1   The following diagrams show part of a micrometer screw gauge and part of a Vernier caliper. Which one shows a reading of 33.5 mm?

A

B

C

D
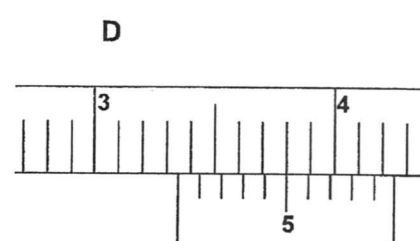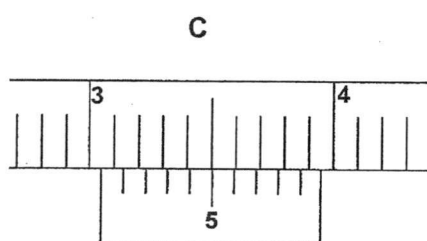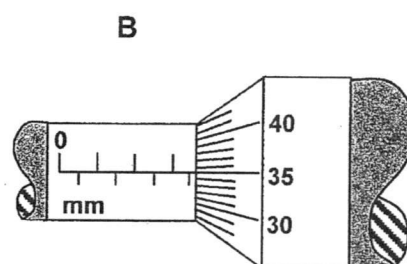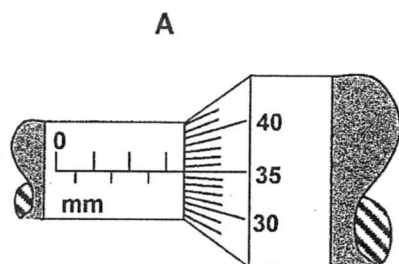
2   The diagrams show a can **P**, filled with sand and a similar can **Q**, which is empty. They are hung close to the surface of the moon.
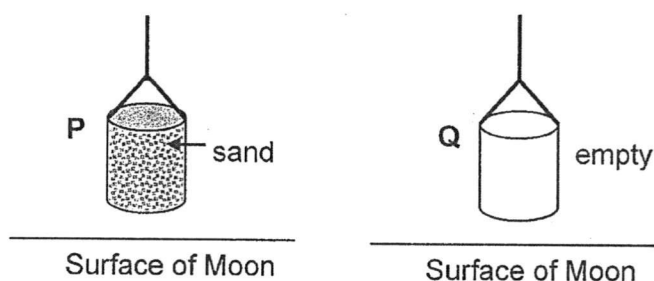
Which of the following is correct?

A   It is easier to push **P** because it has more inertia due to its greater mass.

B   It is easier to push **Q** because it has less inertia due to its smaller mass.

C   It is easier to push **Q** because it has a smaller weight.

D   It is equally easy to push **P** and **Q** as there is less gravitational force on the Moon.

[**Turn over**

3   The distance-time graph of an object is shown below.
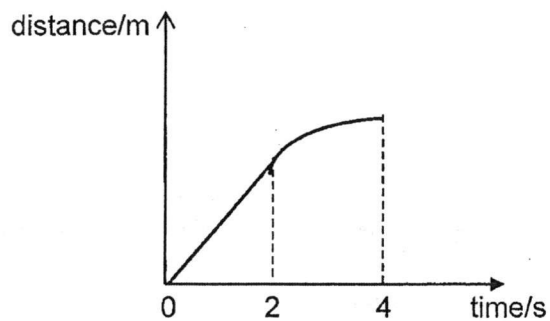
Which of the following correctly shows the speed-time graph of the object?

A

B

C

D
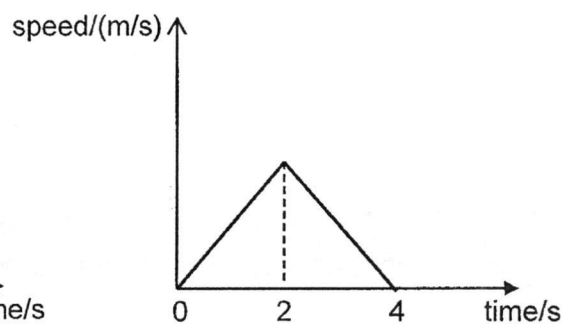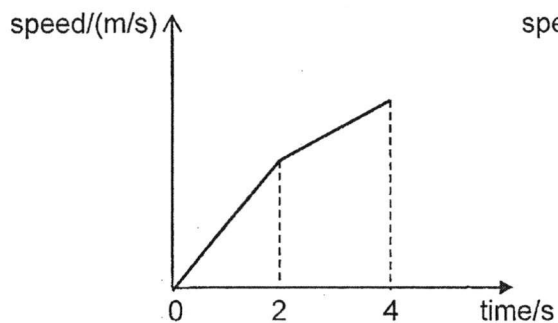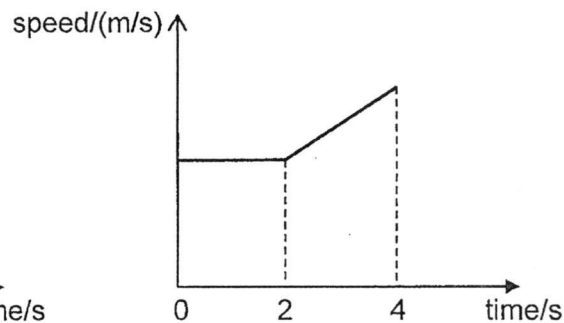
4

