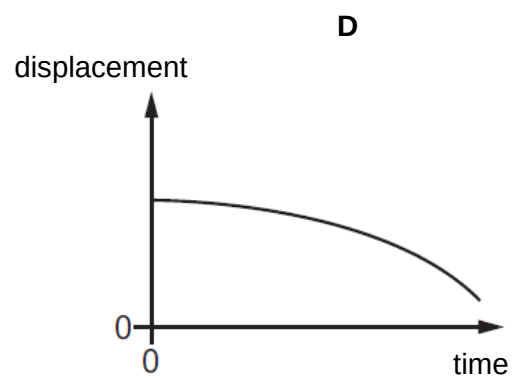
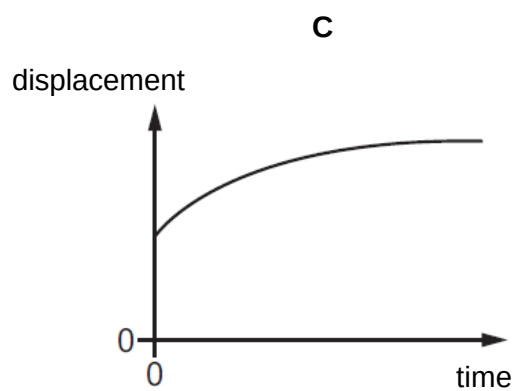
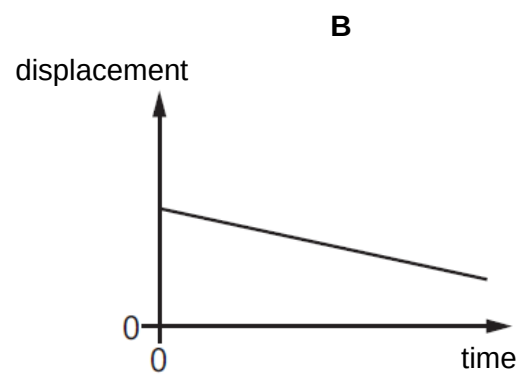
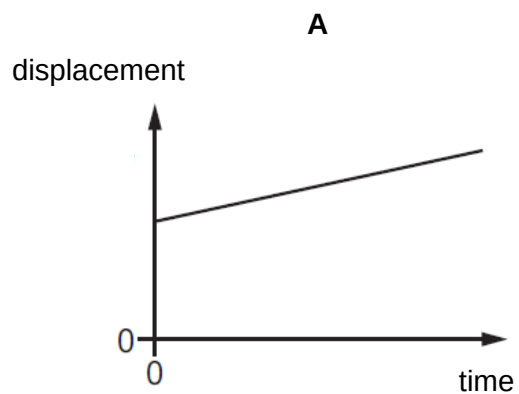
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

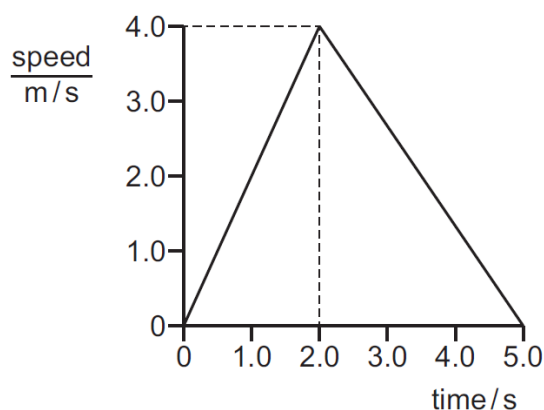
Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

- 1 Which one of the following measurements would a digital micrometer screw gauge be most suitable?
- A length of this page
 - B diameter of a beaker
 - C diameter of a wire
 - D radius of an atom
- 2 Which displacement-time graph represents a body whose velocity is decreasing?



- 3 The diagram shows the speed-time graph for an object travelling in a straight line.



What is the acceleration of the object during the first two seconds and the total distance that it travels?

	acceleration / ms^{-2}	total distance / m
A	0.50	10
B	0.50	20
C	2.0	10
D	2.0	20

- 4 A sphere, **P**, made of steel, has a weight of 10 N on Earth.

Another sphere, **Q**, also made of steel, has a weight of 10 N on Mars.

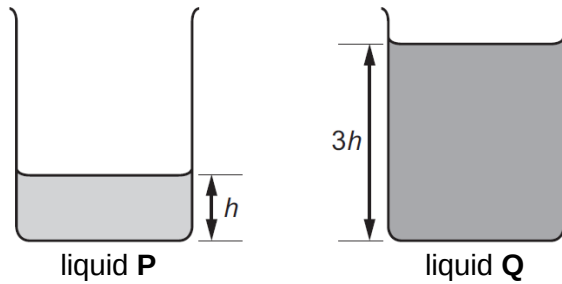
The gravitational field strength on Earth is greater than the gravitational field strength on Mars.

Which of the following statements is correct?

- A** The mass of sphere **P** is the same as the mass of sphere **Q**.
- B** The mass of sphere **P** is less than the mass of sphere **Q**.
- C** On Mars, the weight of sphere **P** is more than 10 N.
- D** On Earth, the weight of sphere **Q** is less than 10 N.

- 5 Two identical beakers contain the same mass of liquid.

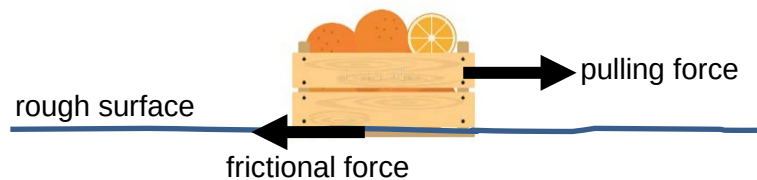
Each beaker contains a different liquid.



Liquid Q has a density ρ .

What is the density of liquid P?

- A $\rho \div 3$
 B ρ
 C 3ρ
 D 9ρ
- 6 A crate of oranges is pulled across a rough surface by a force, causing the crate to accelerate at 1.5 m/s^2 . The combined mass of the crate and oranges is 24 kg .



Which of the following shows the correct pair of the pulling force and frictional force?

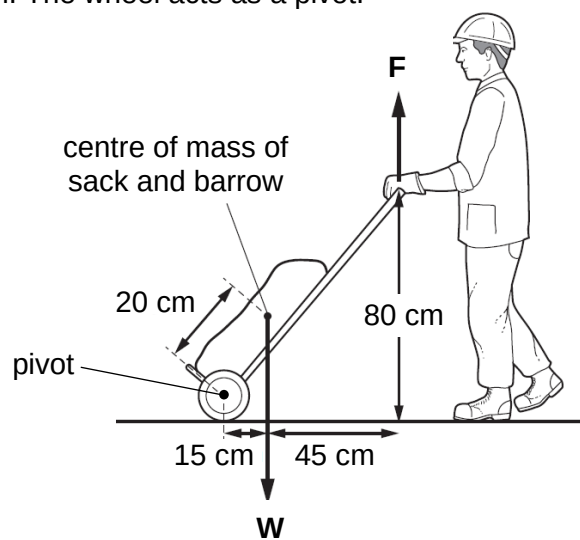
	frictional force / N	pulling force / N
A	17	53
B	22	38
C	38	22
D	53	17

- 7 When a heavy coin falls a short distance towards the ground, it does not reach terminal velocity.

Which of the following statements best explains why this is so?

- A The coin has not hit the ground.
- B The weight of the coin equals the air resistance.
- C The weight of the coin increases as air resistance increases.
- D The weight of the coin is more than the air resistance.

- 8 The diagram shows a man holding a stationary sack and barrow. He applies a vertical force, **F**, to the handle of the barrow. The weight of the sack and barrow, **W**, and the centre of mass are shown. The wheel acts as a pivot.

