YUYING SECONDARY SCHOOL
PRELIMINARY EXAMINATION
Secondary 4 Express

NAME

CLASS **REG. NO**

PHYSICS

6091/1

Paper 1 Multiple Choice

31 August 2022
1 hour
Setter: Mr Soh Wei Yong

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on this question booklet and the separate Answer Sheet.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

For Examiner's Use	
Total	40

This document consists of **20** printed pages.

1. A student uses a micrometer screw gauge to measure the diameter of a ball bearing. Diagram 1 shows the zero error of the gauge and diagram 2 shows the measurement of the diameter before it is corrected.

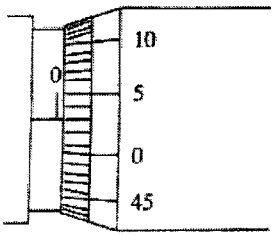


diagram 1

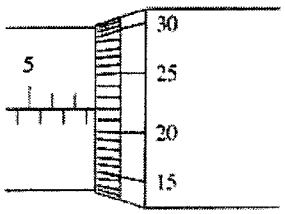


diagram 2

What is the true diameter of the ball bearing?

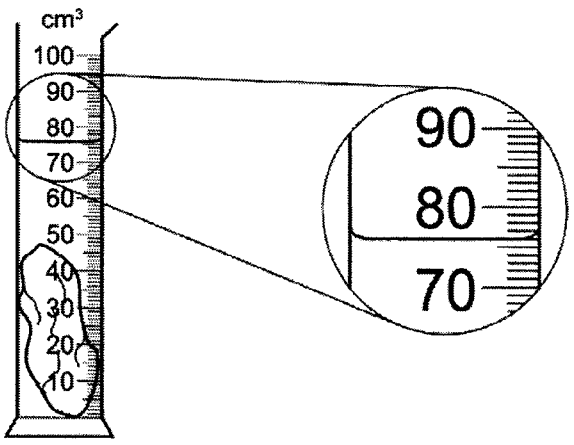
A 7.19 mm B 7.69 mm C 7.72 mm D 7.75 mm

2. An object in a space probe above the Earth weighs 3.5N.
The gravitational field strength at the height of the space probe is 7.0N/ kg.
The gravitational field strength on the Earth's surface is 10N/ kg.

What are the mass and the weight of the object on the Earth's surface?

	mass / kg	weight / N
A	0.50	3.5
B	0.50	5.0
C	2.0	3.5
D	2.0	20

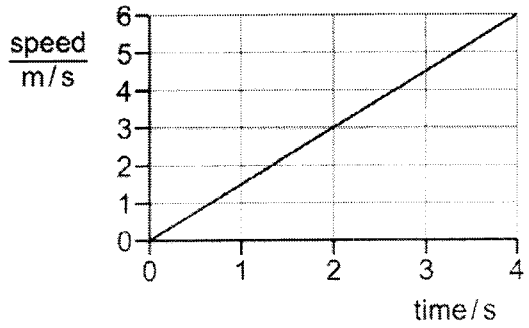
3. A measuring cylinder contains 40 cm^3 of water. A stone of mass 94 g is lowered into the water so that it is fully submerged as shown.



What is the density of the stone?

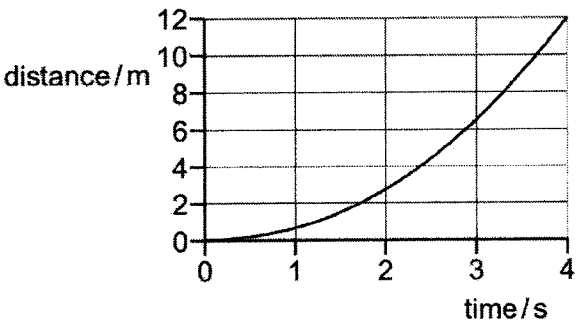
A 1.1 g/cm^3 B 1.2 g/cm^3 C 2.1 g/cm^3 D 2.6 g/cm^3

4. The graph shows how the speed of a car varies with time at the start of a journey.

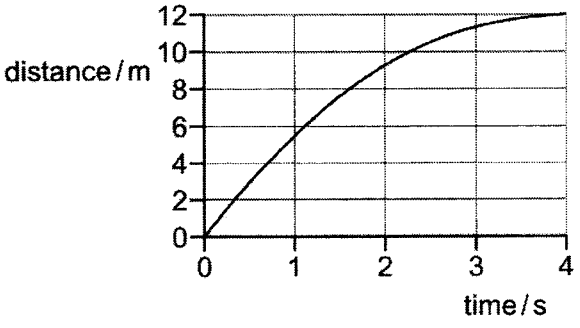


Which distance–time graph represents the motion of the car over the same time period?

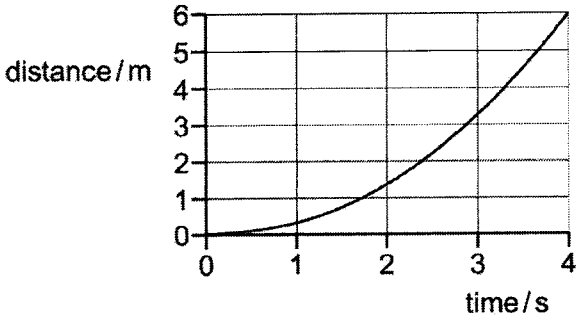
A



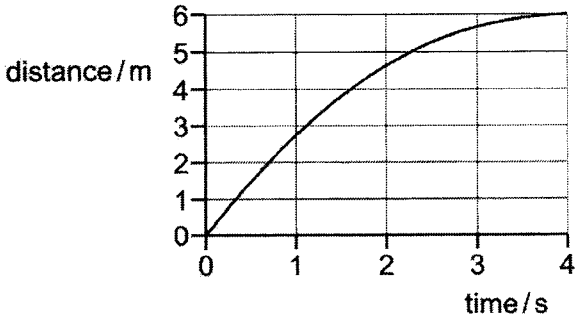
B



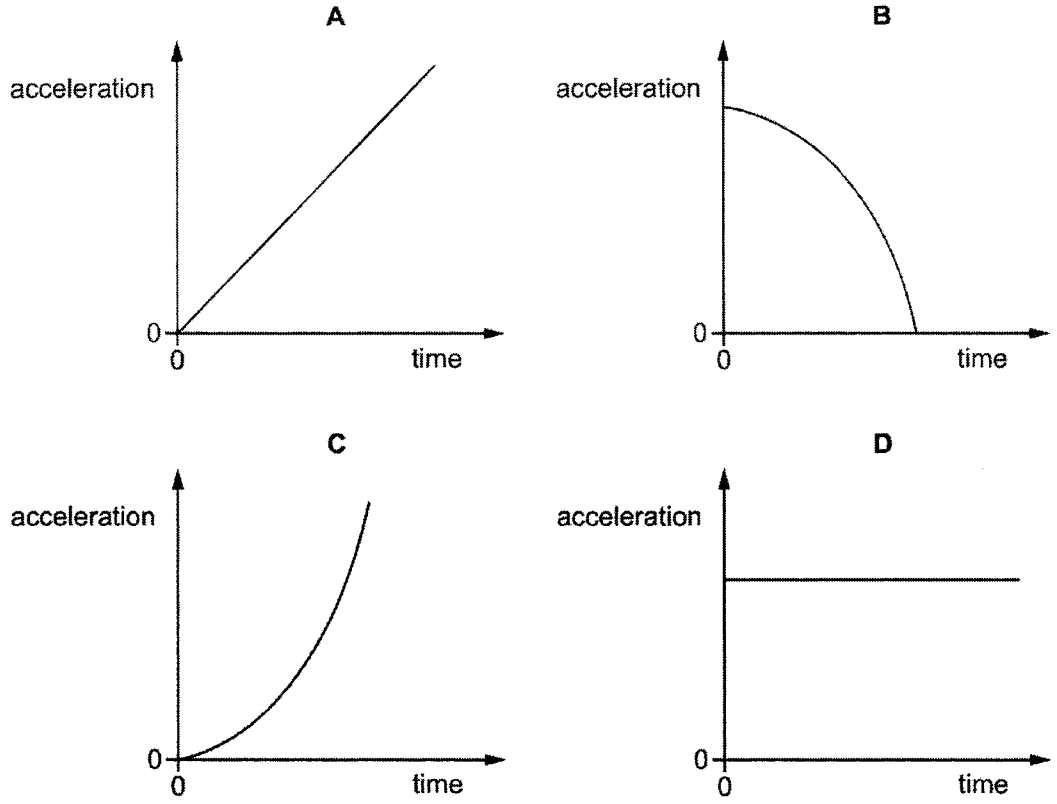
C



D

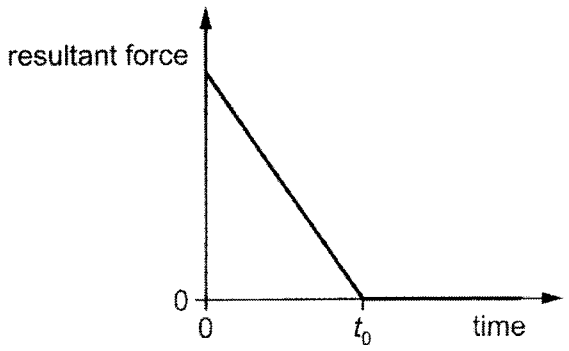


5. A stone falls freely from the top of a cliff. Air resistance may be ignored.
Which graph shows how the acceleration of the stone varies with time as it falls?



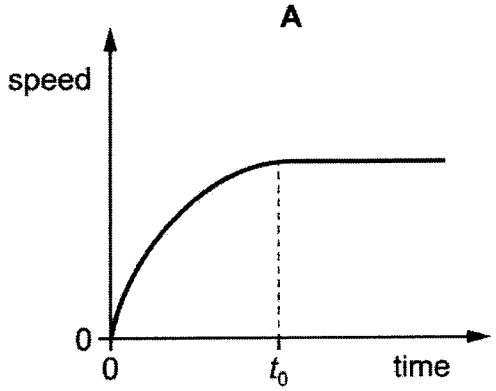
6. A resultant force acts on an object and causes it to move in a straight line.

The graph shows how the resultant force varies with time.



Which graph is the speed-time graph for the object?

A



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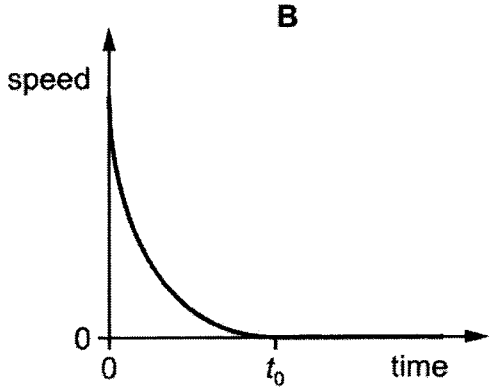

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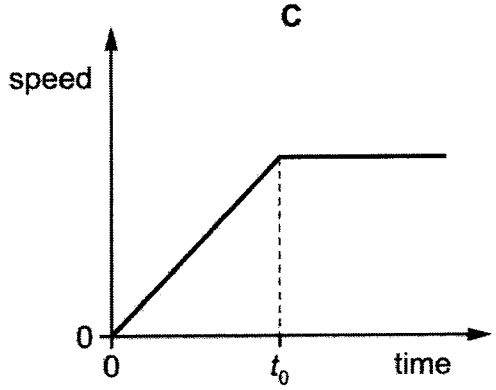

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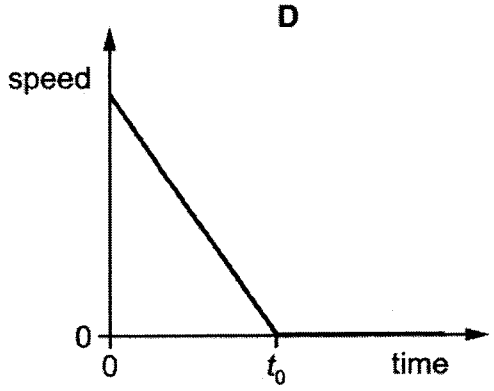
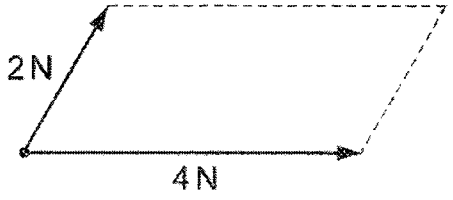


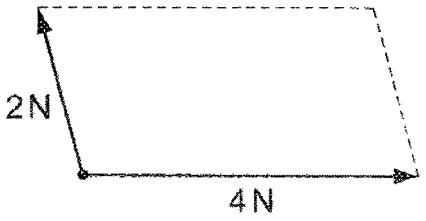
7. Forces of 4 N and 2 N act at a point.