4   A box is being pulled by 2 forces of magnitude 20 N and 12 N acting perpendicularly to each other as shown in the diagram.
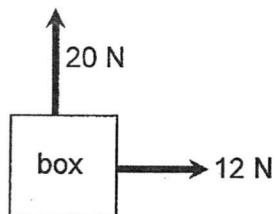
Which of the following vector diagrams correctly shows how the resultant force, R, can be determined?
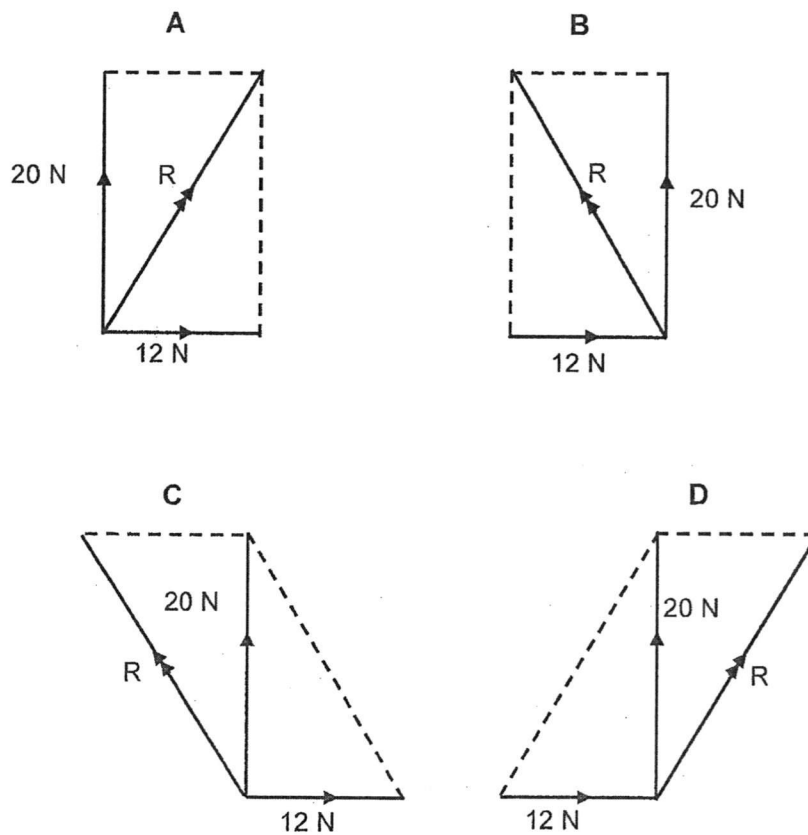
5   A uniform ruler is pivoted at the 60 cm mark. A 4.0 N weight is suspended from one
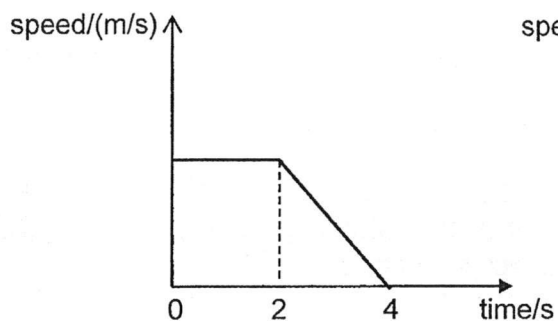   end to keep the ruler horizontal.
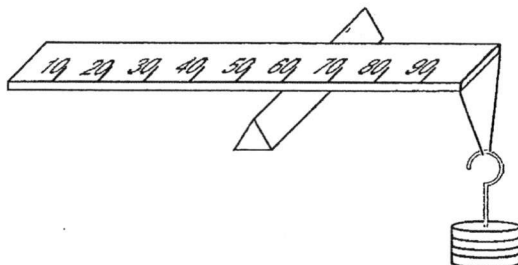
Calculate the weight of the ruler.

A   4.0 N   B   4.8 N   C   16.0 N   D   24.0 N

6   A block of mass 40 kg is pulled by a force of 300 N along a 30 m slope to a height
    of 12 m.
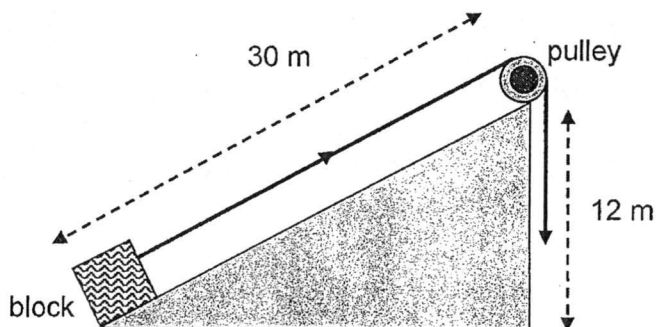
How much work is done against friction?

A   4 200 J   B   4 800 J   C   9 000 J   D   13 800 J

7   An Eskimo of mass 50 kg stands on snow, wearing snow-shoes. The area of each
    snow-shoe in contact with snow is 0.2 m². Given that the gravitational field strength
    is 10 N/kg, what is the pressure exerted on the snow by the Eskimo?

A   25 N/m²   B   125 N/m²   C   200 N/m²   D   1250 N/m²

[Turn over

8   A solid has a fixed shape and volume. Which of the following is NOT a contributing factor?

   A   Strong attractive forces act between the particles.

   B   The particles are constantly attracting and repelling one another.

   C   The particles have fixed positions.

   D   There is very little space between the particles.

9   Two plastic cups are placed one inside the other as shown in the diagram below. Hot water is poured into the inner cup and a lid is put on top as shown.
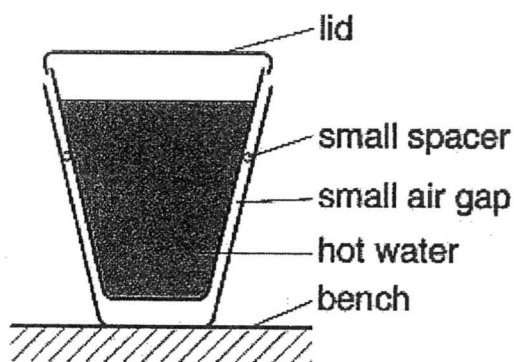
Which statement is correct?

   A   Heat loss by radiation is prevented by the small air gap.

   B   No heat passes through the sides of either cup.

   C   The bench is heated by convection from the bottom of the outer cup.

   D   The lid is used to reduce heat loss by convection.

10 A beaker containing ice and a thermometer is left in a warm room for 15 minutes. No water is visible in the beaker until 5 minutes has passed. After 10 minutes the last piece of ice just disappeared.

| start of experiment | after 5 minutes | after 10 minutes | after 15 minutes |
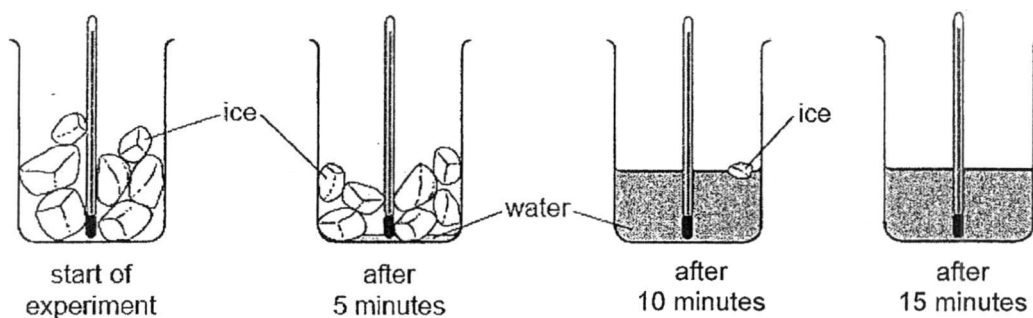
Which graph shows how the thermometer reading changes?