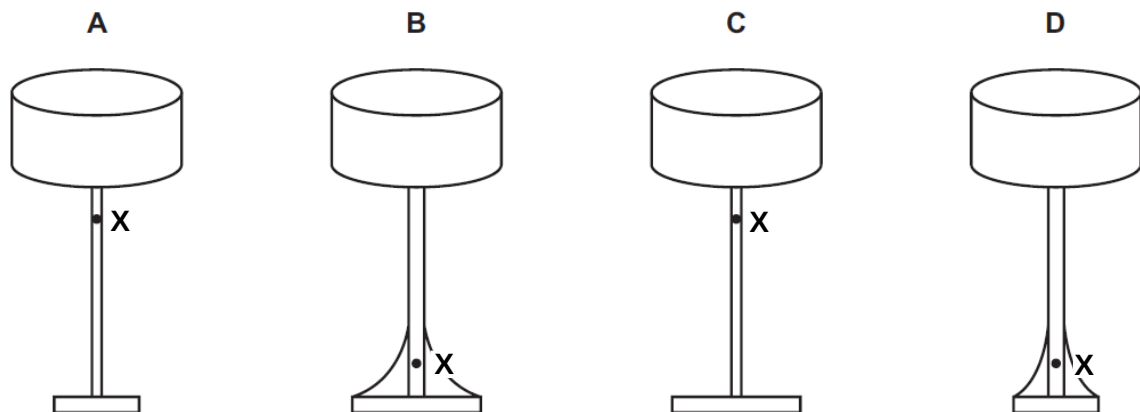


What are the moments produced about the pivot due to **F** and **W**?

	moments due to F / Ncm	moments due to W / Ncm
A	$45 \times \mathbf{F}$	$15 \times \mathbf{W}$
B	$60 \times \mathbf{F}$	$15 \times \mathbf{W}$
C	$60 \times \mathbf{F}$	$20 \times \mathbf{W}$
D	$80 \times \mathbf{F}$	$20 \times \mathbf{W}$

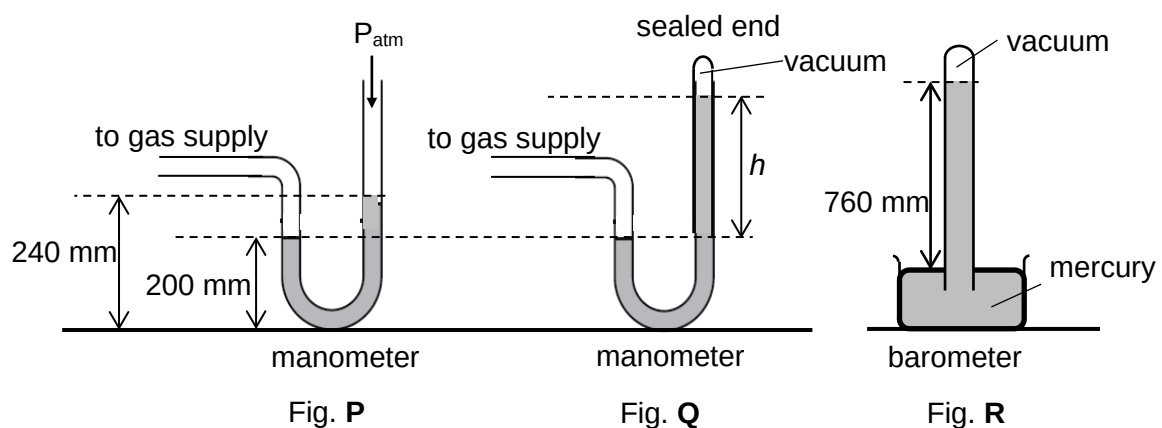
- 9 The diagrams show four table lamps resting on a table. The position of the centre of mass of each lamp is labelled **X**.

Which lamp is the least stable?



- 10 The pressure inside a gas cylinder is measured separately using two different mercury manometers as shown in Fig. **P** and **Q**. One of the manometers has an open end while the other has a sealed end.

A barometer, as shown in Fig. **R**, is used to measure the atmospheric pressure at the location of the experiment.

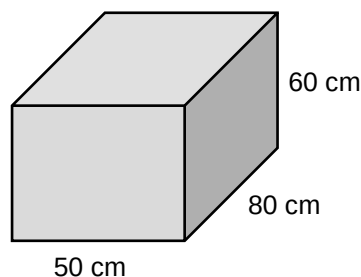


The diagrams are not drawn to scale.

What is the height, h , of the mercury in Fig. **Q**?

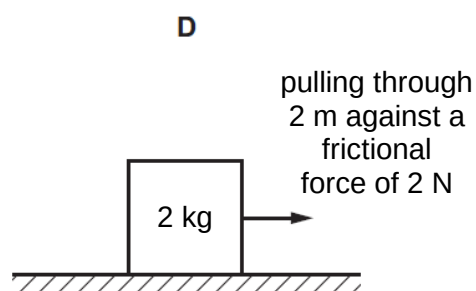
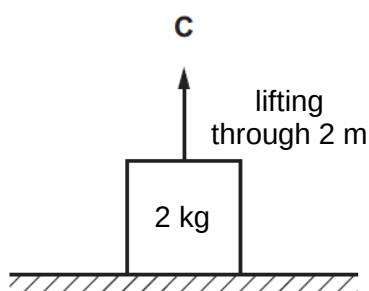
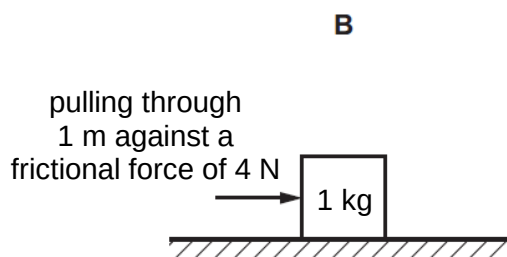
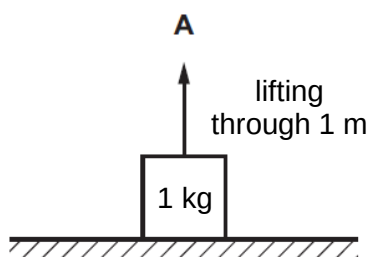
- A 40 mm
- B 720 mm
- C 800 mm
- D 1000 mm

- 11** The block below can be placed in any orientation on the ground.



Given that the minimum pressure exerted by the block on the ground is 100 Pa, what is the maximum pressure exerted by the block on the ground?

- A** 120 Pa
B 140 Pa
C 160 Pa
D 180 Pa
- 12** A student carries out some simple exercises. The gravitational field strength is 10 N/kg.
- Which of the following exercises results in the most work done?



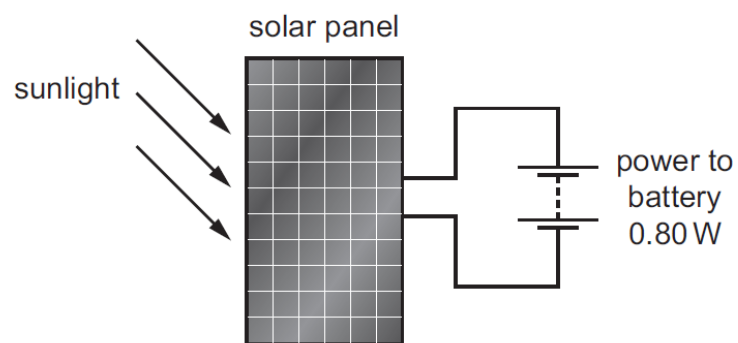
- 13** An object falls from a height of 5.0 m. As it hits the ground, the object has 750 J of energy in its kinetic store.

Air resistance can be ignored. The gravitational field strength is 10 N/kg.

What is the mass of the object?

- A** 15 kg
- B** 50 kg
- C** 75 kg
- D** 150 kg

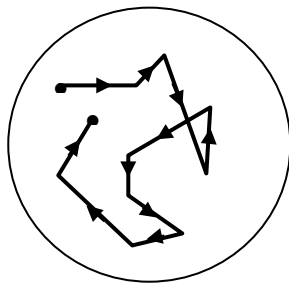
- 14** A solar panel is used to recharge a battery. The solar panel produces 0.80 W of electrical power. The panel is 20% efficient.



What is the power input of the sunlight onto the solar panel?

- A** 0.16 W
- B** 4.0 W
- C** 8.0 W
- D** 16 W

- 15** Smoke particles in a transparent box are observed using a microscope. A small point of light is seen to move around as shown.



What does this experiment demonstrate about air molecules?

- A** They are in continuous random motion.
 - B** They can be seen through a microscope.
 - C** They move because of collisions with smoke particles.
 - D** They move more quickly when they are heated.
- 16** Four cups **A**, **B**, **C** and **D** contain hot coffee.

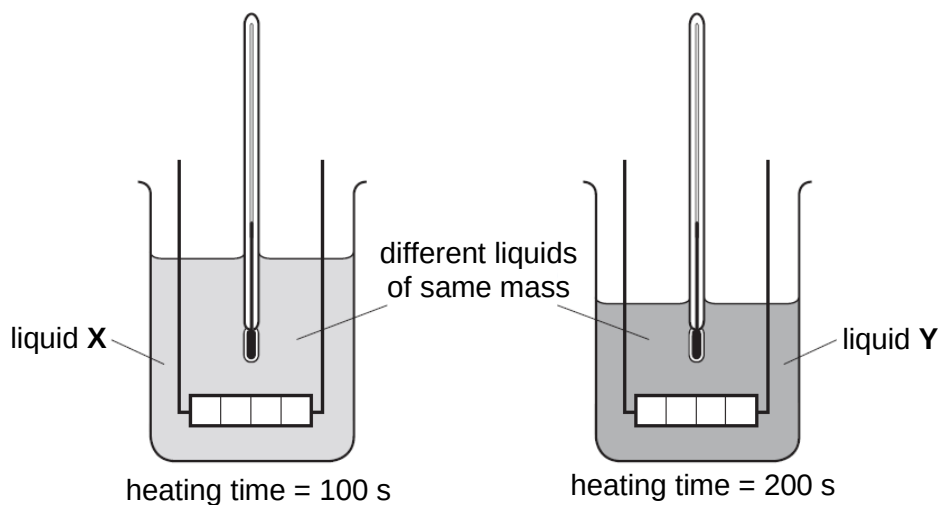
Which of the following cups will the coffee cool the fastest?

	the outer surface of the cup	the top of the cup
A	black	covered with a lid
B	black	no lid
C	white	covered with a lid
D	white	no lid

- 17** Equal masses of two different liquids are put into identical beakers.