Which scale diagram shows the forces that have a resultant of 4 N?

A



B



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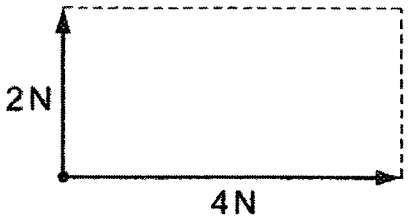
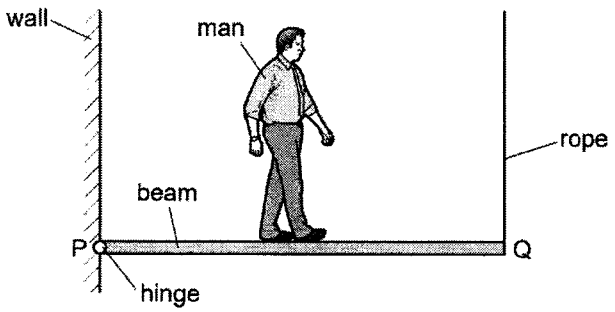


D

8. The diagram shows a wooden beam PQ, of negligible weight, which is attached to a wall by a hinge at P and kept in a horizontal position by a vertical rope attached at Q. The beam is 3.0 m in length.
A man of weight 800 N walks along the beam from P to Q.



What is the distance of the man from P when the tension in the rope at Q becomes equal to 500N?

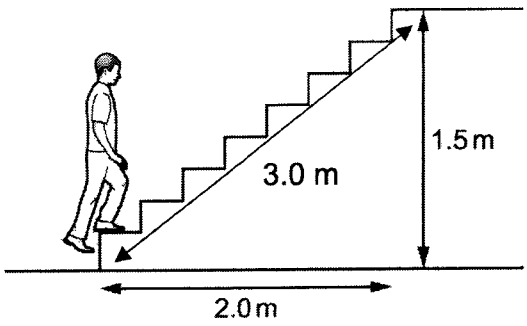
A 0.53 m B 1.1 m C 1.9 m D 2.5 m

9. A ball is dropped onto a floor. Its speed just before hitting the floor is 3.0 m/s.

Ignore any effects due to air resistance.
Which change would result in a speed of 6.0 m/s just before hitting the floor?

A Drop the ball from double the height above the floor.
B Drop the ball from four times the height above the floor.
C Use a ball with double the mass.
D Use a ball with four times the mass.

10. A student of mass 60 kg climbs some steps. He travels a horizontal distance of 2.0 m and a vertical distance of 1.5 m. The gravitational field strength g is 10N/kg.



(not to scale)

What is the work done against gravity as the student climbs up the stairs?

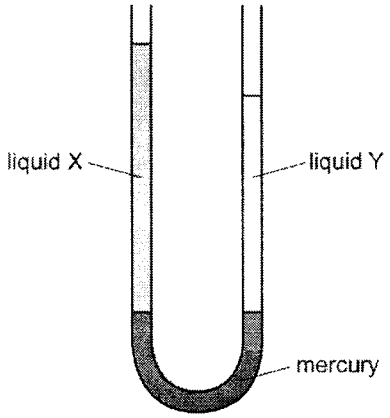
A 90J
B 120J
C 900J
D 1800J

11. A horizontal metal plate of area 0.50 m^2 lies at the bottom of a lake at a depth of 40 m.
The density of water is 1000 kg/m^3 and the gravitational field strength g is 10 N/ kg.

What is the downward force acting on the plate due to the water?

A 20 kN
B 80 kN
C 200 kN
D 800 kN

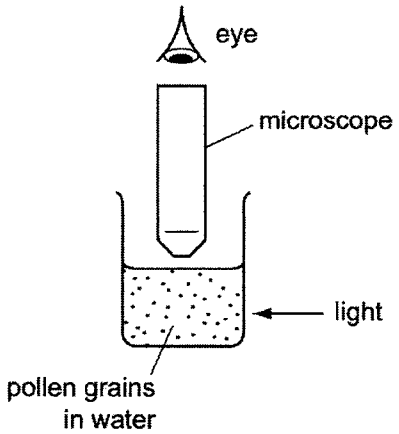
12. The diagram shows a U-tube manometer containing three liquids: mercury, liquid X and liquid Y. Neither liquid X or liquid Y mixes with mercury.



Which row compares the pressure exerted by liquid X and by liquid Y on the mercury, and the density of liquid X and the density of liquid Y?

	pressure exerted by X and by Y on the mercury	densities of X and Y
A	pressure of X is greater than Y	density of X is greater than Y
B	pressure of Y is greater than X	density of Y is greater than X
C	pressure of X and of Y is the same	density of X is greater than Y
D	pressure of X and of Y is the same	density of Y is greater than X

13. Very small pollen grains are suspended in a beaker of water. A bright light shines from the side. Small, bright dots of light are seen through a microscope. The dots move in rapidly changing, random directions.



What are the bright dots?

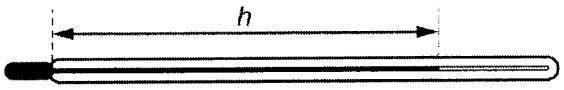
A pollen grains being hit by other pollen grains
B pollen grains being hit by water molecules
C water molecules being hit by other water molecules
D water molecules being hit by pollen grains

14. A liquid at room temperature is put on a metal surface which is also at room temperature.
A student blows gently across the liquid and its temperature decreases.

What causes the liquid to become cooler?

A Bubbles of water vapour form in the liquid and go into the air.
B The moving air reduces the kinetic energy of all the particles in the liquid.
C Thermal energy flows from the liquid into the metal.
D The more energetic particles in the liquid escape into the air.

15. The mercury-in-glass thermometer shown has a linear scale.

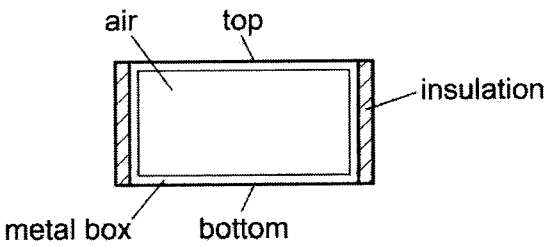


At a temperature of 100°C, h has a value of 28 cm.
At 80 °C, h has a value of 24 cm.

What is the value of h when the temperature is 0 °C?

A 0.0 cm B 2.8 cm C 4.0 cm D 8.0 cm

16. A sealed metal box contains a fixed mass of air. The sides of the box are insulated.



A scientist investigates the thermal conductivity of air. She measures how quickly thermal energy passes between the top and bottom of the box.
Which row gives the correct procedure and conclusion?

	procedure	conclusion
A	heat bottom surface	air is a good thermal conductor
B	heat bottom surface	air is a poor thermal conductor
C	heat top surface	air is a good thermal conductor
D	heat top surface	air is a poor thermal conductor

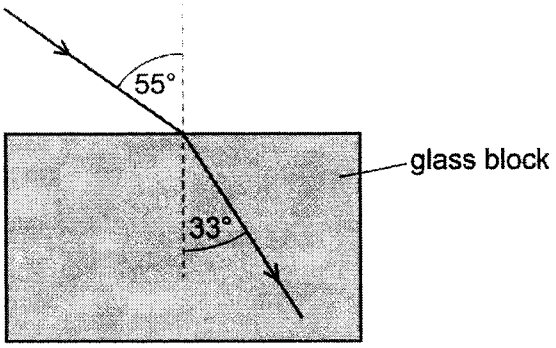
17. The water from two buckets is mixed together. One bucket contains 5 kg of water at 20 °C and the other contains 1 kg of water at 80 °C.

What is the final temperature of the mixture, assuming no heat is lost to the surroundings?

A 30 °C B 50 °C C 60 °C D 70 °C

18. Light travelling at a speed of 3.0×10^8 m/s strikes the surface of a glass block and undergoes refraction as it enters the block.

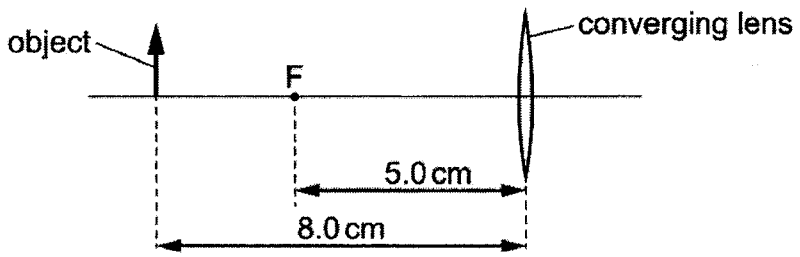
The diagram shows a ray of this light before and after it enters the block.



What is the speed of light in the glass?

A 1.8×10^8 m/s
B 2.0×10^8 m/s
C 4.5×10^8 m/s
D 5.0×10^8 m/s

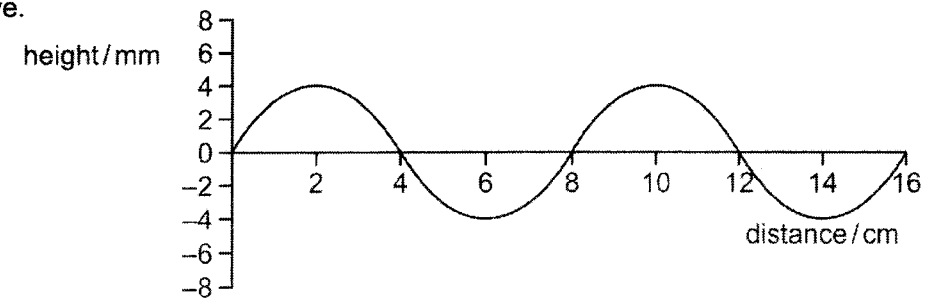
19. An object is placed 8.0cm from a thin converging lens of focal length 5.0cm.



Which statement about the image formed by the lens is correct?

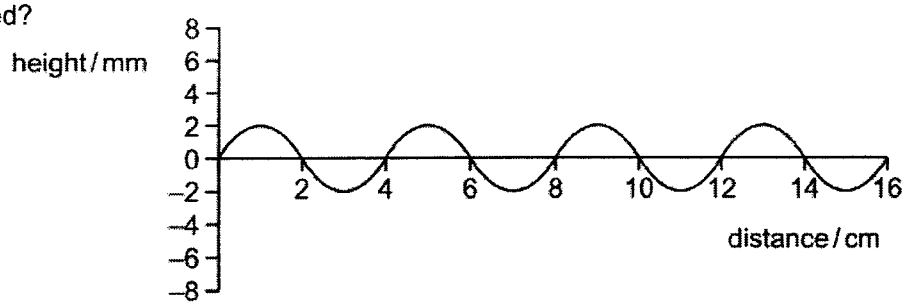
A The image is diminished, real and inverted.
B The image is magnified, real and inverted.
C The image is same size, real and inverted.
D The image is magnified, virtual and upright.