A

temperature /°C

B

temperature /°C

C

temperature /°C

D

temperature /°C

time / min
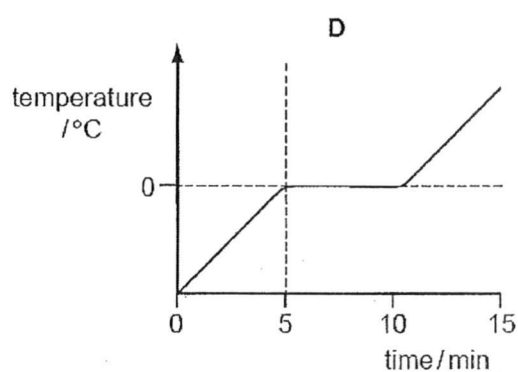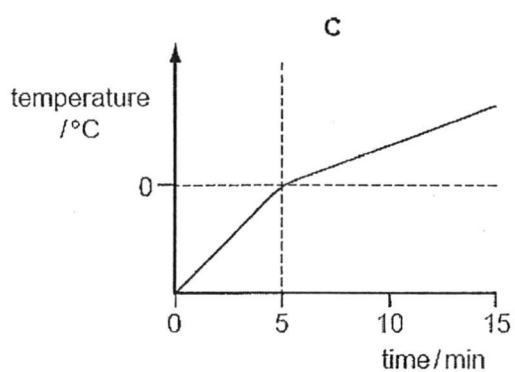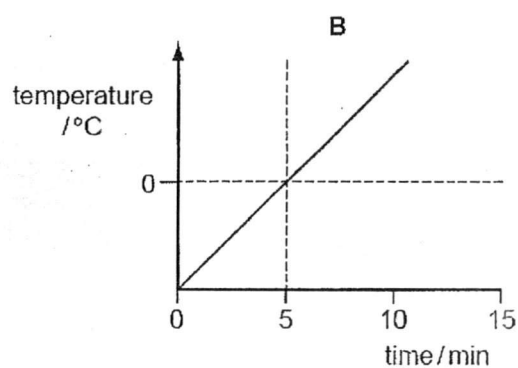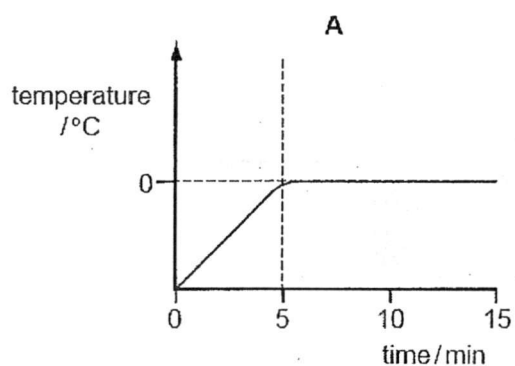
[**Turn over**

11 Which of the following correctly compares an image formed by a mirror and an image formed by a magnifying glass?

	image formed by a mirror	image formed by a magnifying glass
A	real	virtual
B	same size as object	bigger than object
C	laterally inverted	inverted
D	cannot be formed on a screen	can be formed on a screen

12 The diagram shows a student setting up waves on a long elastic chord tied to a tree a distance away.
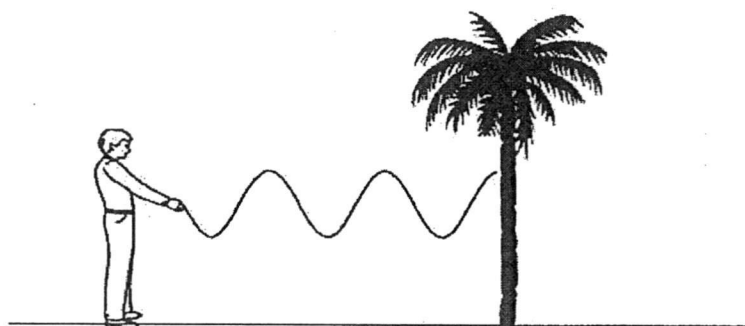
If he uses the same energy but increases his frequency of vibration, which of the following is correct?

	wavelength	amplitude	speed
A	unchanged	increases	increases
B	decreases	unchanged	increases
C	decreases	unchanged	unchanged
D	increases	decreases	increases

[Turn over

13 From the electromagnetic spectrum shown, compare the wavelength, frequency and speed of P and Q in a vacuum.

ultraviolet	P	infrared	Q

	wavelength	frequency	speed
A	$\lambda_P < \lambda_Q$	$f_P > f_Q$	$v_P > v_Q$
B	$\lambda_P > \lambda_Q$	$f_P < f_Q$	$v_P < v_Q$
C	$\lambda_P < \lambda_Q$	$f_P > f_Q$	$v_P = v_Q$
D	$\lambda_P > \lambda_Q$	$f_P < f_Q$	$v_P = v_Q$

14 A police car sounds its siren when travelling to an emergency site. The siren produces two different sounds P and Q, which are emitted alternately. The diagram represents the sound waves emitted by the siren.
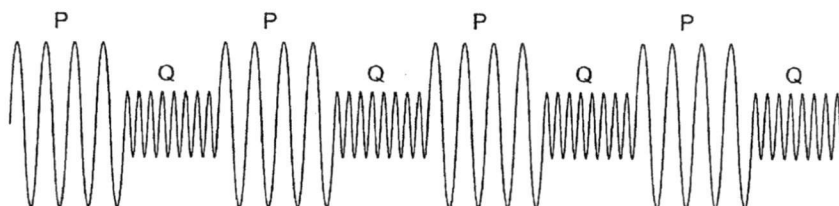
Which of the two sounds P and Q is louder and which has a higher pitch?

	louder sound	sound with higher pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

[Turn over

15 The diagram shows the electric field lines between two electrical charges *P* and *Q*.
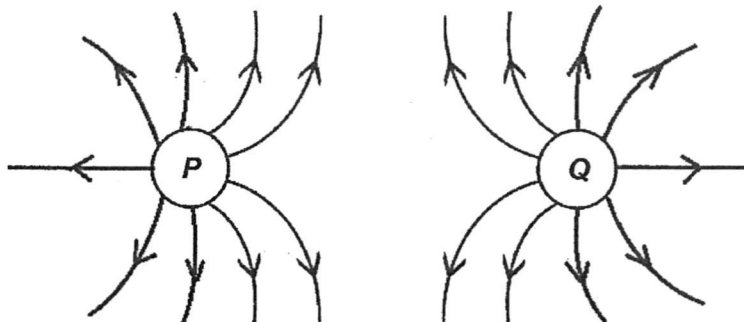
Which of the following statements about the charges *P* and *Q* is correct?