Liquid **X** is heated for 100 s and liquid **Y** is heated for 200 s by heaters of the **same power**.

Each liquid has the same rise in temperature.



Which of the following statements is correct?

- A** Each beaker of liquid has the same heat capacity.
- B** Each beaker of liquid receives the same energy.
- C** Liquid **X** receives more energy than liquid **Y**.
- D** The heat capacity of liquid **X** is less than the heat capacity of liquid **Y**.

- 18** A student splashes water on her face.

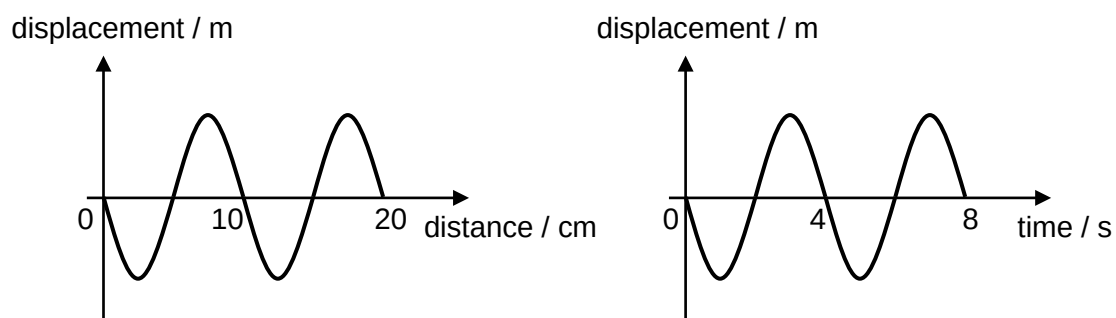
The following are three statements about the possible effects:

- P** The water uses energy to evaporate.
- Q** The water gains energy from the student.
- R** The face of the student cools down.

Which statements are correct?

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

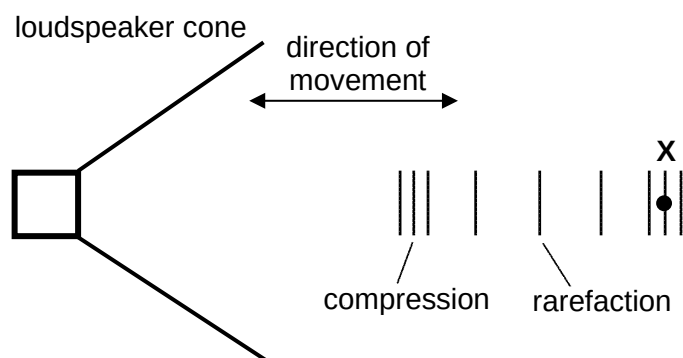
- 19 The graphs below represent the variations in the displacement of a transverse wave with distance and time.



Which row correctly describes the wavelength and frequency of the wave?

	wavelength / cm	frequency / Hz
A	5.0	0.25
B	5.0	4.0
C	10	0.25
D	10	4.0

- 20 Compressions and rarefactions are sent out from a loudspeaker cone as it vibrates backwards and forward. The frequency of vibration is 50 Hz.



A compression is at point X.

How much time elapses before the next rarefaction arrives at X?

- A** 0.010 s
- B** 0.020 s
- C** 25 s
- D** 50 s

- 21** The frequencies of musical note **C** and note **E** are 262 Hz and 330 Hz respectively.

Which of the following statements are correct?

- P** Note **E** is louder than note **C**.
- Q** Note **E** travels faster than note **C**.
- R** Note **E** has a higher pitch than note **C**.
- S** Note **E** has a shorter wavelength than note **C**.

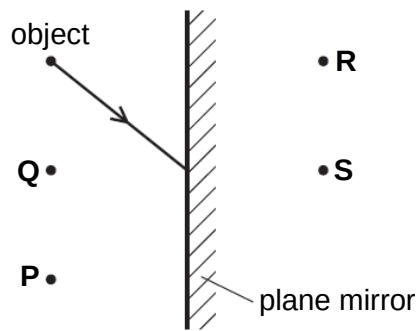
- A** **P** and **Q**
- B** **P** and **S**
- C** **Q** and **R**
- D** **R** and **S**

- 22** Visible light, X-ray and microwaves are all components of the electromagnetic spectrum.

Which of the following statements about the waves is correct?

- A** In a vacuum, microwaves travel faster than visible light and have a shorter wavelength.
- B** In a vacuum, microwaves travel at the same speed as visible light and have a shorter wavelength.
- C** In a vacuum, X-rays travel faster than visible light and have a shorter wavelength.
- D** In a vacuum, X-rays travel at the same speed as visible light and have a shorter wavelength.

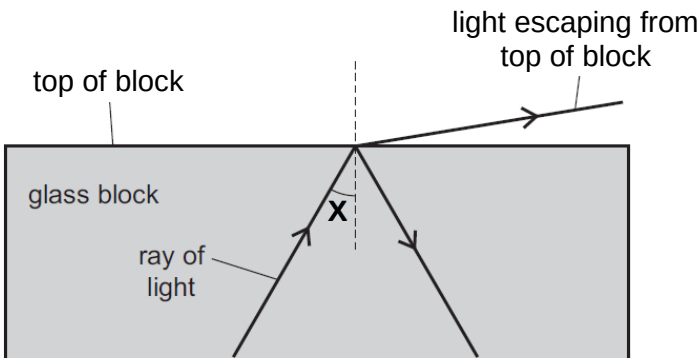
- 23 The diagram shows an object in front of a plane mirror. A ray of light from the object is incident on the mirror.



Through which point does the reflected ray pass, and at which point is the image of the object formed?

	point through which reflected ray passes	point at which image is formed
A	P	R
B	P	S
C	Q	R
D	Q	S

- 24 A scientist tries to direct a ray of light in a glass block so that no light escapes from the top of the block. However, some light escapes.

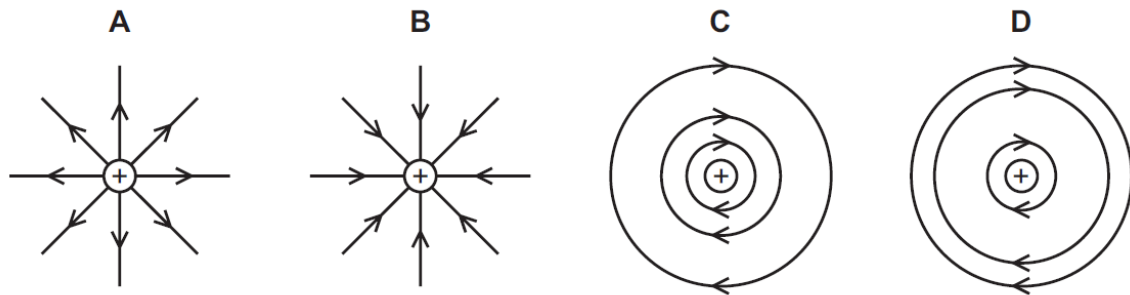


The scientist changes angle **X** and stops the light from escaping through the top of the block.
Which row in the table describes the change to angle **X** and the name of the effect produced?

	change to angle X	name of effect produced
A	decrease	refraction
B	decrease	total internal reflection
C	increase	refraction
D	increase	total internal reflection

25 The diagrams each show a positive point charge.

Which diagram represents the pattern and the direction of the electric field due to the charge?



26 A positively-charged rod is held near to, but not touching, an uncharged metal sphere.

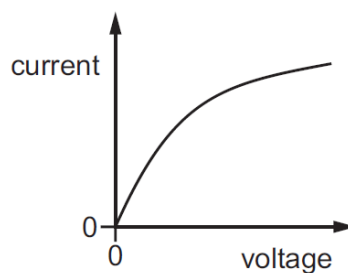
The sphere is briefly connected to the earth.

The rod is then removed.

Which of the following statements about the charge on the sphere is correct?

- A** It is charged negatively because negative charges have moved from earth to the sphere.
- B** It is charged negatively because positive charges have moved from the sphere to earth.
- C** It is charged positively because negative charges have moved from the sphere to earth.
- D** It is charged positively because positive charges have moved to earth from the sphere.