20. The graph shows how the height of a water wave varies with distance along the wave.

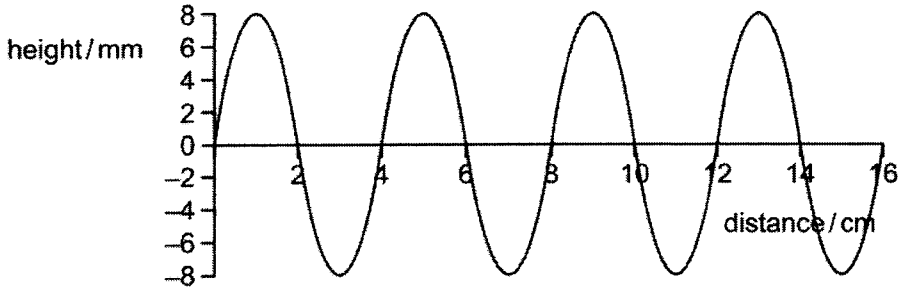


Which graph shows a wave with twice the amplitude, half the frequency, and the same speed?

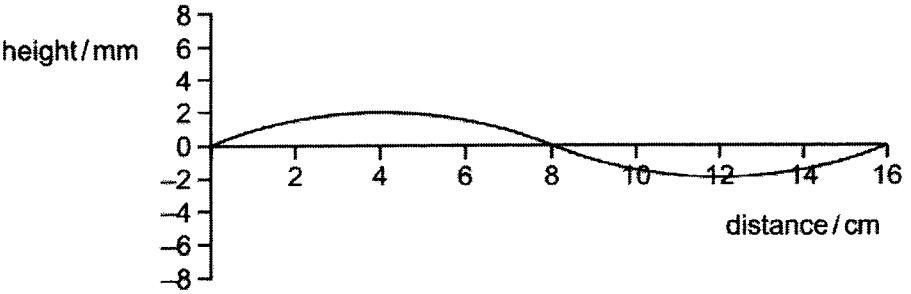
A



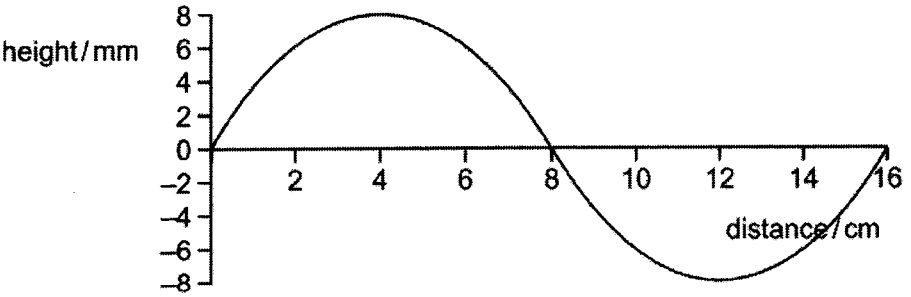
B



C



D



21. A wave of frequency 6600 Hz travels 1320 m in 4.0 s.

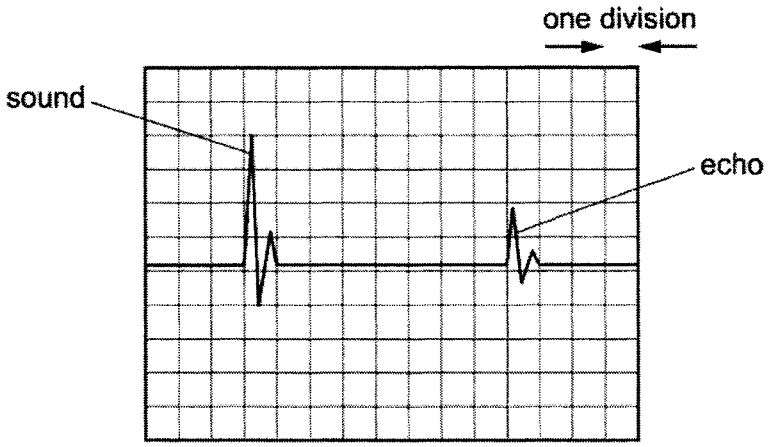
What is the wavelength?

A 0.050 m B 0.80 m C 1.3 m D 20 m

22. A loudspeaker and a microphone are placed in front of a wall.

The loudspeaker makes a sound which is detected by the microphone.

The microphone is connected to an oscilloscope which is set so that each division on the screen represents 0.01 s. The microphone detects the original sound and the echo



display on oscilloscope

The speed of sound in air is 300 m / s.

What is the distance between the loudspeaker and the wall?

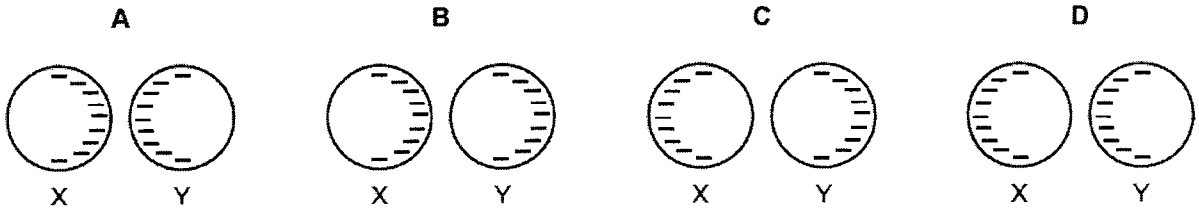
A 6.0 m B 12 m C 24 m D 48 m

23. The Sun emits infrared radiation and light. Light from the Sun reaches the Earth in 8 minutes.
Which row gives correct information about the infrared radiation?

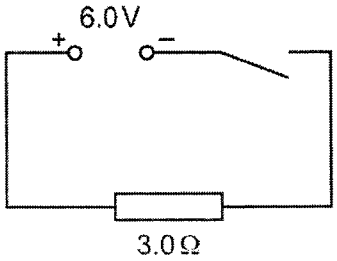
	wavelength of infrared radiation	time taken for infrared radiation to reach the Earth
A	longer than wavelength of light	8 minutes
B	longer than wavelength of light	much less than 8 minutes
C	shorter than wavelength of light	8 minutes
D	shorter than wavelength of light	much more than 8 minutes

24. Two metal spheres X and Y are on insulating bases. Both spheres are negatively charged.

Sphere X is moved towards sphere Y until they almost touch.
Which diagram shows the final pattern of charges?



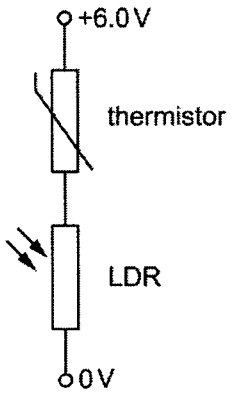
25. The circuit shown is switched on for 1.0 minute.



How much charge passes through the 3.0 Ω resistor?

A 2.0 C B 12 C C 120 C D 720 C

26. A thermistor and a light-dependent resistor (LDR) are connected in series. A potential difference (p.d.) of 6.0 V is applied across them as shown.



The thermistor has a resistance of 6000 Ω in a cold room and 1000 Ω in a warm room. The LDR has a resistance of 2000 Ω in dim light and 500 Ω in bright light.

When is the p.d. across the LDR equal to 2.0 V?

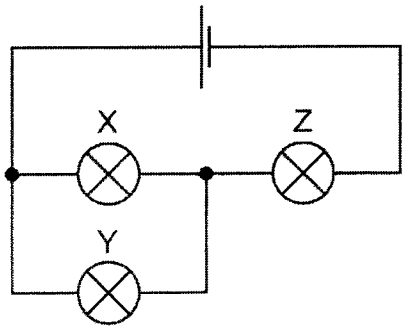
A in a cold room with bright light
B in a cold room with dim light
C in a warm room with bright light
D in a warm room with dim light

27. A copper wire has a resistance of 2.0 Ω.
A second copper wire is twice as long as the first wire, and its diameter is twice the diameter of the first wire.

What is the resistance of the second wire?

A 1.0 Ω B 2.0 Ω C 8.0 Ω D 16.0 Ω

28. The circuit diagram shows a cell connected to three identical lamps X, Y and Z. All the lamps are lit.



Lamp Y is removed by unscrewing it from its holder.

What happens to lamp Z?

A It goes out completely.
B It becomes dimmer but stays lit.
C It stays the same brightness.
D It becomes brighter.

29. A desk lamp should have a 3 A fuse fitted, but a 13 A fuse has been fitted by mistake. The lamp is not faulty.

The lamp is switched on. What happens?

A The fuse blows.
B The fuse does not blow but the lamp does not light.
C The lamp draws too much current and the supply cables could melt.
D The lamp works normally.

30. A microwave oven uses 6.0 A of current when plugged into a 240 V mains supply. It is used for two minutes each day and electricity costs $0.24 per kWh.

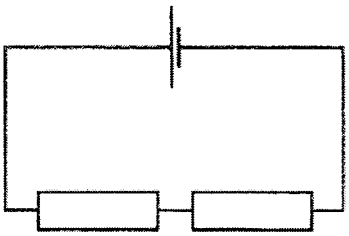
What is the cost of using it for a year (365 days)?

A $4.20
B $11.50
C $420
D $691

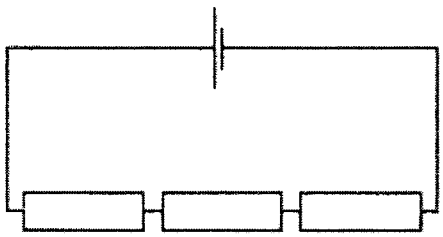
31. The circuits show a cell joined to different combinations of identical resistors.

In which circuit is electrical energy transformed at the greatest rate ?

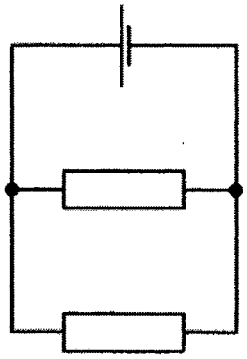
A



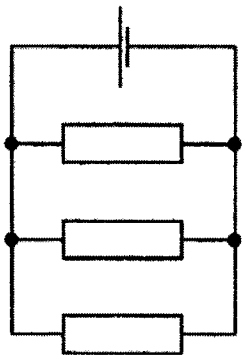
B



C



D



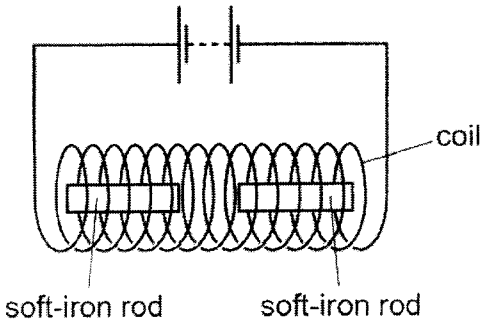
32. An old and expensive steel watch becomes magnetised.

The owner wants to use the watch again. He must demagnetise the watch.

What is the **best** method to do this?

A Insert the watch in a solenoid that carries alternating current and then slowly remove it.
B Insert the watch in a solenoid that carries direct current and then slowly remove it.
C Pass alternating current through the watch.
D Pass direct current through the watch.

33. Two soft-iron rods are placed end to end inside a coil which is connected to a battery.



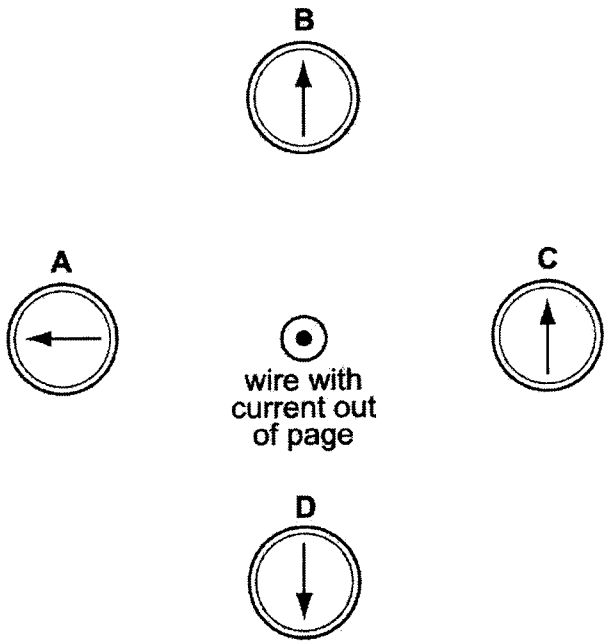
The connections from the battery to the coil are now reversed.