	P	*Q*
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

16 The circuit diagram shows four resistors connected to a battery of 12 V, with negligible internal resistance.
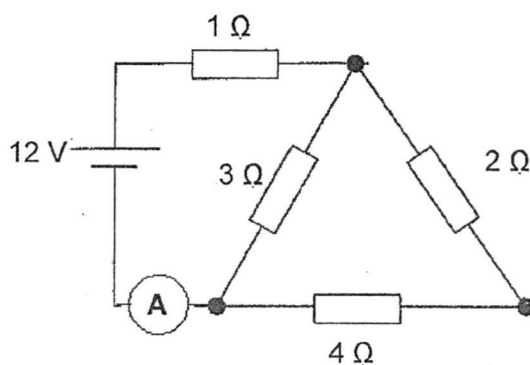
What is the reading on the ammeter?

A   1.2 A   B   3.0 A   C   4.0 A   D   6.0 A

[Turn over

17 What is the total charge that has passed through a bulb when an electric current of 5 A is flowing for 2 minutes?

   A   2.5 C   **B**   10 C   **C**   24 C   **D**   600 C

18 Which of the following statements concerning a fuse is/are correct?

    I   A fuse should be installed at the live wire of an electrical appliance.

    II   Fuse rating is the minimum current that can flow through the fuse.

    III   The fuse rating should be slightly higher than the operating current of an electrical appliance as the voltage may fluctuate.

   A   I is correct

   B   II is correct

   C   I and II are correct

   D   I and III are correct

19 Which of the following correctly shows the direction of the plotting compasses when a current flows from the top to the bottom?
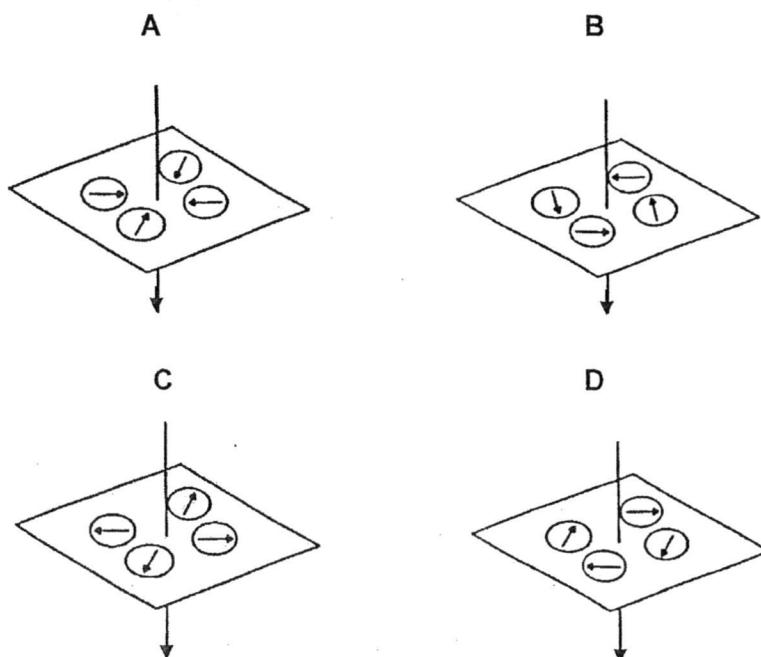
20 The diagram shows a brass rod supported on two copper rails which are connected to a battery. The north pole of the magnet is placed as shown beneath the rails. In which of the directions **A**, **B**, **C** or **D** does the brass experience a force?
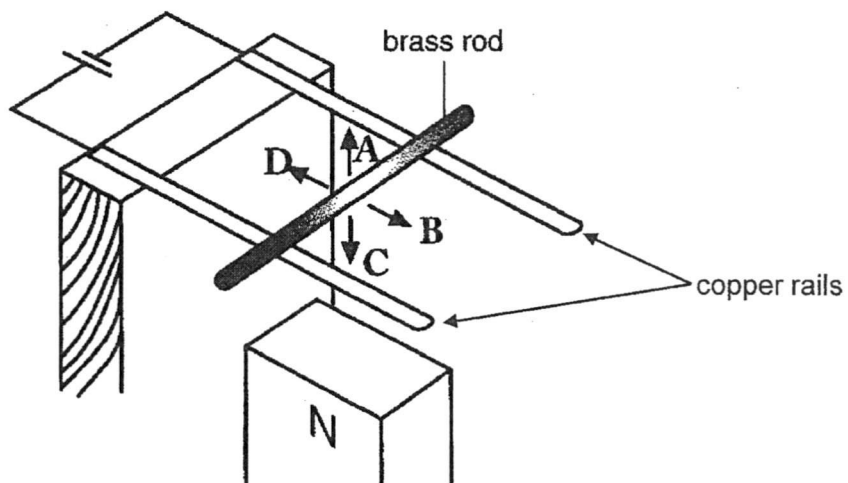
Name

BENDEMEER SECONDARY SCHOOL
2017 PRELIMINARY EXAMINATION 2
SECONDARY 4 EXPRESS & 5 NORMAL (ACADEMIC)
SCIENCE (PHYSICS) PAPER 2
5076/02

DATE   :   24 August 2017
DURATION   :   1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen.
You may use a 2B pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer any 2 questions.

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.

The number of marks is given in brackets [ ] at the end of each question or part question.

65
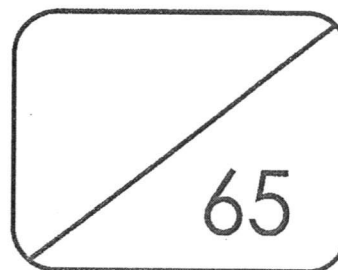
This document consists of **18** printed pages.

Section A: Structured Questions [45 marks]
Answer **all** the questions in the spaces provided.

1 Fig. 1.1 shows how the speed of two cars changes as they move from rest along a straight road.

car A	
time / s	speed / (m/s)
0	0
5.0	20
10.0	40
15.0	60
20.0	60
25.0	60
30.0	60

car B	
time / s	speed / (m/s)
0	0
5.0	10
10.0	20
15.0	30
20.0	40
25.0	50
30.0	60

Fig. 1.1

(a) Plot the speed-time graphs in Fig. 1.2 for both cars **A** and **B**. Label your graphs clearly.