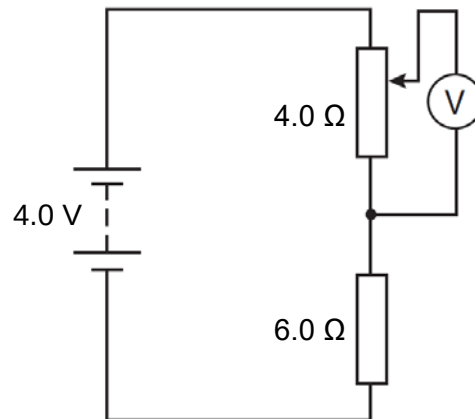
27 The graph shows the current–voltage characteristic for a filament lamp.



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

- A** The resistance decreases to zero.
- B** The resistance decreases, but not to zero.
- C** The resistance increases.
- D** The resistance remains constant.

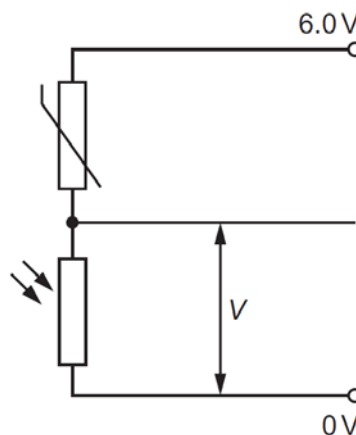
- 28** The diagram shows a circuit with a potential divider joined in series with a fixed resistor.



What are the minimum and maximum readings that can be obtained on the voltmeter when the potential divider is adjusted?

	minimum reading / V	maximum reading / V
A	0	1.6
B	0	2.0
C	1.0	4.0
D	4.0	10

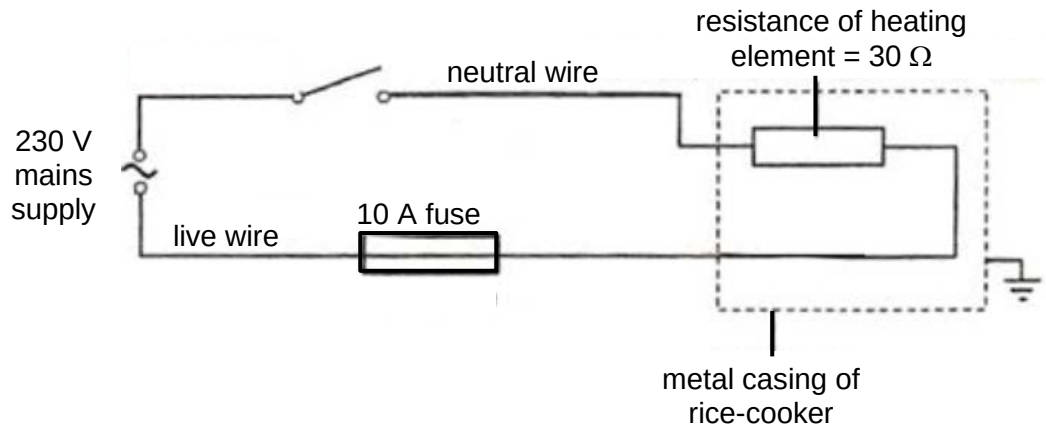
- 29** A potential divider consists of a Negative Temperature Coefficient (NTC) thermistor and a light-dependent resistor (LDR).



Which of the following conditions will give the smallest voltage V across the LDR?

- A** cold and dark
- B** cold and bright
- C** hot and dark
- D** hot and bright

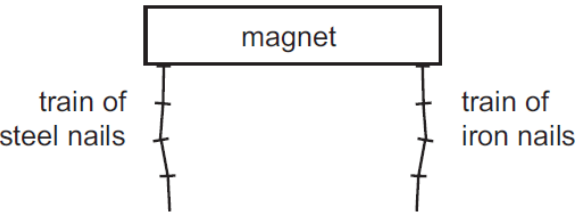
- 30** The diagram below shows the circuit formed when a rice-cooker is plugged into a mains socket.



What is the fault in this arrangement?

- A** The earth wire is missing.
 - B** The fuse rating is too low.
 - C** The resistance of the heating element is too high.
 - D** The switch is connected wrongly.
- 31** What is the most effective method of de-magnetising a bar magnet?
- A** placing the magnet in a solenoid carrying a large alternating current and gradually decreasing the current
 - B** placing the magnet in a solenoid carrying a large direct current and gradually decreasing the current
 - C** placing the magnet in a solenoid that produces a magnetic field in the opposite direction to the magnet
 - D** placing the magnet next to an identical bar magnet with its poles in the opposite direction

32 A train of steel nails and a train of iron nails hang from two ends of a strong magnet.



The trains are then carefully removed from the magnet.

What happens to the trains of nails?

- A** Both trains of nails fall apart.
- B** Both trains of nails stay together.
- C** Only the train of iron nails falls apart.
- D** Only the train of steel nails falls apart.

33 A student sets up the experiment as shown in the diagram.



P and **Q** repel each other.

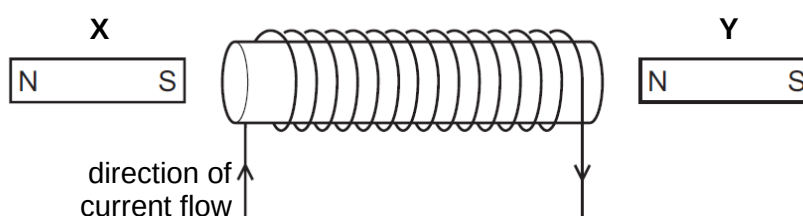
Which of the following row correctly states the poles at **P** and **Q**?

	P	Q
A	north	north
B	north	south
C	south	north
D	south	south

34 In which device is a split-ring commutator used, and what is its purpose?

	device	purpose
A	a.c. generator	to change the direction of the current in the coil as it turns
B	a.c. generator	to change the output current from d.c. into a.c.
C	d.c. motor	to change the direction of the current in the coil as it turns
D	d.c. motor	to change the input current from a.c. into d.c.

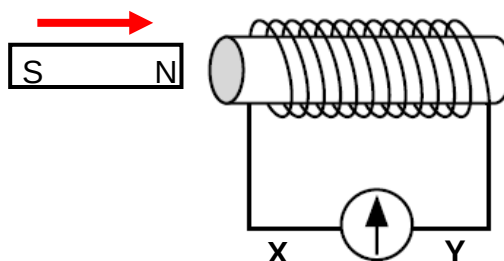
35 Two magnets are placed near a current-carrying coil. The diagram shows this experimental arrangement and the direction of the current in the coil.



Which of the following statements is correct?

- A** Both **X** and **Y** are attracted to the coil.
- B** Both **X** and **Y** are repelled by the coil.
- C** **X** is attracted to the coil and **Y** is repelled.
- D** **X** is repelled by the coil and **Y** is attracted.

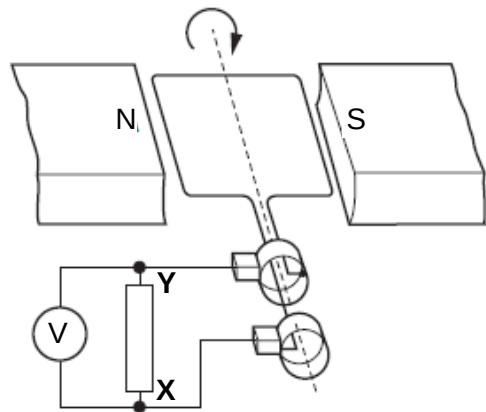
36 A small coil is connected to a galvanometer as shown below.



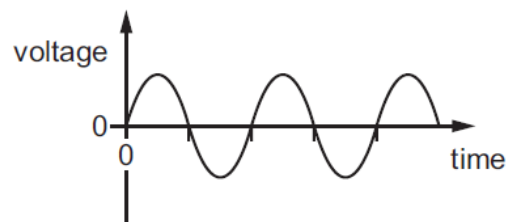
When the magnet is allowed to move towards the coil, which of the following statements shows the current flow?

- A** continuously from **X** to **Y**
- B** continuously from **Y** to **X**
- C** momentarily from **X** to **Y**
- D** momentarily from **Y** to **X**

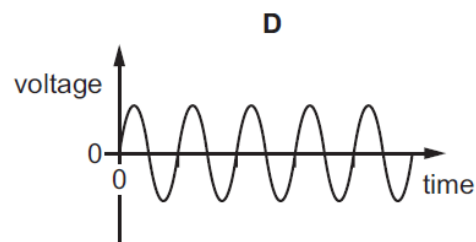
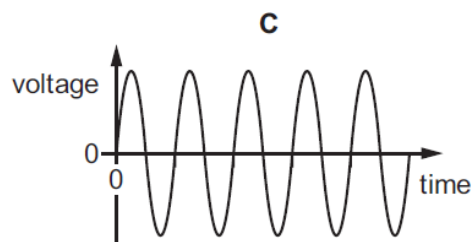
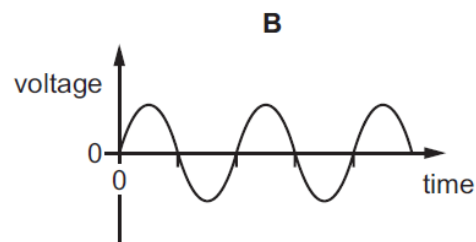
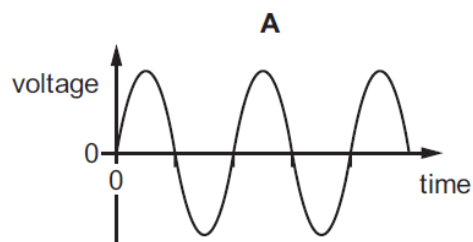
37 The diagram shows an a.c. generator.