What happens to the soft-iron rods in each case?

	battery connections as shown	battery connections reversed
A	rods attract	rods attract
B	rods attract	rods repel
C	rods repel	rods attract
D	rods repel	rods repel

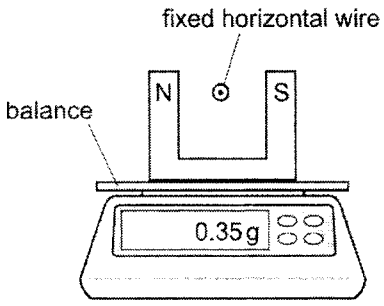
34. A wire perpendicular to the page carries an electric current in a direction out of the page. There are four compasses near the wire.

Which compass shows the direction of the magnetic field caused by the current?

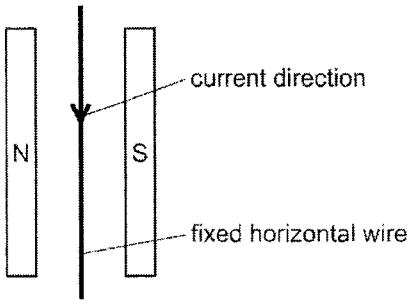


35. The diagrams show a horizontal wire in a magnetic field.
The horizontal wire is firmly held at each end (not shown) and cannot move.
The magnets and holder are on a balance.

When there is no current in the wire, the reading on the balance is 0.35 g.



view from side



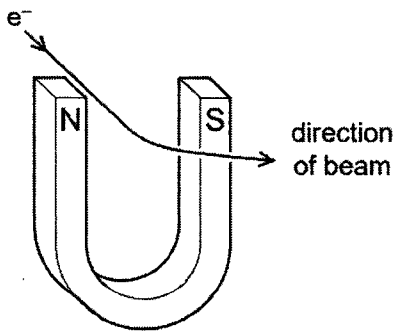
view from above

There is a d.c. current in the wire, as shown.
What happens to the reading on the balance?

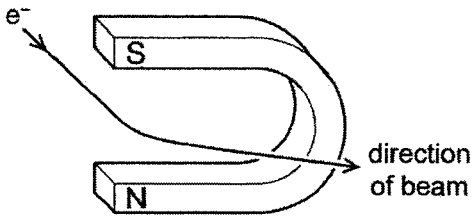
A smaller than 0.35 g
B no change
C changing from smaller to larger than 0.35 g repeatedly
D larger than 0.35 g

36. A beam of electrons is passed through the magnetic field of a magnet. How must the magnet be positioned to deflect the beam in the direction shown?

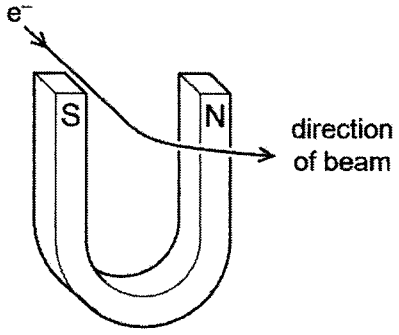
A



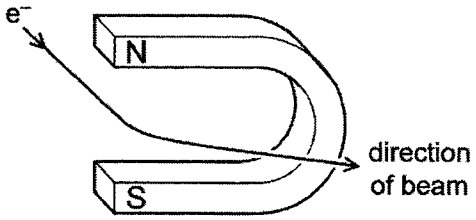
B



C



D



37. Diagram 1 shows a coil of wire P between the poles of a magnet. The ends of coil P are connected to a battery by slip rings.

Diagram 2 shows a coil of wire Q between the poles of a different magnet. The ends of coil Q are connected to a battery by a split-ring commutator.

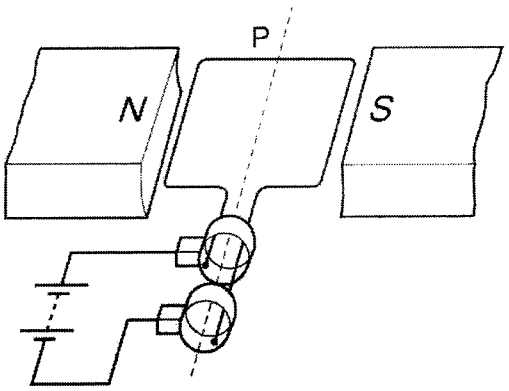


diagram 1

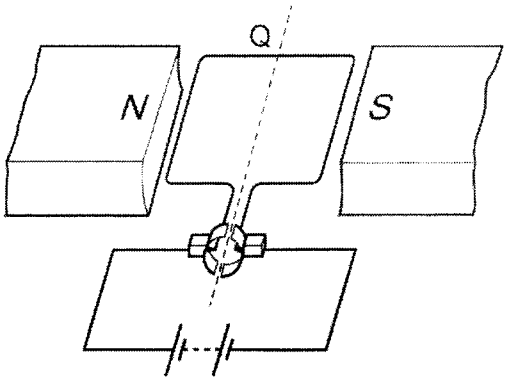
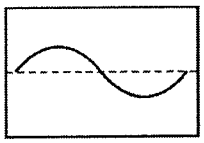


diagram 2

What happens to coils P and Q?

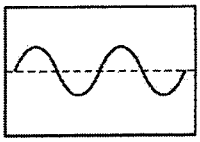
	coil P	coil Q
A	continuously turns anticlockwise	makes one quarter turn anticlockwise then stops
B	continuously turns clockwise	makes one quarter turn clockwise then stops
C	makes one quarter turn anticlockwise then stops	continuously turns anticlockwise
D	makes one quarter turn clockwise then stops	continuously turns clockwise

38. The coil of an a.c. generator is rotated and the output is displayed on the screen of a cathode-ray oscilloscope (c.r.o.).
The diagram shows the trace on the screen.

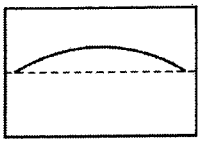


Which trace appears on the screen when the speed of rotation of the coil is doubled but the settings on the c.r.o. are unaltered?

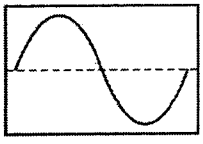
A



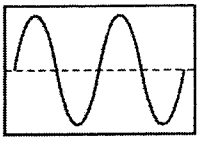
B



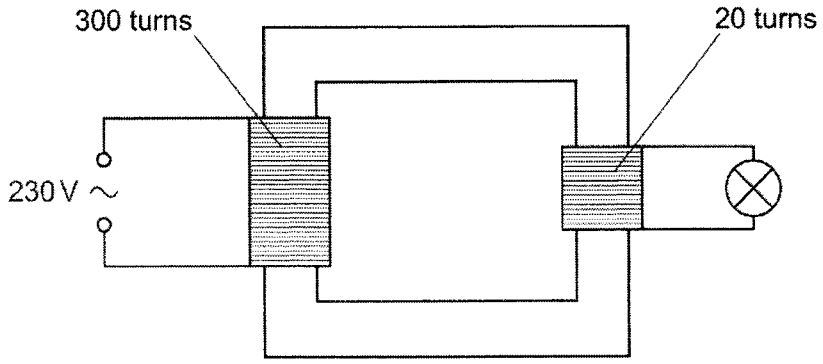
C



D



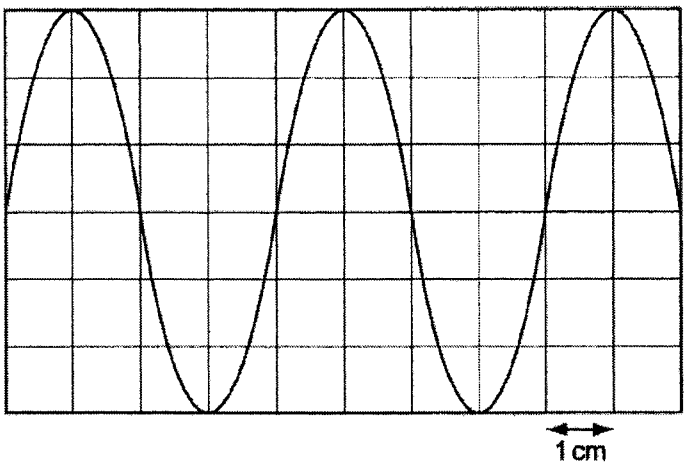
39. A student uses a transformer to light a filament lamp using a 230 V a.c. supply. The lamp has a maximum voltage rating of 6.0 V.



What happens when the circuit is switched on?

A The lamp does not light at all.
B The lamp lights dimly.
C The lamp lights at normal brightness.
D The lamp lights up brightly and then goes out.

40. An alternating supply with a period of 0.020 s is connected to a cathode-ray oscilloscope (c.r.o.).



What is the time-base setting of the c.r.o. ?

A 0.2 ms/cm B 0.5 ms/cm C 2 ms/cm D 5 ms/cm

END OF PAPER

YUYING SECONDARY SCHOOL
PRELIMINARY EXAMINATION
Secondary 4 Express

NAME

CLASS REG. NO

PHYSICS 6091/2

Paper 2

29 August 2022

1 hour 45 minutes

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

Setter: Mr Soh Wei Yong

READ THESE INSTRUCTIONS FIRST

Write your name, class and register 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 soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Section B
Answer all **three** questions. The last question is in the form either/or and only one of the alternatives should be attempted.
Write your answers in the spaces provided on the Question Paper.
Write your answers on the writing papers provided.

The use of an approved calculator is expected, where appropriate.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Total	/80

This document consists of **27** printed pages.

Section A

Answer **all** the questions in this section in the spaces provided.
The total mark for this section is 50.

1. Fig. 1.1 is a distance-time graph showing the motion of an object.

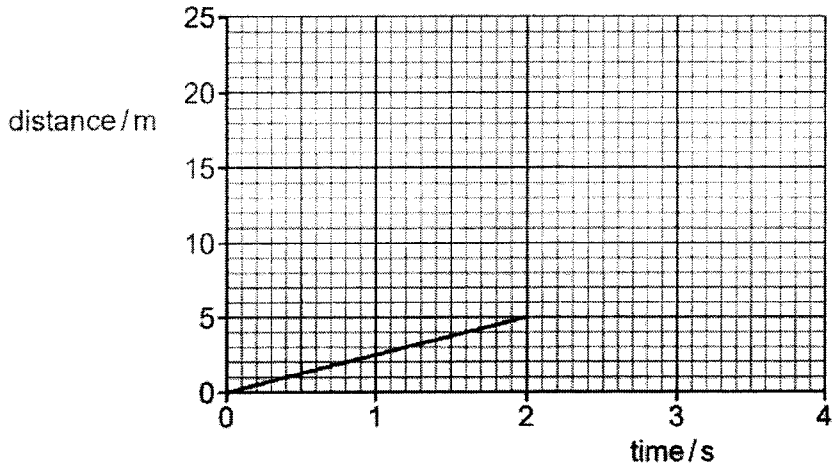


Fig. 1.1

(a) (i) Describe the motion shown for the first 2 s, calculating any relevant quantity. [1]

(ii) After 2 s the object accelerates. On Fig. 1.1, sketch a possible shape of the graph for the next 2 s. [1]

(b) Describe how a distance-time graph shows an object that is stationary. [1]

(c) Fig. 1.2 shows the axes for a speed-time graph.