Speed / (m/s)
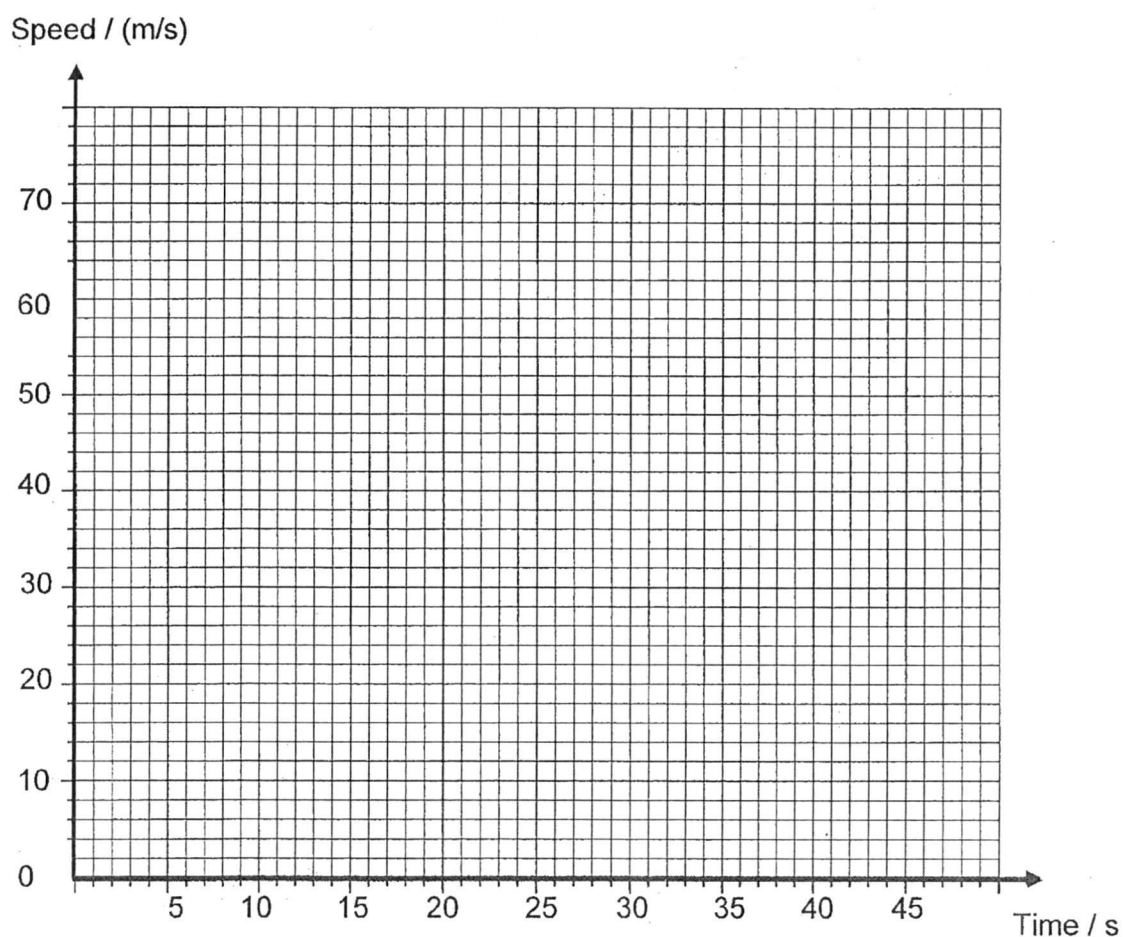
Fig. 1.2

[2]

(b) At the end of 30.0 s, calculate the distance between the two cars.

distance = ... m [2]

(c) If the mass of the car **B** is 500 kg, calculate the net force acting on it.

net force = ... N [2]

2 Fig. 2.1 shows an apparatus used by a student to determine the density of air.
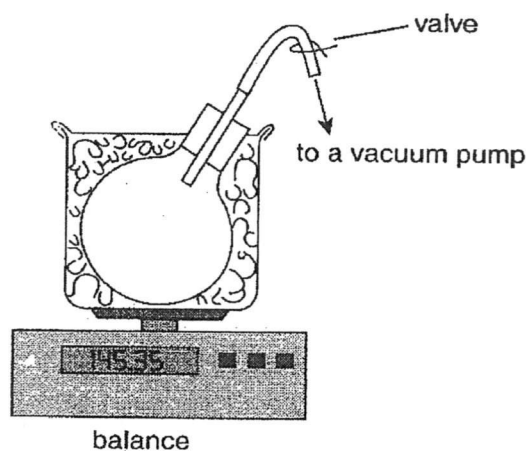
Fig. 2.1

When the valve is opened, the 1000 cm³ flask, together with the beaker, has a mass of 145.35 g. When the flask has been evacuated using a vacuum pump and the air-tight valve is shut, the flask and the beaker have a total mass of 144.47 g.

(a) Explain why there is a mass decrease when the flask is evacuated.

....

.... [1]

[Turn over

4

(b) Use the data given above to calculate the density of air in g/cm³.

density of air = ... g/cm³   [2]

(c) The above experiment will give a reading that is higher than the actual density of air. What is one source of error?

....

.... [1]

3 Fig. 3.1 shows the total forces acting forward and backward on a car at different times **X**, **Y** and **Z** during a journey. In each case, the car is moving forward. The mass of the car is 1000 kg.

direction of motion

time **X**   3000 N ← car → 3000 N

time **Y**   3000 N ← car → 5000 N

time **Z**   4000 N ← car → 500 N

Fig. 3.1

5
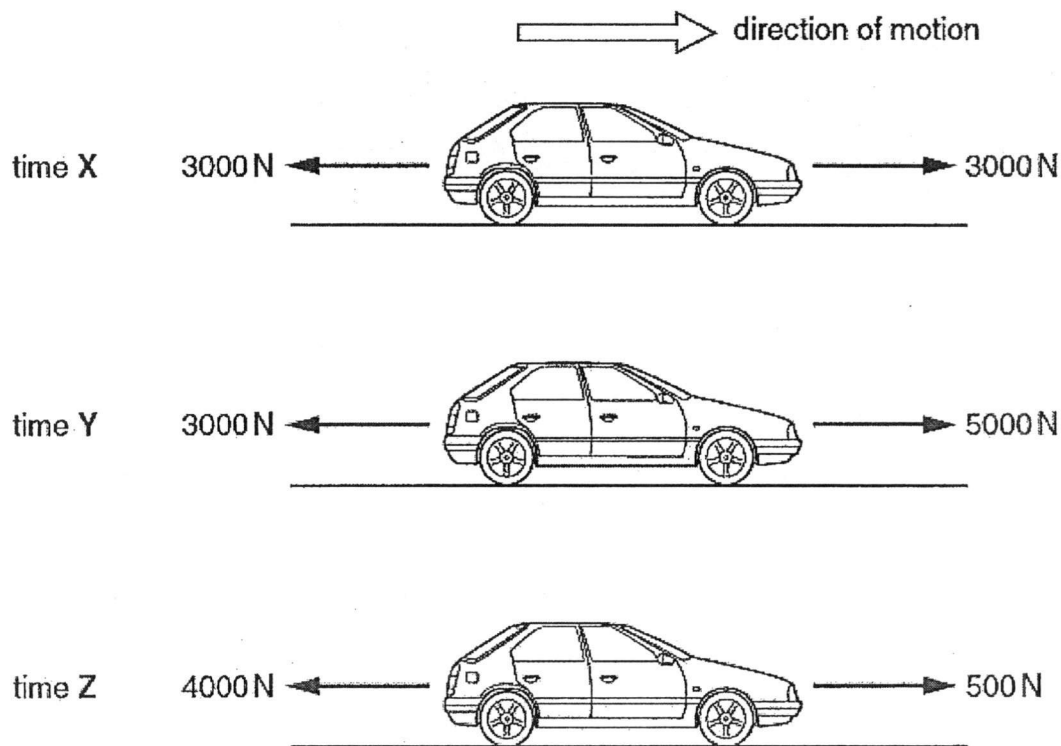
(a) State the name of **one** of the forces that is acting in the opposite direction to the motion of the car.