The graph shows how the voltmeter reading across the resistor **YX** changes with time as the coil rotates.



Which graph shows what happens when the coil rotates at a faster rate?



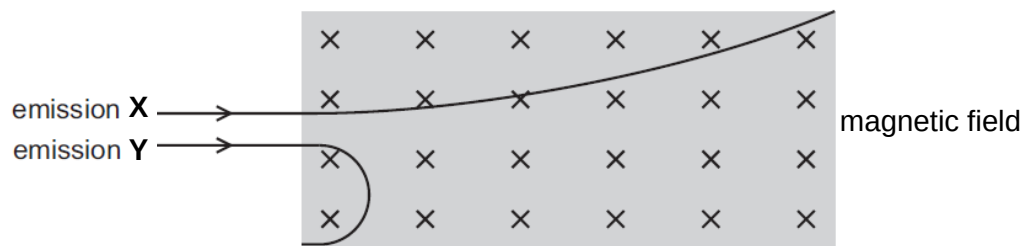
38 Nuclear fusion is a reaction that can take place in the sun.

Which row describes this reaction?

	action of atomic nuclei	energy
A	an atomic nucleus splits into two or more smaller nuclei	absorbed
B	an atomic nucleus splits into two or more smaller nuclei	released
C	atomic nuclei join together to form a larger nucleus	absorbed
D	atomic nuclei join together to form a larger nucleus	released

- 39** Emissions **X** and **Y** from a radioactive material are passed through a magnetic field.

The diagram shows the direction of the emissions, the direction of the magnetic field and the effect on the emissions.



Which type of emission is **X**, and which type of emission is **Y**?

	emission X	emission Y
A	α -particles	β -particles
B	α -particles	γ -rays
C	β -particles	α -particles
D	β -particles	γ -rays

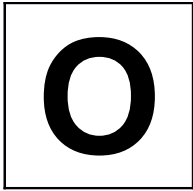
- 40** A detector of ionising radiation gives a background reading of 20 counts/minute.

A radioactive isotope with a half-life of 2.0 days is brought near to the detector. The reading on the detector increases to 100 counts/minute.

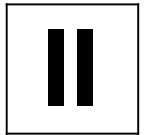
How long does it take for the reading on the detector to decrease to 40 counts/minute?

- A** 2.0 days
- B** 4.0 days
- C** 5.0 days
- D** 10 days

END OF PAPER



[Pure] Physics O Level Exam Paper
Preliminary Examination Set [II]
Secondary Four Express



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

(Updated 2024)

5059/02

Physics

1 hour 45 minutes

Paper 2 Theory

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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.

Section A	
Section B	
Total	

SECTION A

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

- 1 Fig. 1.1 shows a bungee jumper falling from a bridge above a river.

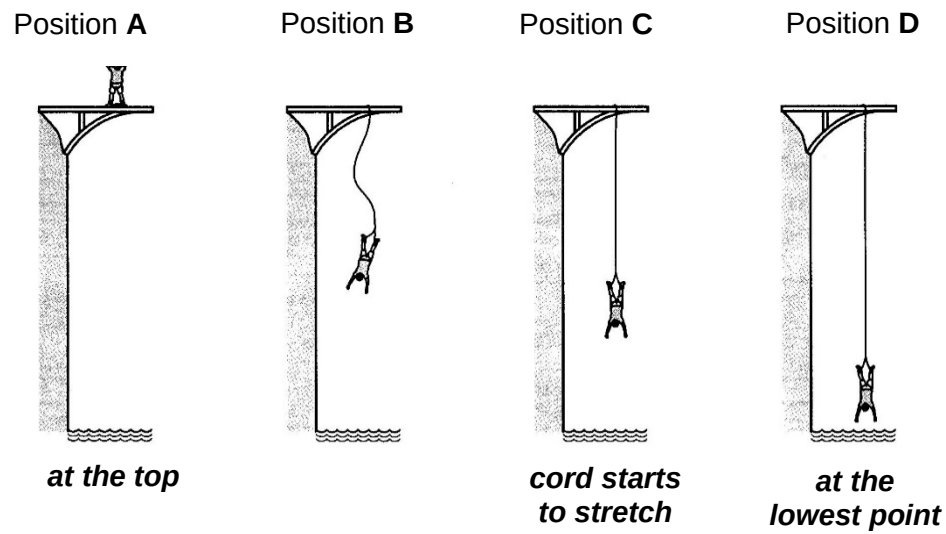


Fig. 1.1

The man starts from position **A**. The elastic cord starts to stretch at position **C** and he stops for the first time at position **D**. He continues to rise and fall.

Fig. 1.2 shows how the velocity of the man varies with time t .

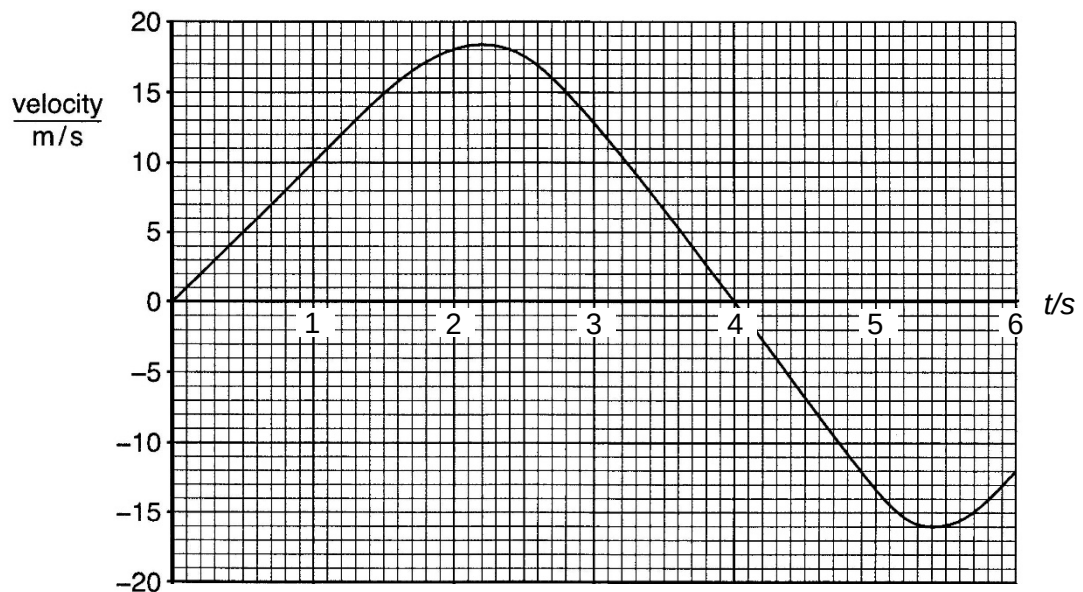


Fig. 1.2

- (a) State the difference between the positive velocity and negative velocity of the bungee jumper.

.....

..... [1]

- 1 (b)** In the first 1.4 s, the acceleration is uniform.

Using values from Fig. 1.2, determine the acceleration of the man in the first 1.4 s.

acceleration = [2]

- (c)** With reference to Fig. 1.2, state the time when the man is at position **D**.

..... [1]

- (d) (i)** State the two forces acting on the man at position **D**.

..... [1]

- (ii)** Explain, in terms of the forces acting, why the man is accelerating upwards at position **D**.

.....

.....

.....

..... [2]

- 2 An aircraft flies at a constant height. The force from the engine of the aircraft and air drag together produce a force of 36 kN on the aircraft due east as shown in Fig. 2.1. The wind produces a force of 12 kN towards the south.

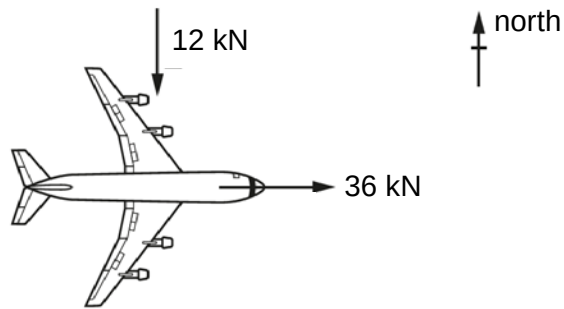


Fig. 2.1

Draw a scale drawing to show the resultant force acting on the aircraft. Use your drawing to determine the size of the resultant force and the angle between the resultant force and east.

scale = cm : N

size of resultant force =

angle =

[3]

- 3 A student designed a box which can slow down the process of melting for ice-cream cakes as they are delivered from the restaurant to the parties.