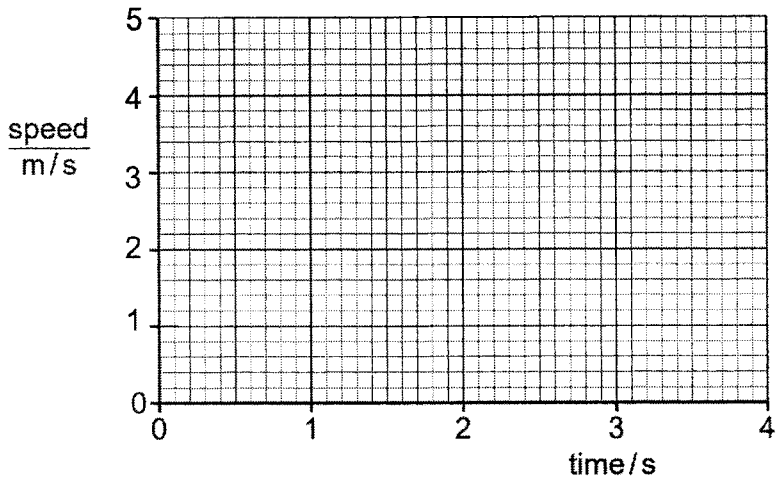


Fig. 1.2

On Fig. 1.2, draw

(i) the graph of the motion for the first 2 s as shown in Fig. 1.1, [1]

(ii) an extension of the graph for the next 2 s, showing the object accelerating at a constant rate 1.0 m/s^2. [1]

2. The rocket shown in Fig. 2.1 is about to be launched.

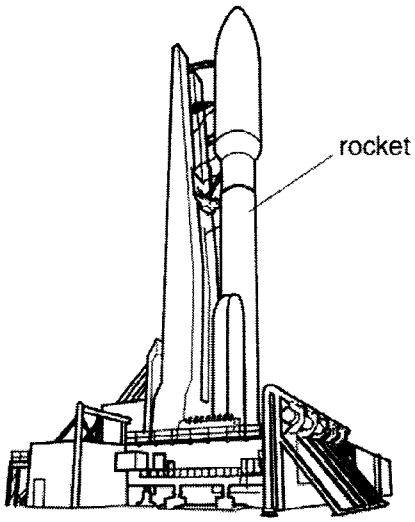


Fig. 2.1

The total mass of the rocket and its full load of fuel is 2.8×10^6 kg. The constant force provided by the rocket's motors is 3.2×10^7 N.

The gravitational field strength, g near the surface of the Earth is 10 N/kg.

(a) Calculate the vertical acceleration of the rocket immediately after lift-off. [2]

(b) Suggest one reason why the acceleration of the rocket increases as it rises above the Earth's surface. [1]

(c) As the rocket burns fuel, it ejects hot gas downwards.

Explain how Newton's third law of motion applies to the force on the rocket. [2]

3. A microphone in a recording studio has a mass of 0.55 kg. The gravitational field strength, g is 10 N/kg.

The microphone is suspended from the ceiling by a cord attached to a small ring. Fig. 3.1 shows the microphone pulled to one side and kept stationary by a horizontal thread.

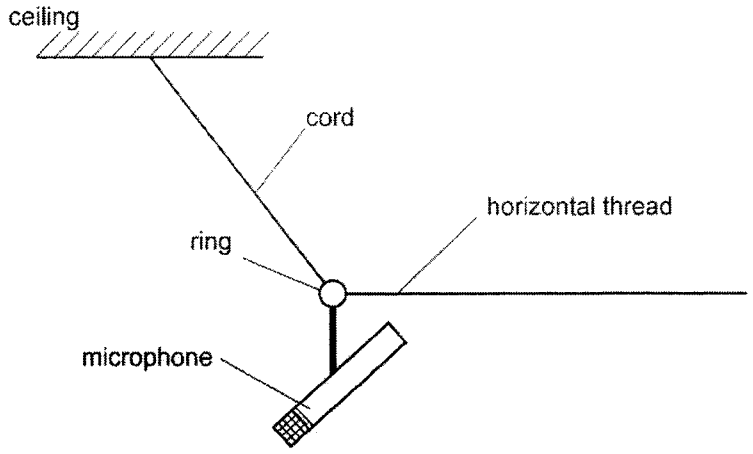


Fig. 3.1 (not to scale)

The tension T in the cord is 8.0 N.

Use a scaled vector diagram to determine the size of the force exerted by the horizontal thread on the ring. State your scale clearly. [3]

scale : _____

size of force by horizontal thread: _____

4. When the lid of a freezer is opened, it pivots about the hinge at the back of the freezer. The handle is at the front.
Fig. 4.1 is a side view of the freezer.

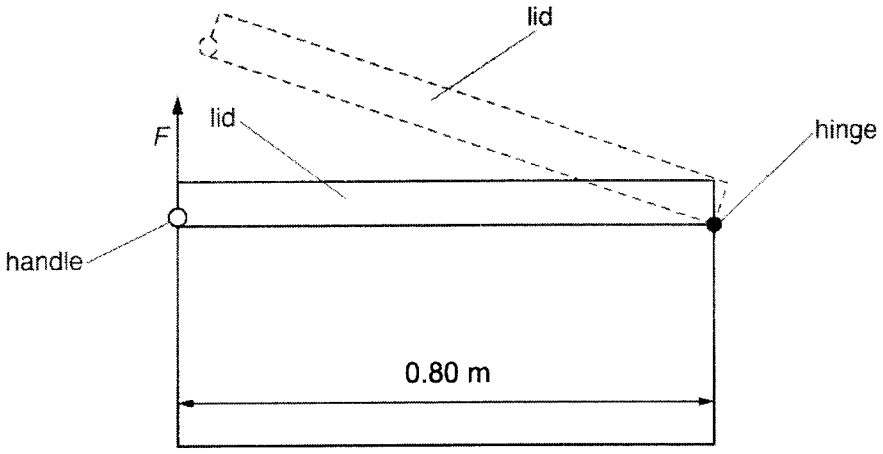


Fig. 4.1

The handle is 0.80 m from the hinge. The lid has a mass of 2.0 kg. The lid is non-uniform and its centre of gravity is at a distance of 0.45 m from the handle.

The gravitational field strength g is 10 N kg.

(a) The lid is closed. To open the lid, a force F is applied to the handle as shown in Fig. 4.1.

Determine the size of force, F required to open the lid. [2]

(b) The direction of F is vertically upwards and F is the smallest possible force that opens the lid.

A force on the handle in any other direction must be larger than F in order to open the lid. Explain why. [1]

5. Fig. 5.1 shows a container of gas connected to a manometer. The tube in the manometer has a constant cross-sectional area.

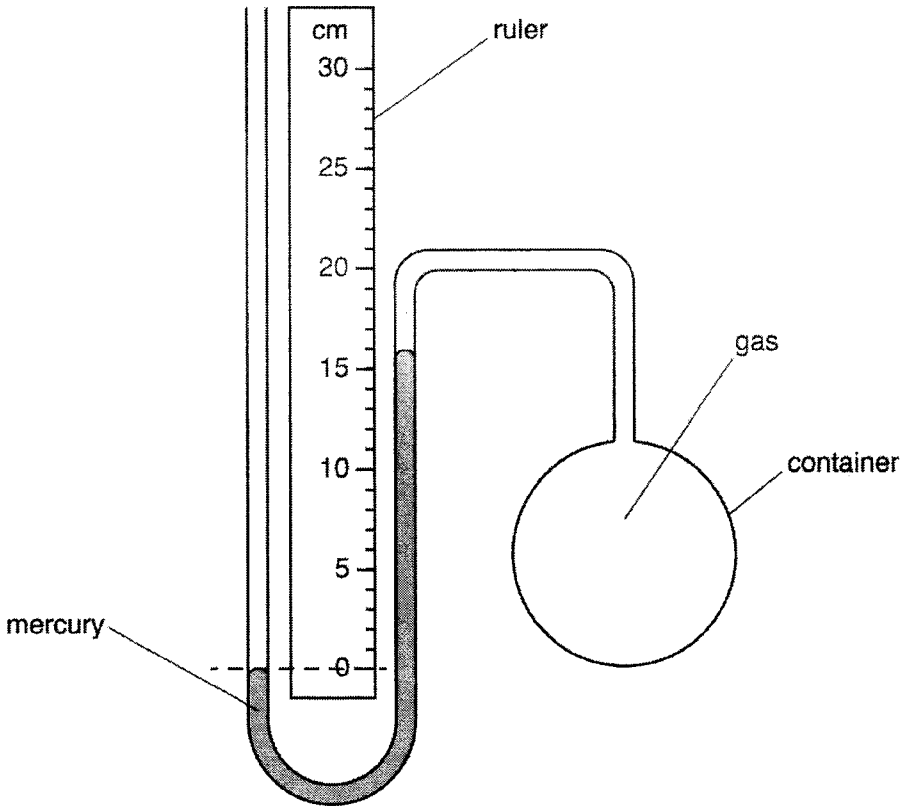


Fig. 5.1

The density of mercury is 1.4×10^4 kg/m^3. The gravitational field strength g is 10 N/kg. The pressure of the atmosphere is 76 cm Hg.

(a) Calculate the pressure of the gas **(in Pa)** in the container. [2]

(b) In Fig. 5.1, the mercury level on the left-hand side of the manometer is lower than on the right-hand side.
The gas inside the container is heated. This causes the mercury levels on both sides to become the same.

(i) Determine the mercury level, as shown on the ruler, when this happens. [1]

(ii) Explain, in terms of the gas molecules, what causes the level of mercury to become the same. [2]

6. Fig. 6.1 shows a kettle containing water placed on the burner of a gas cooker.

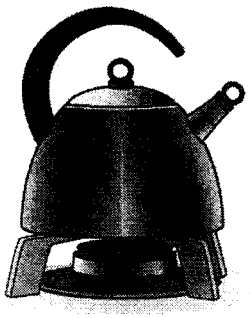


Fig. 6.1

The gas burner is lit at time t = 0.
At t = 250 s the temperature of the water is 100 °C, the boiling point of water.

(a) Fig. 6.2 shows how the temperature of the water changes with time t.

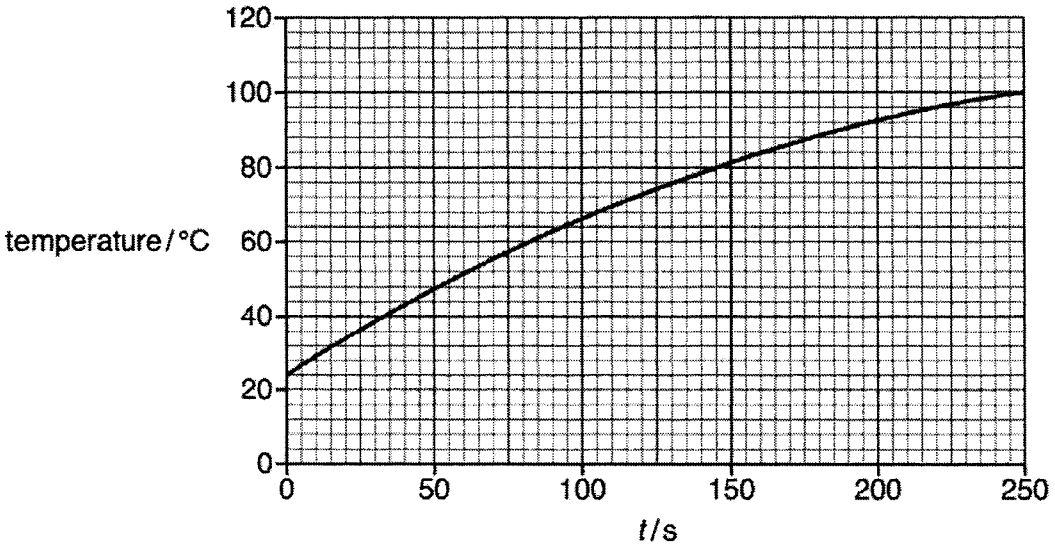


Fig. 6.2

(i) The kettle contains 1.5 kg of water which has a specific heat capacity of 4200 J/(kg °C).
Using Fig. 6.2, determine the increase in the internal energy of the water between t = 0 and t = 250 s. [2]

(ii) Thermal energy (heat) is transferred to the water at a constant rate but the temperature of the water increases at a rate that is not constant, as shown in Fig. 6.2.

Explain why the temperature increases in this way. [1]

(b) When the temperature reaches 100 °C, the kettle is left on the burner. Thermal energy is still supplied to the water. The water boils as the molecules form bubbles and rise to the surface.