.... [1]

(b) State whether the speed of the car is changing at time **X**. Explain your answer.

....

....

.... [2]

(c) State whether the speed of the car at time **Z** is increasing, decreasing or constant. Explain your answer.

....

....

.... [2]

(d) Calculate the acceleration of the car at time **Y**.

acceleration   = ... m/s² [2]

[Turn over

4   Fig. 4.1 shows a children's ride. A carriage containing children is pulled up the slope by a motor. The carriage stops at A and then runs through B and C without further input of energy. The height of the ride is 30 m at A and 10 m at C. Assume that the friction of the track is negligible.
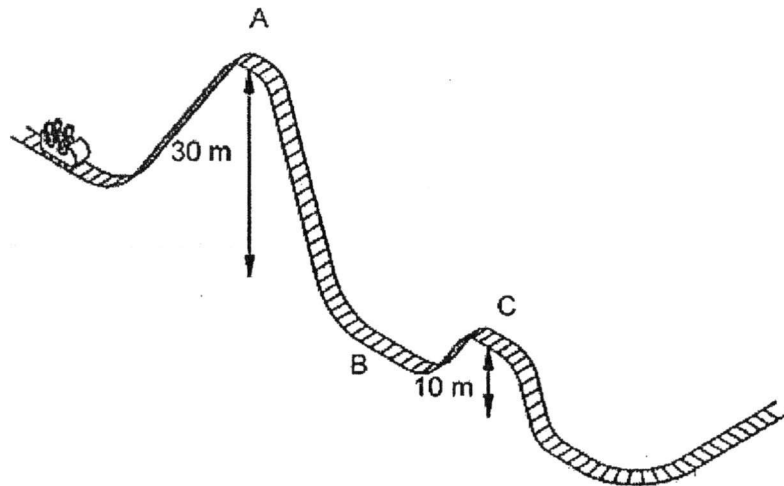
Fig. 4.1

The mass of the carriage and the children is 500 kg.

(a)   Calculate the gravitational potential energy of the carriage and children at A.

gravitational potential energy   = ... J   [1]

(b)   Using your answers in **(a)**, calculate the kinetic energy of the carriage and children at C.

kinetic energy   = ... J   [2]

7

(c) Hence, calculate the speed of the carriage and the children at C.

speed = ... m/s   [2]

5   Fig. 5.1 shows the main parts of an electric grill. An electric current in the heating
element causes it to become red hot and emit visible light and infrared radiation. The
infrared radiation is used to cook the food placed under it.
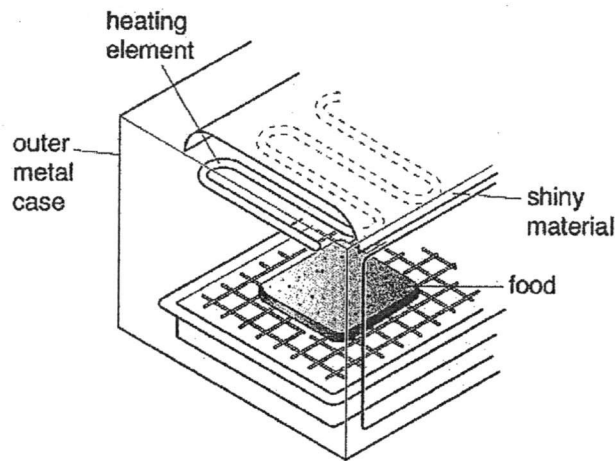
Fig. 5.1

(a) Explain why heat cannot be transferred by conduction from the heating element
to the food.

....

....

....   [2]

(b) Explain why heat cannot be transferred by convection from the heating element
to the food.

....

....

....   [2]

[Turn over

(c) There is a layer of shiny material between the heating element and the outer case on top of the grill. Explain the function of this layer of shiny material.

....

....

.... [2]

6 Fig. 6.1 shows a man **P** standing a certain distance from a vertical wall. A second man **Q** is located 200 m behind **P**.
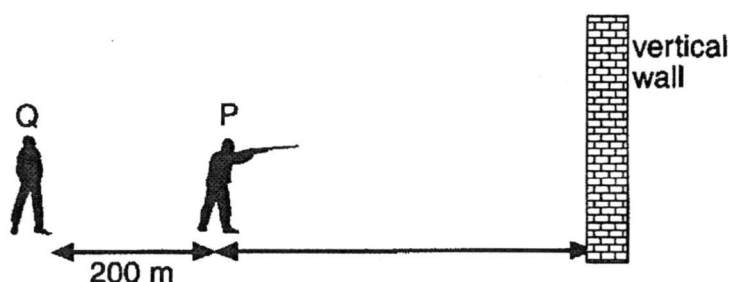
Fig. 6.1

When **P** fires a gun, one sound will travel directly to **Q** and another sound will travel forward to the vertical wall and reflects from it before reaching **Q**.

(a) If **Q** hears the first sound 0.625 s after **P** fires the gun, calculate the speed of sound in air.

speed of sound = ... m/s [1]

(b) If **Q** hears a second sound 3.125 s after hearing the first sound, calculate how far **P** is standing from the wall.

distance from wall = ... m [2]

7   Fig. 7.1 represents equally spaced beads on a spring. The beads are 1 cm apart.

1 cm
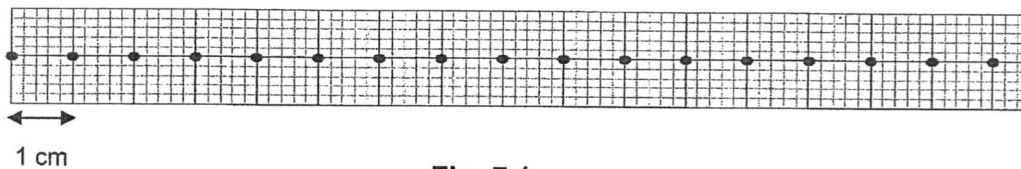
Fig. 7.1

A longitudinal wave propagates along the spring. Fig. 7.2 shows the position of the beads at a particular instant.