The box is made of expanded polystyrene with a cold pack attached to its cover as shown in Fig. 3.1.

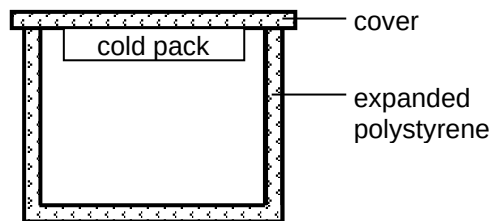


Fig. 3.1

- (a) State and explain **two** features of the box which help to slow down the melting of the ice-cream cake.

feature 1:

explanation:

.....

feature 2:

explanation:

.....

[4]

- (b) Suggest **one** improvement that the student could make to the design of the box to further slow down the melting of the ice-cream cake.

.....

..... [1]

4 Ultrasound and X-rays are both used in medical imaging.

- (a) An ultrasound scanner can emit and detect reflected sound waves. To produce an image of an unborn child, an ultrasound scanner is placed on the mother's skin as shown in Fig. 4.1.

Fig. 4.2 shows pulses detected by the ultrasound scanner. Pulse **A** is the emitted pulse and pulse **B** is the first pulse that returns from the unborn child.

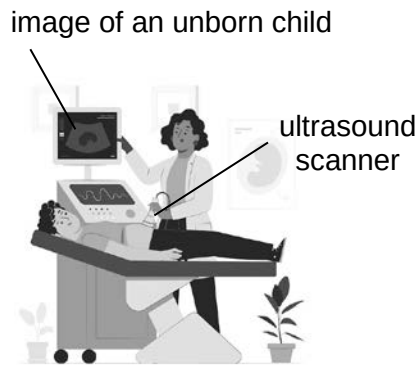


Fig. 4.1

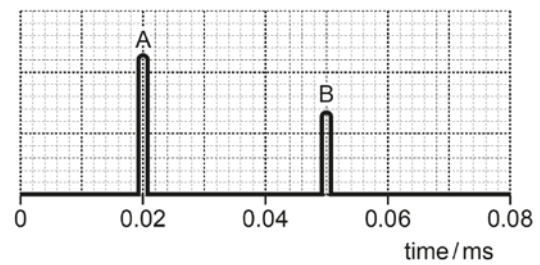


Fig. 4.2

- (i) Define what is meant by *ultrasound*.

.....
..... [1]

- (ii) The average speed of ultrasound in human tissue is 1500 m/s.

Using the information in Fig. 4.2, calculate the distance between the ultrasound scanner and the unborn child.

distance = [2]

- 4 (b) An X-ray detector is placed just below an arm.

Fig. 4.3 shows an X-ray image of the arm with a broken bone and human tissue which are formed on a screen by the detector.



Fig. 4.3

The wavelength of the X-rays used is 2.0×10^{-9} m.

- (i) Calculate the frequency of the X-rays.

frequency = [2]

- (ii) Suggest **one** reason why X-rays are **not** used to form an image of an unborn child.

.....

..... [1]

- 5 Electrical energy distribution takes place in a country through a network of transmission cables, as shown in Fig. 5.1.

A power station generates 100 MW of power at a voltage of 25 kV.

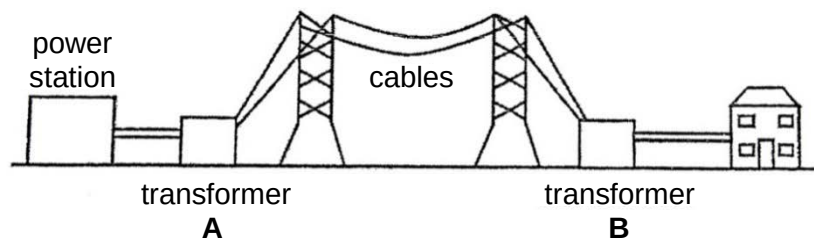


Fig. 5.1

Transformer **A**, which links the power station to the transmission cables, has 4000 turns in the primary coil and 44000 turns in the secondary coil.

- (a) Calculate the current in the secondary coil of transformer **A**, assuming the transformer is 100% efficient.

current = [3]

- (b) Explain why electrical transmission in the cables is typically at a very high voltage.

.....
.....
..... [1]

- 5 (c) After transmission through the cables, only 80% of the original power generated at the power station reaches transformer **B**.

Determine the total resistance of the transmission cables.

total resistance = [2]

- 6 Fig. 6.1 shows an uncharged metal sphere hung on an insulated thread between two metal plates **X** and **Y**, which are connected to a circuit.

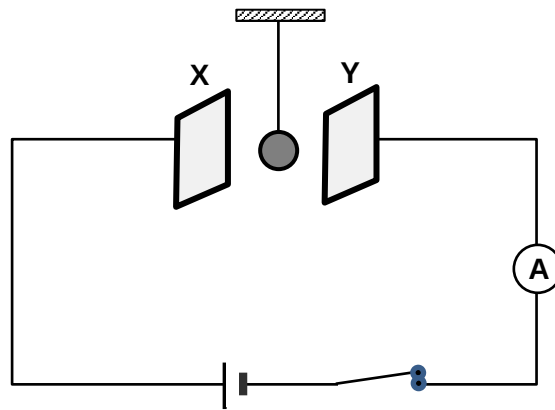


Fig. 6.1

- (a) State whether the metal sphere is *positively charged* or *negatively charged* when it is first brought to touch **X**.

..... [1]

- (b) Explain what happens to the metal sphere after it is released from **X**.

.....
.....
.....
.....
.....
..... [3]

- 7 A student moves a metal bar upwards between the poles of a magnet, as shown in Fig. 7.1.

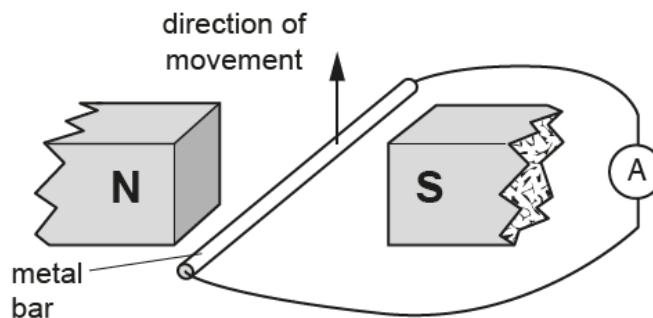


Fig. 7.1

The ammeter connected to the metal bar shows a small **positive reading** as the bar moves upwards.

- (a) Explain why there is a reading on the ammeter.

.....

.....

.....

..... [2]

- (b) Describe how Lenz's law applies when the bar is moved upwards.

.....

..... [1]

- (c) The metal bar is then moved in the direction shown by the arrows in Fig. 7.2.

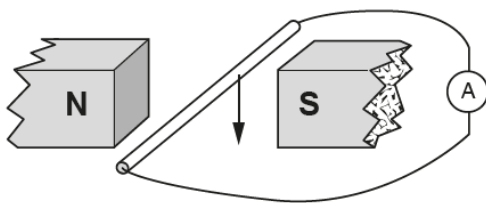


Fig. 7.2(i)

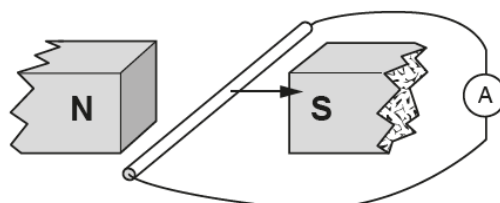


Fig. 7.2(ii)

Describe the ammeter reading as the bar is moved in the directions shown in

- Fig. 7.2(i) [1]
- Fig. 7.2(ii) [1]

[Part (d) continues on the next page.]

- 7 **(d)** A stronger magnet increases the reading on the ammeter.

State **one** other way in which a larger reading can be produced on the ammeter, using the same rod.

.....

..... [1]

- 8 Fig. 8.1 shows a circuit connecting an electrical heater to a 240 V mains socket.

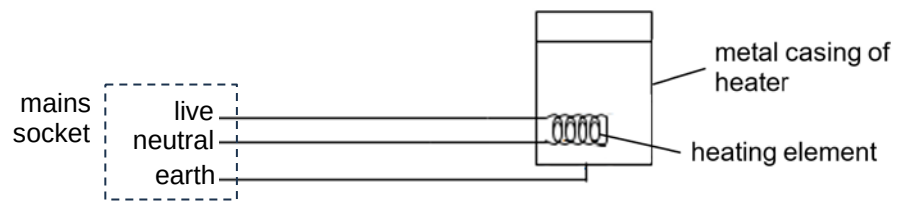


Fig. 8.1

The heating element has a resistance of $60\ \Omega$ when in use.

- (a) When the switch of the circuit is closed, the heater functions normally.