Explain, in terms of the molecules, why it is necessary to supply thermal energy in order to keep the water boiling. [2]

7. Figs. 7.1 and 7.2 show a semi-circular glass block as rays of blue light are directed into the block at different angles. The rays are directed towards the centre C of the semi-circle so that no refraction occurs as the rays enter the block.

(a) At the angle shown in Fig. 7.1, no refracted ray emerges from the block at C.

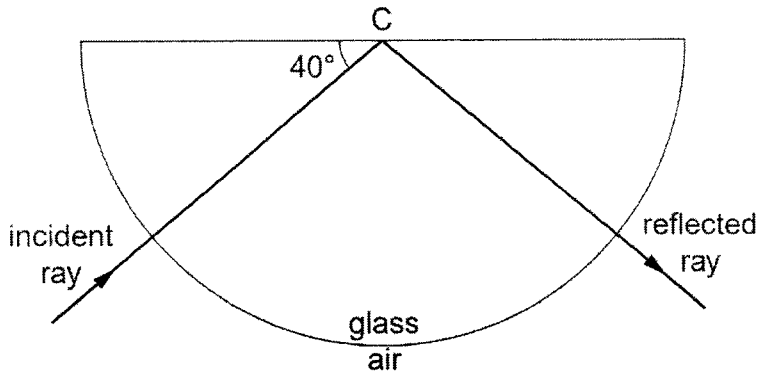


Fig. 7.1

(i) Determine the angle of incidence at C. [1]

(ii) State and explain the type of phenomenon occurring at C. [2]

(b)

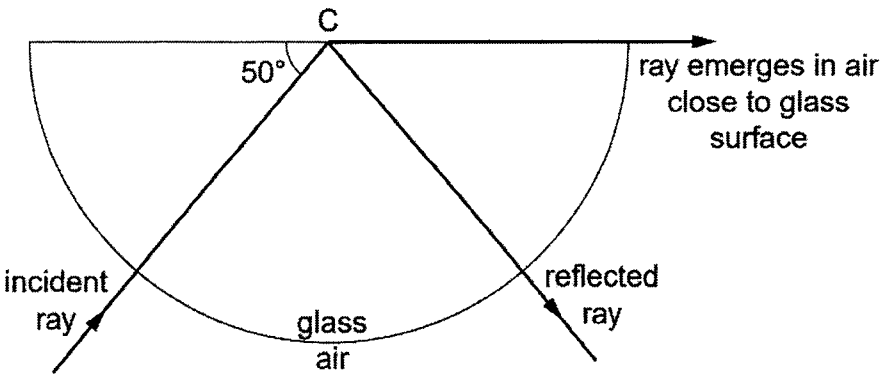


Fig. 7.2

Calculate the refractive index of the glass. [2]

(c) The experiment in **(b)** is now repeated with red light. The refractive index of red light in the glass block is smaller than the refractive index of blue light.

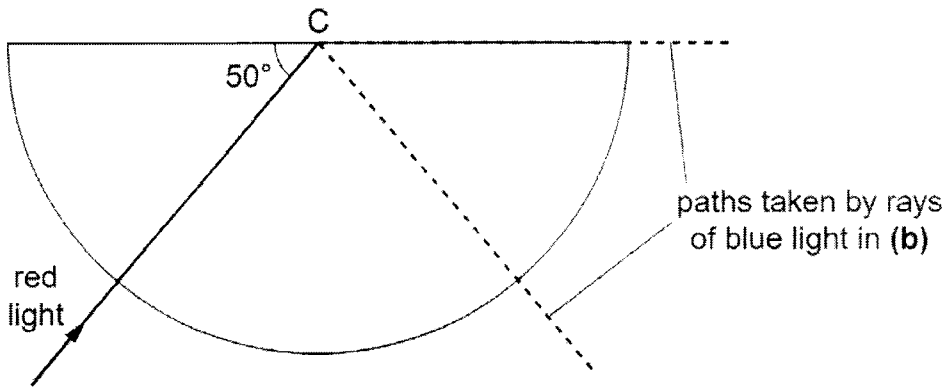


Fig. 7.3

On Fig. 7.3, draw and label the paths of the reflected and refracted rays of red light. The dashed lines show the paths taken by the blue light in **(b)**. [2]

8. Fig. 8.1 shows the position of a man working in a rock quarry. A single explosion is used to break part of one rock face.

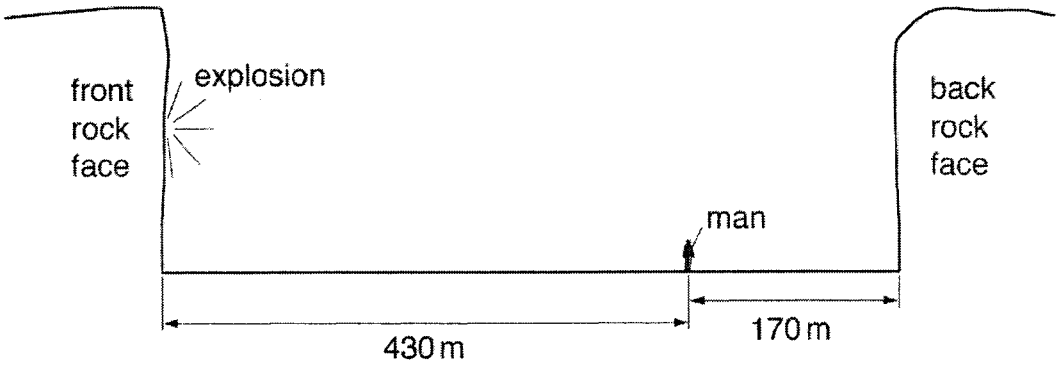


Fig. 8.1

(a) The man hears a second bang shortly after the first bang.

State and explain how the second bang compares with the first bang in terms of its amplitude and wavelength. [3]

(i) amplitude: _____

_____

(ii) wavelength: _____

_____

_____

(b) The man stands 170 m from the back rock face. The time between hearing the first bang and hearing the second bang is 1.0 s.

Use the information in Fig. 8.1 to determine the speed of sound in the quarry. [2]

9. Fig. 9.1 shows a wire PQ placed between the poles of a magnet. There is a current in wire PQ.

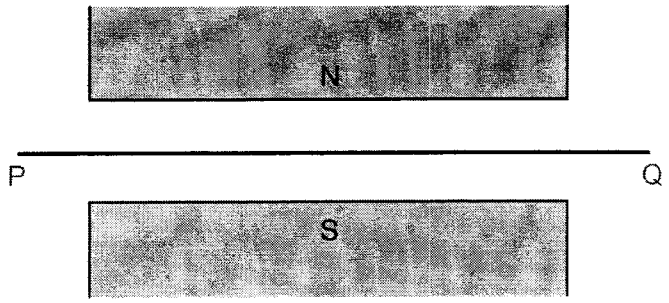


Fig. 9.1

(a) The force on PQ is into the paper.
Draw an arrow on PQ to show the direction of the current. [1]

(b) Explain the method you used to determine the direction of the current in part **(a)**. [2]

10. A straight length of copper wire lies horizontally between the poles of a U-shaped magnet.

Fig. 10.1 shows the two ends of the wire connected to a very sensitive, centre-zero ammeter.

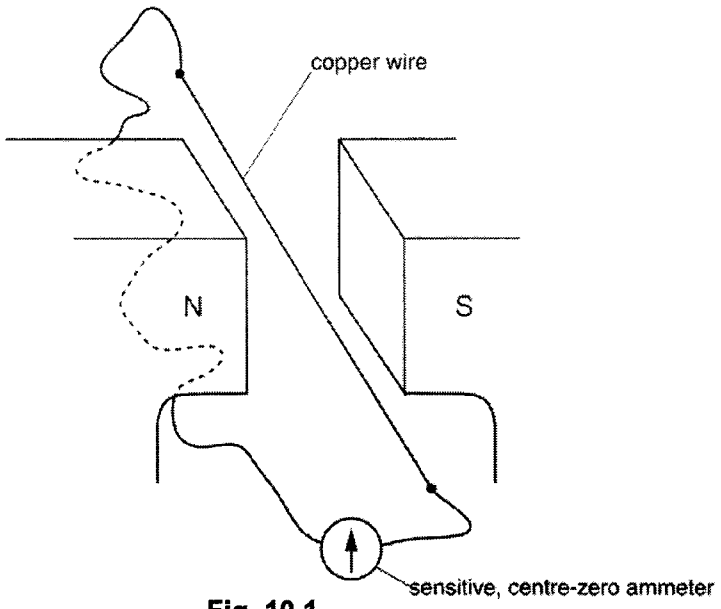


Fig. 10.1

The copper wire is moved upwards slowly between the two magnetic poles. The needle on the ammeter deflects to the right.

(a) Explain why the needle on the ammeter deflects. [2]

(b) The wire is moved downwards very quickly between the two magnetic poles. State what happens to the needle on the ammeter. [1]

(c) State and explain what happens to the needle on the ammeter when the copper wire is moved horizontally between the two poles. [2]

11. Fig. 11.1 shows a laptop and a charger. The charger contains a step-down transformer.

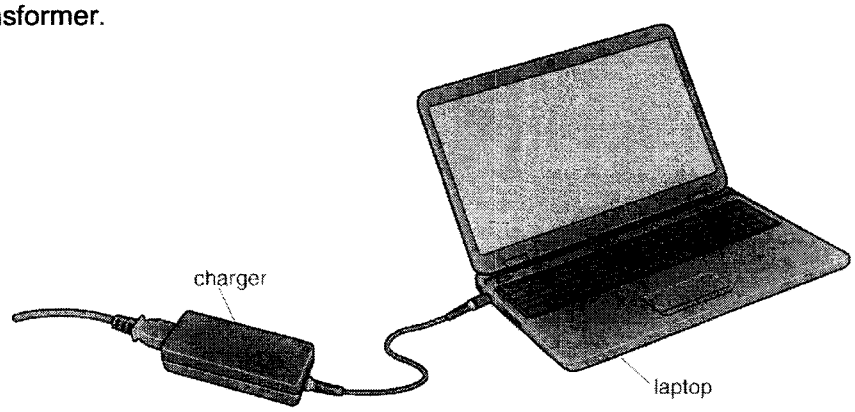


Fig. 11.1

(a) (i) Explain the function of a step-down transformer. [1]

(ii) The transformer has an input voltage of 240V and an output voltage of 12V. There are 10 000 turns on the input coil. Calculate the number of turns on the output coil. [1]

(b) Electricity is transmitted at high voltages.
State two advantages of transmitting electricity in this way. [2]

Section B

Answer **all** the questions in this section in the spaces provided.
The last question is in the form either/or and only **one** of the alternatives should be attempted.
The total mark for this section is 30.

12. A length of fuse wire is cut into two pieces X and Y. Each piece of wire is clamped, in turn, between two metal clips, as shown in Fig. 12.1.

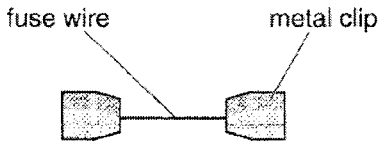


Fig. 12.1

The length of wire between the clips is 1.5 cm for wire X and 0.4 cm for wire Y.

(a) The potential difference (p.d.) across each wire is slowly increased. The p.d. is measured at various values of current until the wire melts. Fig. 12.2 shows the readings obtained.

	wire X	wire Y
current / A	p.d. / V	p.d. / V
0	0	0
0.5	0.15	0.04
1.0	0.30	0.08
1.5	0.49	0.14
2.0	0.77	0.23
2.5	1.19	0.37
3.0	1.99	0.70
3.5	2.98	1.10
3.8	melts	1.50
4.0		melts

Fig. 12.2

(i) Using data from Fig. 12.2, describe the relationship between the current in X and the p.d. across X [2]

1. for low currents, _____

_____

_____

2. for high currents, _____

_____

_____

(ii) The data in Fig. 12.2 provide some evidence of a relationship between the length of the wire and the current that causes it to melt.
State this possible relationship. [1]

(iii) With the same current, the p.d. across the two wires is different.
Explain why. [2]

(b) The experiment is repeated with a strong wind blowing over the wires.
Fig. 12.3 shows the new readings obtained at low currents.

	wire X	wire Y
current / A	p.d. / V	p.d. / V
0.5	0.14	0.03
1.0	0.28	0.06

Fig. 12.3

(i) Suggest a reason why the values of the p.d. at the same current are lower in Fig. 12.3 than in Fig. 12.2. [1]

(ii) Suggest one other difference that is seen when readings at values of current greater than 1.0 A are compared to those in Fig. 12.2. [1]

(c) Just before each wire melts, the middle of the wire in Fig. 12.1 becomes red hot.