1 cm
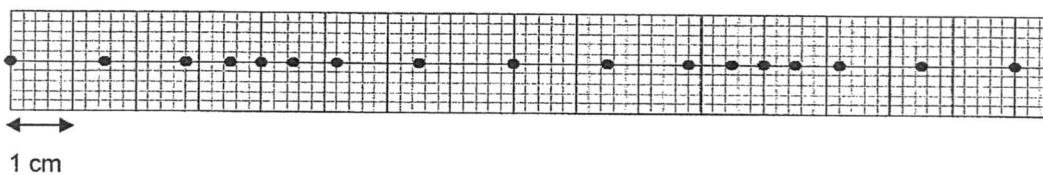
Fig. 7.2

(a)   Explain why the wave is a longitudinal wave.

....

....

.... [2]

(b)   State the meaning of the terms, wavelength and amplitude.

Wavelength is ....

....

.... [1]

Amplitude is ....

....

.... [1]

(c)   From Fig. 7.2, determine the wavelength and the amplitude of the wave.

wavelength   = ... cm   [1]

amplitude   = ... cm   [1]

8   Fig. 8.1 shows an electric iron, which has a label '220 V, 1100 W' marked on it. The electric iron is connected to a 220 V mains supply by the live, neutral and earth wires.

live wire ●——

neutral wire ●——

earth wire ●——

metal case

heating element

Fig. 8.1

[3]

(a) In Fig. 8.1, draw suitable wires to connect the electric iron to the mains supply, including a fuse and a switch for the electric iron. Label them.

(b) If the electric iron is used for 2 hours daily, calculate the total cost of using the electric iron for a month of 30 days, if 1 unit of electricity costs 30 cents.

cost   = $ .... [2]

9   Fig. 9.1 shows two electromagnets placed next to each other.
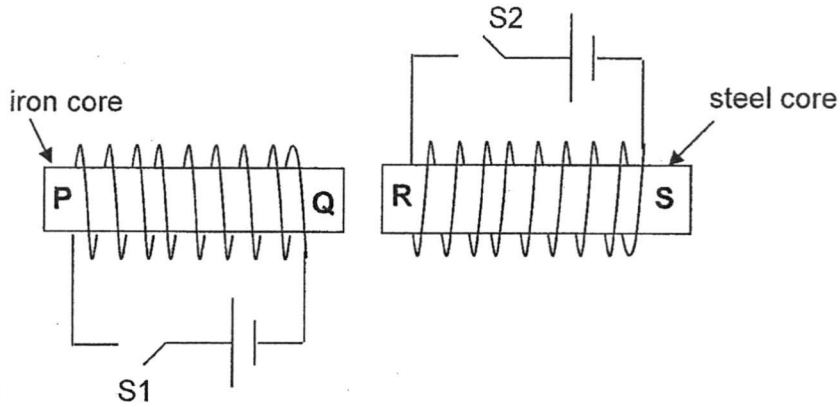
Fig. 9.1

(a) When both switches S1 and S2 are closed, ends **Q** and **R** will repel. What are the polarities of ends **Q** and **R**?

Both end **Q** and end **R** have .... poles.   [1]

(b) When both switches are open, state and explain what will be observed.

....

....

....

....   [2]

Section B: Structured Questions [20 marks]
Answer any **two** questions in the spaces provided.

10   Fig. 10.1 shows a manual car park barrier.
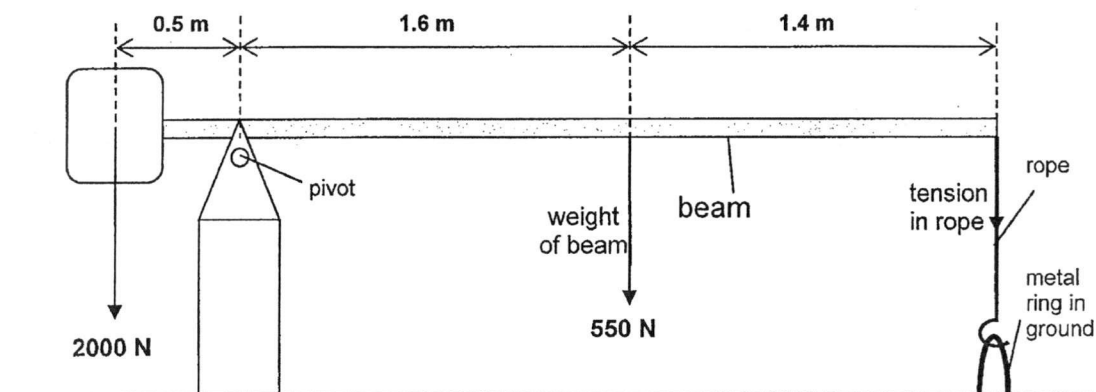
Fig. 10.1

(a)   The weight of the barrier beam is 550 N and acts at 1.6 m to the right of the pivot. Calculate the tension needed in the rope in order to keep the beam horizontal.

tension   = ... N   [3]

(b)   Describe and explain what will happen if the rope is suddenly detached from the metal ring.

....

....   [2]

Fig. 10.2 shows two similar cones made of wood and metal.

Fig. 10.2

Fig. 10.3 shows the cones being tilted by a force.

Fig. 10.3

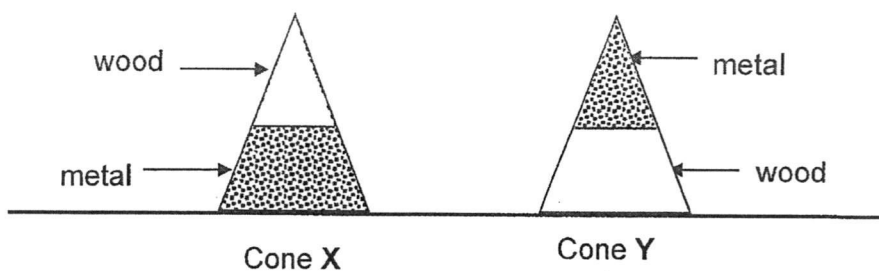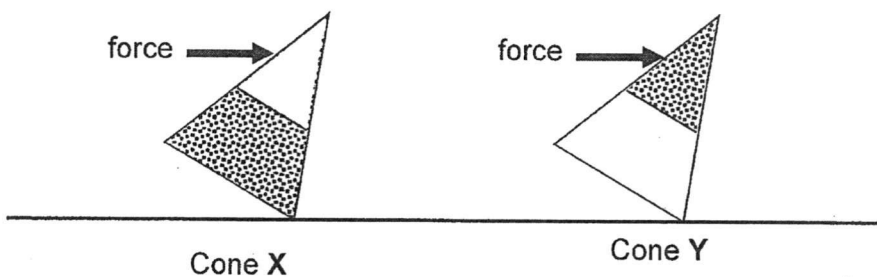(c) In Fig. 10.3, mark a possible position for the centre of gravity by 'x' and draw an arrow to show the weight for both cone X and cone Y. [1]

(d) Using your answer for (c), explain why cone X is in a state of stable equilibrium.