Determine the current, if any, flowing in the live, neutral and earth wire.

current in live wire =

current in neutral wire =

current in earth wire =

[2]

- (b) It is important that the electrical heater is fitted with a fuse of suitable rating.

Explain how a fuse acts as a safety device for the electrical heater.

.....

.....

..... [1]

- (c) Explain why the earth wire is connected to the metal casing of the electrical heater.

.....

.....

..... [1]

- 8 (d)** The electrical heater is switched on daily for 45 minutes. The cost of electricity is 20 cents per kWh.

Assuming there are 30 days in a month, calculate the monthly cost of switching on the heater.

cost = \$..... [3]

- 9 Radon-222 is an isotope of radon which undergoes a series of radioactive decays. Fig. 9.1 shows the proton number and nucleon number of the nuclei involved in a series of decays.

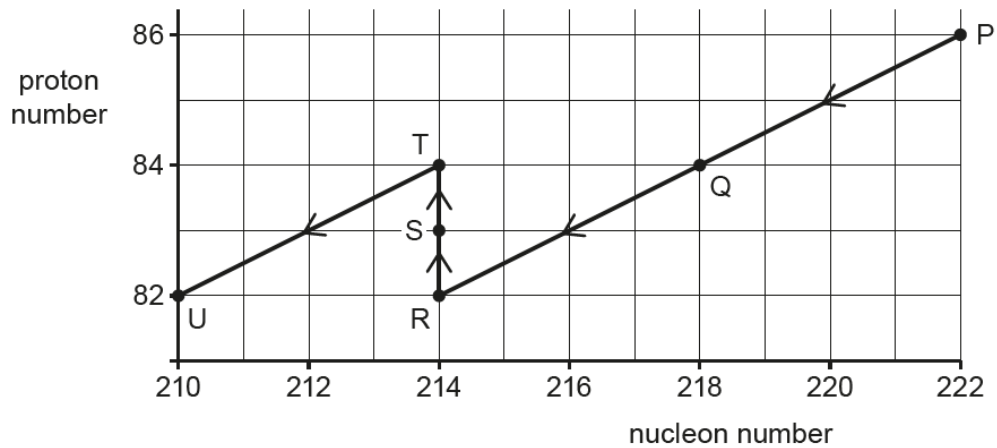


Fig. 9.1

The point **P** represents a nucleus of radon-222. Starting at **P**, a nucleus of radon-222 decays to **Q**; then from **Q** to **R**; then from **R** to **S**; then from **S** to **T**; and finally from **T** to **U**.

- (a) (i) Different isotopes of the same element have different atomic compositions. State what is meant by isotopes.

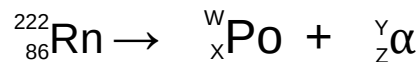
.....
 [1]

- (ii) State **two** points on Fig. 9.1 which represent isotopes of the same element.

..... [1]

- (b) In nuclide notation, radon-222 is written as $^{222}_{86}\text{Rn}$. When a nucleus of radon-222 emits an alpha-particle (α), it decays to an isotope of polonium (Po).

Complete the equation below for this decay process.



W: X:

Y: Z: [1]

- (c) (i) Using information from Fig. 9.1, state the name of the particle emitted as a nucleus of **R** decays to a nucleus of **S**.

..... [1]

- (ii) Describe the change in the composition of a nucleus of **R** as it decays to a nucleus of **S**.

.....

 [2]

- 10 A measuring cylinder of substance **X** in its liquid state is placed inside a freezer where the temperature is $-18\text{ }^{\circ}\text{C}$. Fig. 10.1 shows how the temperature of the liquid varies with time t .

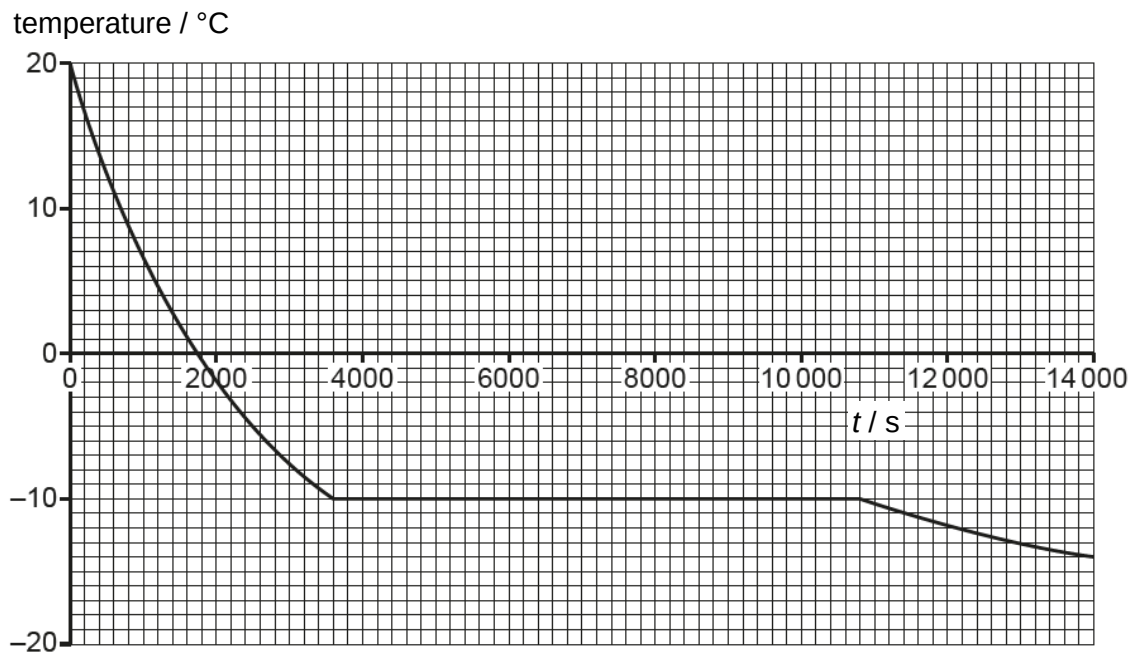


Fig. 10.1

- (a) Fig. 10.1 shows that it takes 700 s for the temperature of substance **X** to decrease from $20\text{ }^{\circ}\text{C}$ to $10\text{ }^{\circ}\text{C}$ but that it takes 1900 s to decrease from $0\text{ }^{\circ}\text{C}$ to $-10\text{ }^{\circ}\text{C}$.

Explain why these timings are different.

.....
.....
.....
..... [2]

- (b) Explain, using the kinetic model, what happens to the energy in the internal store of the molecules of substance **X** as the temperature decreases from $20\text{ }^{\circ}\text{C}$ to $0\text{ }^{\circ}\text{C}$.

.....
.....
.....
..... [2]

- 10 (c)** There is 45 g of substance **X** in the measuring cylinder and the specific latent heat of fusion of substance **X** is 5.7×10^4 J/kg.

- (i)** Explain, in terms of molecules, why the temperature of substance **X** does not change between $t = 3600$ s and $t = 10800$ s.

.....
.....
.....
..... [2]

- (ii)** Calculate the amount of energy transferred from substance **X** between $t = 3600$ s and $t = 10800$ s.

energy = [2]

- (iii)** Calculate the average rate at which energy is transferred from substance **X** between $t = 3600$ s and $t = 10800$ s.

rate = [1]

- (d)** The graph in Fig. 10.1 is steeper before the horizontal section than it is after.

Use this observation to compare the specific heat capacity of substance **X** in its different states.

.....
..... [1]

- 11** Fig. 11.1 shows a circuit. The circuit includes three resistors and two open switches, S_1 and S_2 . The power supply in the electric circuit is a battery of electromotive force (e.m.f.) 12 V.

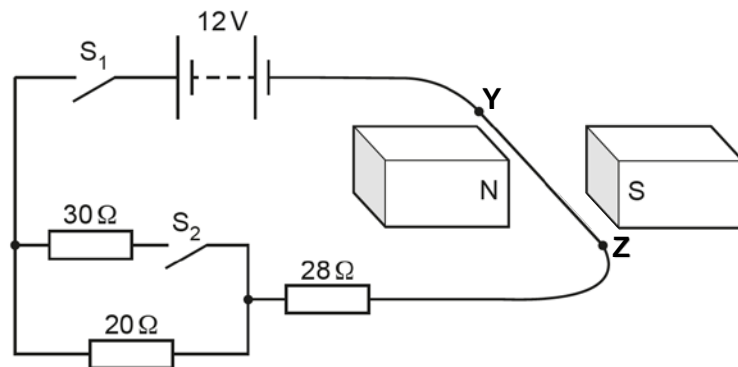


Fig. 11.1

YZ is a straight, horizontal section of connecting wire that lies between two magnets.

- (a)** State how the e.m.f. of the battery differs from that of an alternating current (a.c.) power supply.

.....
 [1]

- (b)** S_1 is now closed.

- (i)** Calculate the current flowing through **YZ**.

current = [2]

- (ii)** Explain why **YZ** experiences a force.

.....