(i) Describe **two** ways in which thermal energy (heat) is lost from the middle of the wire. [2]

(ii) Explain why the ends of the wire are colder than the middle. [1]

13. A student sets up the circuit shown in Fig. 13.1 in a laboratory at room temperature.

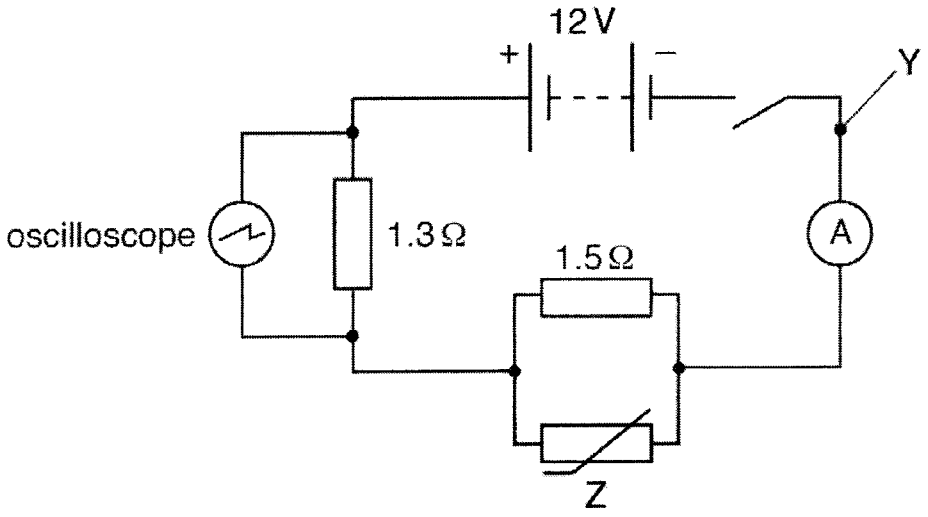


Fig. 13.1

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. [1]

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

(i) State the name of component Z. [1]

(ii) Calculate the current measured by the ammeter. [2]

(iii) Calculate the potential difference (p.d.) across the 1.3 Ω resistor. [1]

(c) Fig. 13.2 shows the screen of the oscilloscope.

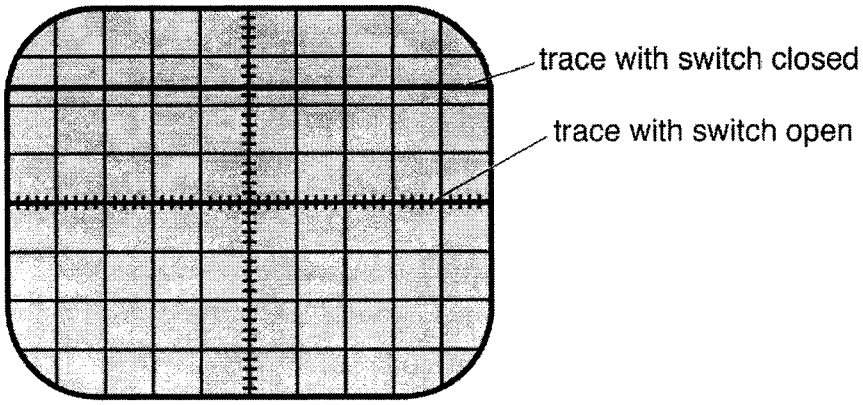


Fig. 13.2

Before the switch is closed, the trace is a horizontal line across the middle of the screen, as shown in Fig. 13.2.

When the switch is closed, the trace remains horizontal and moves up the screen.

(i) Use your answer in (b) (iii) to determine the Y-gain in V/div of the oscilloscope shown in Fig. 13.2 when the switch is closed. [2]

(ii) Component Z is heated.
State and explain what is observed on the oscilloscope screen as the temperature of Z increases. [3]

EITHER

14. Fig. 14.1 shows a large container ship travelling at constant speed in a straight line.

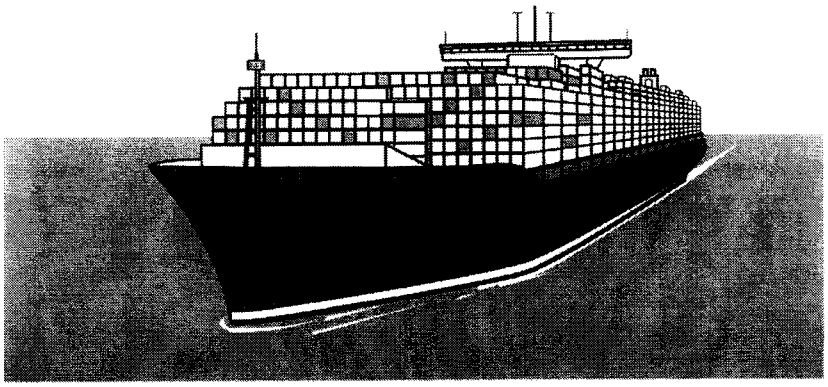


Fig. 14.1

The resistive force acting on the ship is 2.8×10^6 N.

(a) The ship is travelling at constant speed of 9.7 m/s.

(i) Calculate the work done against the resistive force on the ship in 2.0 s. [2]

(ii) The engines are powered by oil.
State the energy transfer that is taking place when the ship is travelling at constant speed. [1]

_____

_____

(iii) State the size of the forward force produced by the engines. [1]

_____

_____

(b) The mass of the ship is 2.2×10^8 kg.
The engines are switched off and the resistive force causes the ship to decelerate.

(i) Calculate the initial deceleration of the ship. [1]

(ii) As the speed of the ship decreases, its deceleration changes.
Suggest and explain how the deceleration changes. [2]

(iii) On Fig. 14.2, sketch a possible speed-time graph for the ship as it decelerates to rest. [1]

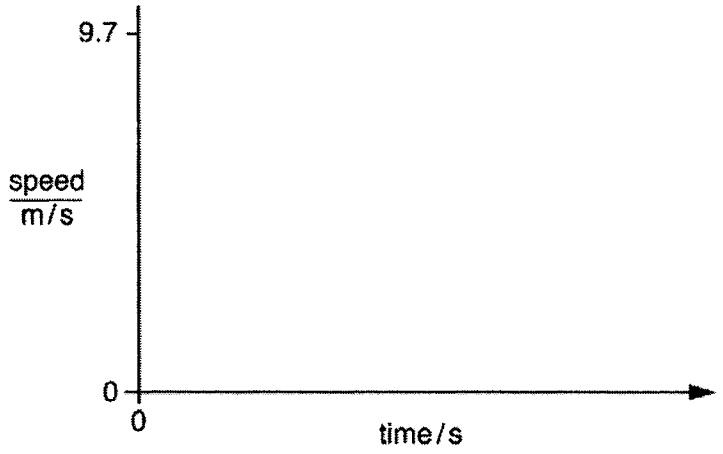


Fig. 14.2

(c) When the ship is travelling at a different speed, energy is being supplied to the engines at a rate of 33 MJ/s. The efficiency of the engines is 36%.

(i) State a relationship that defines efficiency. [1]

_____

_____

(ii) Calculate the rate at which energy is wasted in the engines. [1]

OR

14. (a) Fig. 14.1 shows a thunder cloud with a flat, positively charged base. It passes over a tall tree growing in a region of flat, open land.

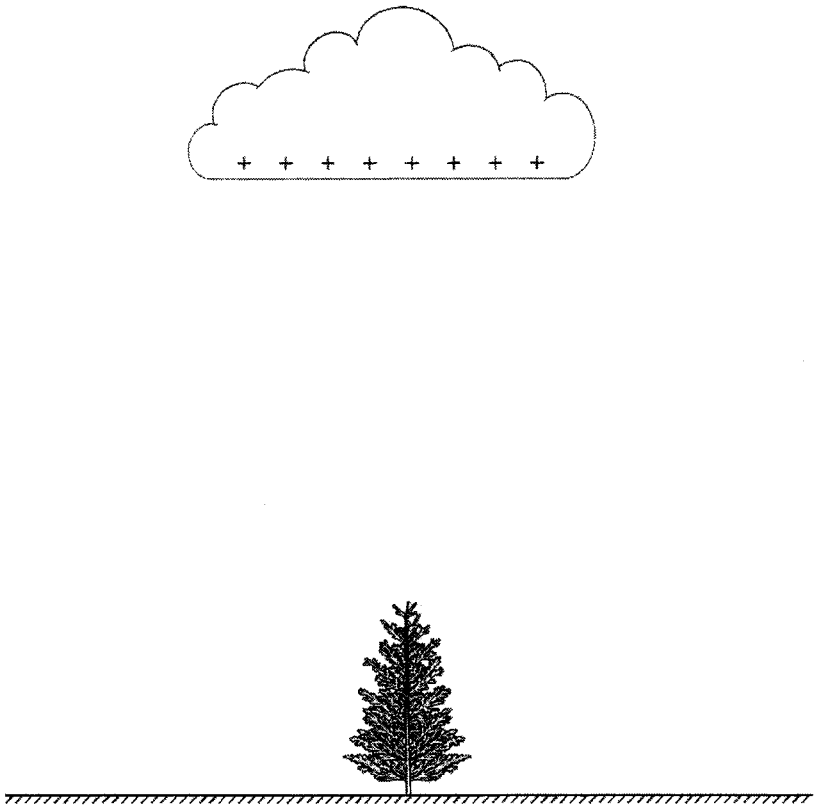


Fig. 14.1 (not to scale)

(i) On Fig. 14.1, mark the charge on the tree. [1]

(ii) Explain how the tree becomes charged. [2]

(iii) A lightning strike occurs and, in 2.0×10^{-4} s, a charge of 560 C passes from the cloud to the tree.
The size of the charge on an electron is 1.6×10^{-19} C.

Calculate the number of electrons that pass between the tree and the cloud. [1]

(iv) Calculate the average current in the lightning strike. [1]

(b) Two flat metal plates are positioned horizontally, one above the other.
Fig. 14.2 shows the positive terminal of a high-voltage supply unit connected to the bottom plate and the negative terminal connected to the top plate.

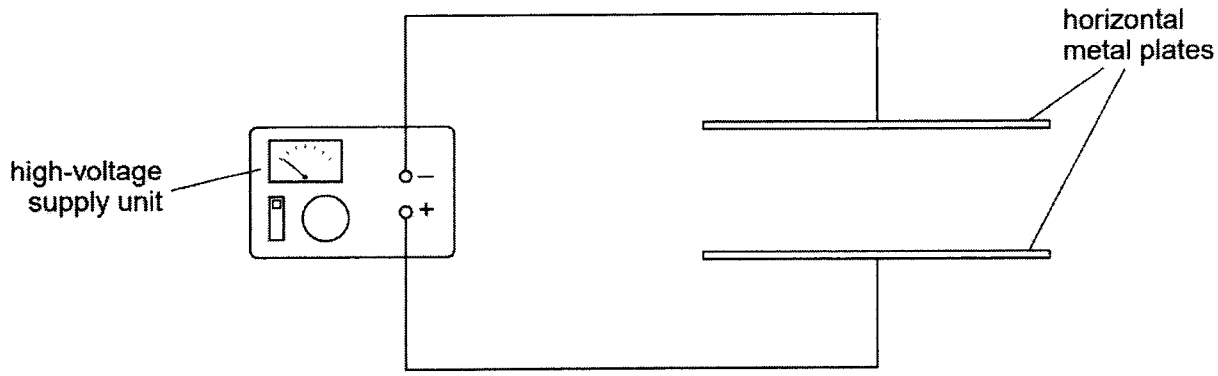


Fig. 14.2

The high-voltage supply is switched on.

(i) On Fig. 14.2, draw the shape and the direction of the electric field produced between the 2 metal plates. [1]

(ii) Explain why a small, charged oil droplet placed between the two metal plates accelerates upwards. [3]

(iii) The oil droplet touches the top metal plate. State and explain what happens to the charge on the oil droplet. [1]

END OF PAPER

PHYSICS 6091
PRELI EXAMINATION 2022
MARKING SCHEME

Sec. 4E

Paper 1 [40 marks]

1 B	6 A	11 C	16 D	21 A	26 C	31 D	36 B
2 B	7 B	12 D	17 A	22 B	27 A	32 A	37 C
3 D	8 C	13 B	18 B	23 A	28 B	33 A	38 D
4 A	9 B	14 D	19 B	24 C	29 D	34 C	39 D
5 D	10 C	15 D	20 D	25 C	30 A	35 A	40 D

Paper 2

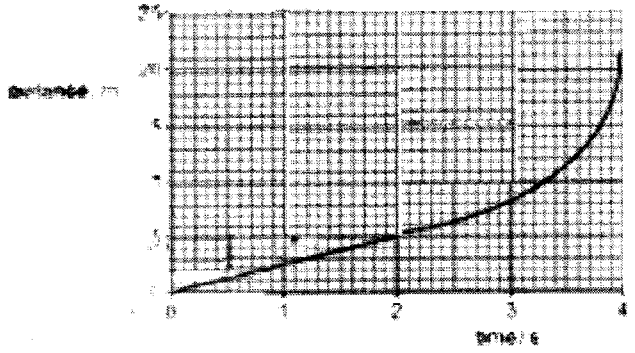
-1/2 for wrong unit used in each part question
Final numerical answer should be given to a maximum of 3 significant figures, otherwise minus of 1/2 mark.
The total mark deducted for each part question should not exceed the mark allotted.

Section A [50 marks]

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

1. (a) (i) **constant speed [1/2] of 2.5 m/s [1/2]**

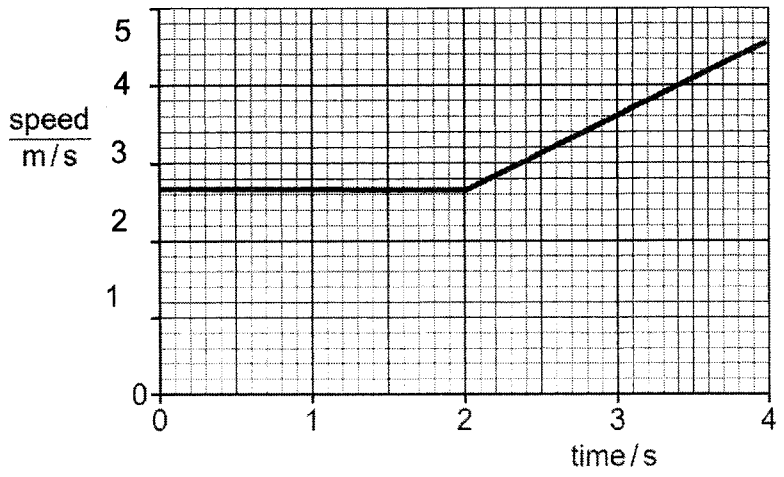
(ii)



Any graph with increasing gradient [1]

(b) **distance is constant//zero gradient//horizontal line** [1]

(c)



(i) 1 mark, allow for e.c.f from (a) (i)
(ii) 1 mark for correct line

2. (a) Upthrust – weight = ma

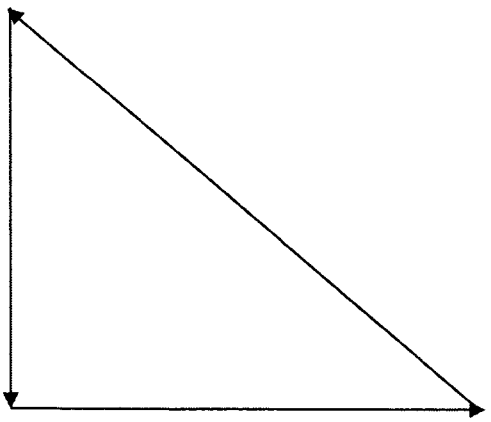
$3.2 \times 10^7 - (2.8 \times 10^6)(10) = (2.8 \times 10^6)\, a$ [1]

$a = 1.43\ m/s^2$ [1]

(b) **mass of rocket decreases** due to burning of fuel
OR **air resistance will decrease** due to smaller air density at greater height
Either answer will be 1 mark

(c) The rocket will exert a downward force on the hot gas, at the same time the **hot gas will exerts an upward force** [1] on the rocket that is **equal in magnitude.[1]**

3.



Correct triangle/vector diagram: [2]
Answer [1]

4. (a) clockwise moment = anticlockwise moment
(F x 0.8) = (20 x 0.35) [1]
F = 8.75 N [1]

(b) **The perpendicular distance** from pivot for any other direction will be **smaller than 0.8 m.** **[1]**

5. (a) Gas pressure = (76-16) cm Hg = 60 cm Hg
= (0.6)(14 000)(10) [1]
= 84 000 Pa [1]

(b) (i) 8 cm [1]

(ii) speed/K.E of the gas molecules increase [1/2]
Gas molecules will collide against the mercury will greater force or pressure of gas will increase [1/2]
The gas at higher pressure will push the mercury until it is equal to atmospheric pressure or no pressure difference [1]

6. (a) (i) Increase in internal energy = (1.5)(4200)(100-24) [1]
= 478 800 J [1]

(ii) **greater heat is lost (to the surroundings) at higher temperature** or **evaporation at higher temperatures is greater** **[1]**

(b) molecules separate / are pulled apart / are far apart / break bonds / overcome forces of attraction [1]
work done separating the molecules or molecules gain PE [1]

7. (a) (i) angle of incidence = 50° [1]

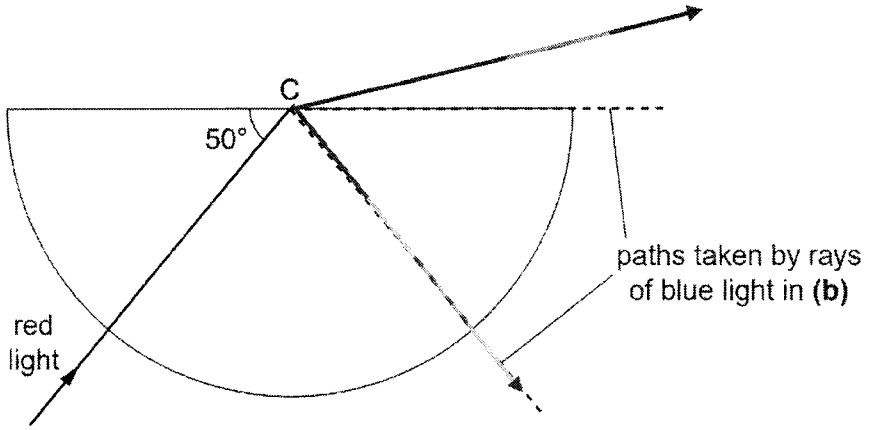
(ii) Total internal reflection [1]
Angle of incidence is greater than the critical angle [1]

(b) refractive index, $\eta = \frac{1}{\text{isnc}}$

$= \frac{1}{sin40}$ [1]

= 1.34 [1]

(c)



1 mark for refracted ray into air
1 mark for weak reflected ray

8. (a) State and explain how the second bang compares with the first bang in terms of its amplitude and wavelength. [3]

(i) amplitude: **lower [1/2]** as second bang has **lower energy level [1]**

(ii) wavelength: **same [1/2]** as the **speed & frequency is the same as the first bang. [1]**

(b) speed of sound = $\frac{difference\ in\ distance}{time\ interval}$

$= \frac{(2\ x\ 170)}{1}$ [1]

= 340 m/s [1]

9. (a) direction of current is right/PQ [1]

(b) Flemming left hand rule with labelled [1] drawing/diagram [1]

10. (a) Moving the wire upward will result **changing in the magnetic field linking the wire/cutting of the magnetic lines of force,** by Faraday Law, an e.m.f and current will be induced in the wire.

(b) **greater deflection** to the **left** [1]

(c) **No deflection** [1] as there is **no cutting of magnetic field line** [1] of forces by the conductor.

11. (a) (i) To make the **output voltage lower** than the input voltage. [1]

(ii)
$$\frac{N_s}{N_p} = \frac{V_s}{V_p}$$
$$\frac{N_s}{10\,000} = \frac{12}{240}$$

N_s = 500 turns [1]

(iii) The electricity is transmitted at very high voltage so that the **transmission current** will be **much smaller** since **P = VI**.
The smaller current will mean **lesser power/energy loss along the cables** that results from the **heating effect of the current.**

If current is lowered, **thinner cables** can be used, which will result in cost savings.

Section B [30 marks]

12. (a) (i) low currents: current in X is **linearly related** to p.d. across X **OR directly proportional** **[1]**

high currents: when current increases, p.d across **increases at increasing rate.** **[1]**

(ii) the shorter the wire, the larger the current required melt it [1]

OR the longer the wire, the smaller the current required melt it

(iii) They have **different resistance [1]** as **length affect resistance** **[1]**

(b) (i) The wires has **smaller resistance** [1/2] due to **lower temperature** [1/2]

(ii) The **current** that cause the wire **to melt will be higher.** [1]

(c) (i) By conduction as the wire is a good conductor of heat. [1]
By radiation in form of infra-red waves. [1]

(ii) As heat is conducted away by the metal clip. [1]

13. (a) electrons [1/2] ,

towards the positive terminal of the battery [1/2]
towards the ammeter or
away from the negative terminal

(b) (i) thermistor [1]

Total resistance, $R_T = \left(\frac{1}{6} + \frac{1}{1.5}\right)^{-1} + 1.3$
$= 2.5\ \Omega$ [1]

(ii) Current = 12/2.5
= 4.8 A [1]

p.d. across 1.3 Ω resistor = 1.3 x 4.8 = 6.24 V [1]

allow for e.c.f

(c) (i) Y-gain = 6.24/2.4 [1]
= 2.60 V/div [1]

(ii) resistance of Z / thermistor decreases [1]
resistance of parallel combination decreases or total resistance (of circuit) decreases or current increases
voltage (across 1.3 Ω) increases [1]
trace moves towards top of screen / upwards **[1]**

Either

14. (a) (i) W.D = force x dist

$= 2.8 \times 10^6$ x 9.7 x 2 [1]
= 5 432 0000 J [1]

(ii) chemical potential energy to thermal energy/internal energy [1]

(iii) forward force = 2.8×10^6 N [1]

(b) (i) F = ma
$a = -2.8 \times 10^6 / 2.2 \times 10^8$

$= -0.013\ m/s^2$

Initial deceleration = **$0.013\ m/s^2$** [1]

(ii) deceleration decrease [1]
As resultant force decrease/resistive force decrease [1]

(iii) curve with decreasing gradient [1]
Allow for e.c.f

(c) (i) The efficiency of a system is defined as the ratio of useful energy/power output to the energy/power input. [1]

(ii) Power wasted in the engines = 0.64 x 33 MJ/s
= 21.1 W or 21.1 MJ/s [1]

OR

14. (a) (i) negative charge on tree. [1]

(ii) tree gain electrons [1] from earth [1]

(iii) Number of electrons = 560 C / 1.6×10^{-19} C

= 3.5×10^{21} [1]

(iii) average current = 560 / 2.0×10^{-4}
= 2800000 A [1]

(b) (i) parallel and equal spacing with upward direction [1]

(ii) oil droplet positively charged [1]
attraction force on (droplet) and in direction of field/upwards [1]
force greater than weight (of droplet) or resultant force upward [1]

(iii) (droplet becomes) negative OR
(droplet) gains electrons [1]

********** END OF PAPER **********