 [2]

- (iii)** On Fig. 11.1, draw an arrow to indicate the direction of the force on **YZ**. [1]

11 (c) Switches S_1 and S_2 in the circuit in Fig. 11.1 are now closed at the same time.

(i) Calculate the total resistance of the circuit.

resistance = [2]

(ii) State and explain how the force on **YZ** will change as both switches are closed, as compared to the force on **YZ** when only S_1 was closed.

.....
.....
.....
..... [2]

Section B

Answer **one** question from this section.

- 12** A hydraulic press is used at a recycling centre to compress waste material. Fig. 12.1 is a side view of the press.

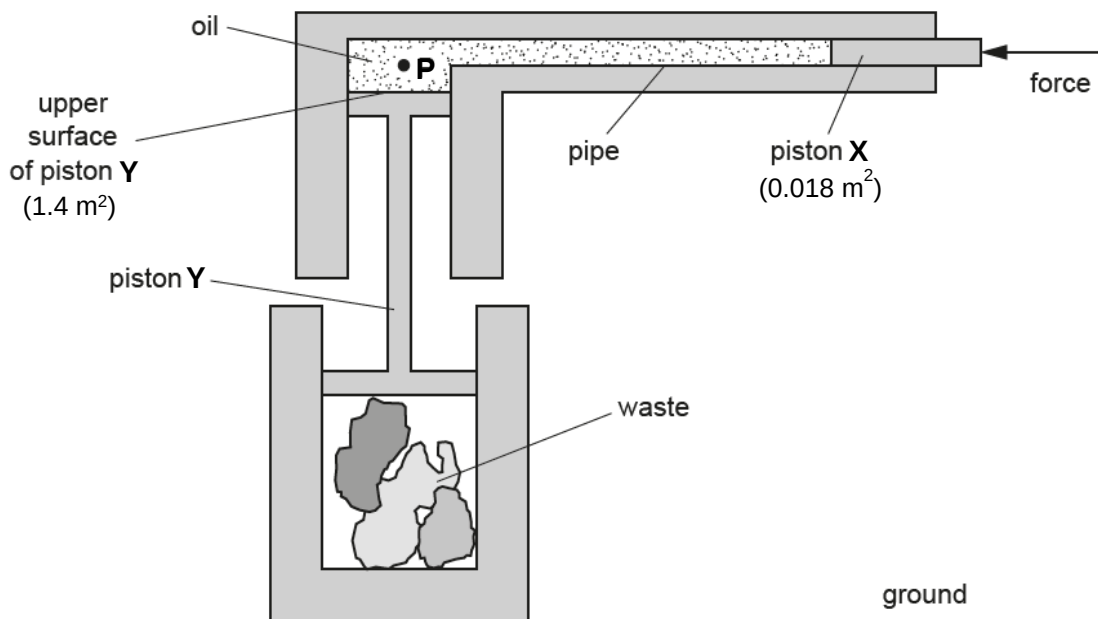


Fig. 12.1

A force to the left is exerted on piston **X**. Oil is pushed along the pipe and this moves piston **Y** downwards. Piston **Y** compresses the waste.

- (a)** Oil is a liquid.

State the property of the oil that makes it suitable for use in a hydraulic system.

..... [1]

- (b)** The cross-sectional area of piston **X** is 0.018 m^2 . Piston **X** exerts a force of 4500 N on the oil.

- (i)** Define pressure.

.....

..... [1]

- (ii)** Calculate the pressure of the oil due to the force by piston **X**.

pressure = [2]

- 12 (b) (iii) The area of piston **Y** that is in contact with the oil is 1.4 m^2 . Initially, the upper surface of piston **Y** is level with point **P**.

Calculate the force exerted on piston **Y** due to the pressure calculated in (b)(ii).

force = [1]

- (c) As piston **X** moves along the pipe:

- the pressure of the oil at point **P** due to the force by piston **X** remains constant
- piston **Y** moves downwards
- the pressure of the oil at the upper surface of piston **Y** increases

- (i) Explain why the pressure at the upper surface of piston **Y** increases as it moves downwards.

.....

..... [1]

- (ii) The density of the oil is 900 kg/m^3 . The upper surface of piston **Y** is now 0.50 m below the level of the pipe. The gravitational field strength $g = 10 \text{ N/kg}$.

Calculate the increase in the pressure at the upper surface of piston **Y** due to the oil.

increase in pressure due to oil = [2]

- (d) There is air trapped in the plastic bags that contain the waste. The temperature of the air in the bags remains constant.

Explain, in terms of molecules, why the pressure of the trapped air increases as it is compressed.

.....

.....

.....

..... [2]

- 13 (a)** Fig. 13.1 shows a regular hexagonal glass piece of refractive index 1.42. A light ray enters the glass piece at **P**, at a direction parallel to its top surface.

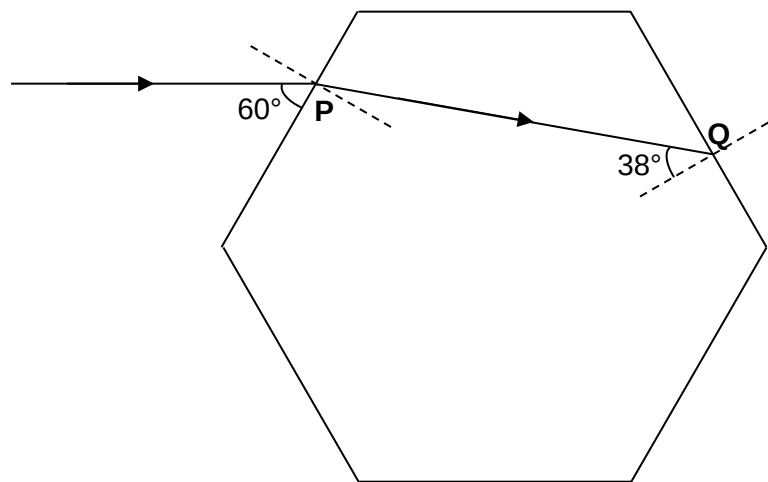


Fig. 13.1 (not drawn to scale)

- (i)** Determine the angle of refraction of the light ray at **P**.

angle of refraction = [2]

- (ii)** State what is meant by *critical angle*.

.....
 [1]

- (iii)** Determine the critical angle of glass.

critical angle = [2]

- (iv)** On Fig. 13.1, complete the path of the light ray after it strikes the surface at **Q**. [1]

- 13 (b)** Fig. 13.2 shows an object placed in front of a converging lens. The image of the object is shown on the other side of the lens.

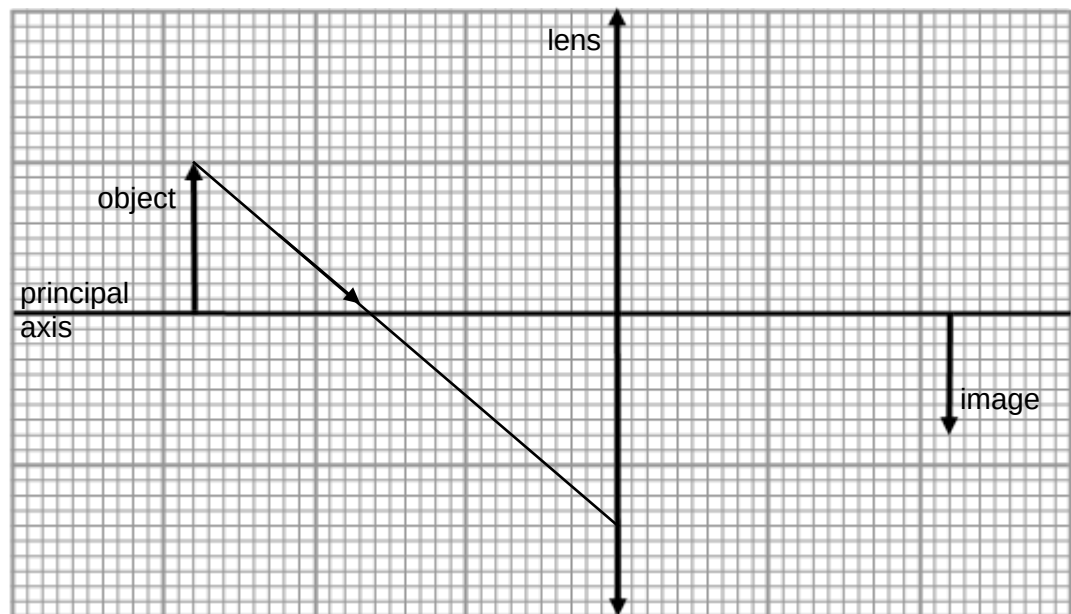


Fig. 13.2

An incomplete light ray has been given.

- (i) Complete the ray diagram and determine the focal point of the lens. Mark and label the focal point with "F". [3]
- (ii) The object is now placed at a distance nearer to the lens than the focal length of the lens.

Describe the characteristics of the image formed.

.....

..... [1]

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