....

....

.... [2]

(e) Using your answer for (c), explain why cone Y is in a state of unstable equilibrium.

....

....

.... [2]

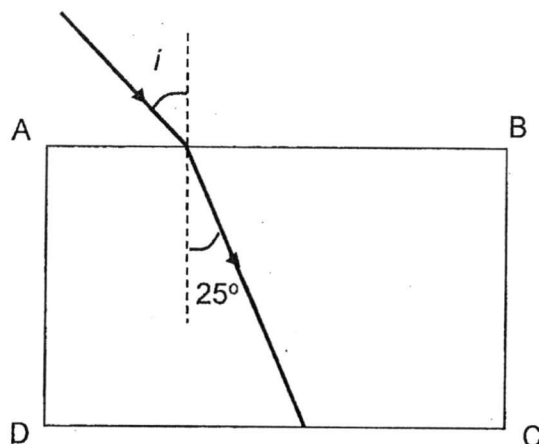**11** Fig. 11.1 shows a ray of light traveling from air into a rectangular glass block.

Fig. 11.1

(a) Given that the refractive index is 1.58, calculate the angle of incidence, *i*.

angle of incidence, *i* = ... ^{0} [2]

(b) In Fig. 11.1, draw how the ray emerges from the side CD. [1]

(c) Fig. 11.2 shows the ray of light entering the same glass block but close to one edge of the block and how it travels through the glass block and emerges from the side CD.
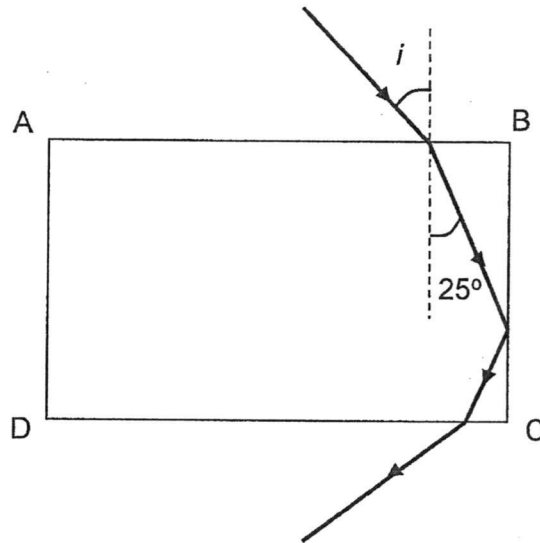

Fig. 11.2

State and explain what has happened to the ray at side BC.

....

....

....

.... [2]

(d) Fig. 11.3 shows an object (arrow) placed in front of a converging lens with focal length 10 cm. It is placed 40 cm from the lens.
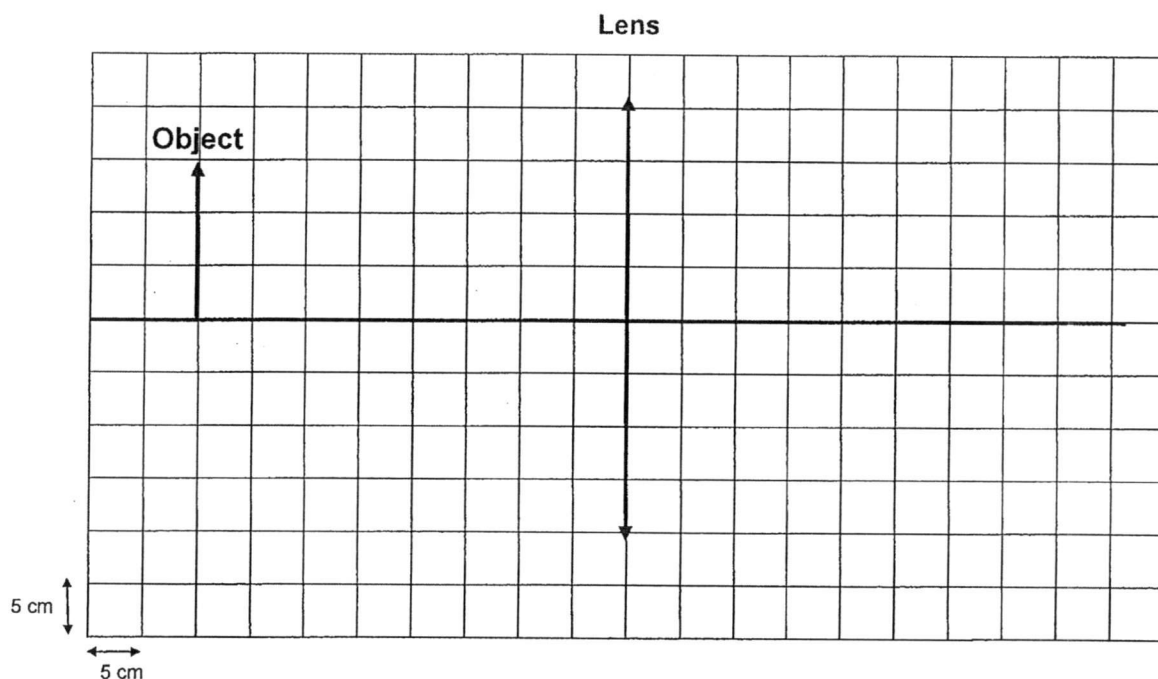
Lens

Fig. 11.3

(i) Using two rays of light, draw the ray diagram to find the image of the object. [3]

(ii) State 2 characteristics of the image formed.

1 ....

2 .... [1]

(iii) The object is slowly moved towards the lens. Without drawing any ray diagram, state **2 changes** that would be observed about the image when the object is placed 15 cm from the lens.

Change 1: ....

Change 2: .... [1]

12 Fig. 12.1 shows 3 identical resistors R_1, R_2 and R_3. The resistance of each resistor is 20 Ω. The resistance of the lamp is 10 Ω.
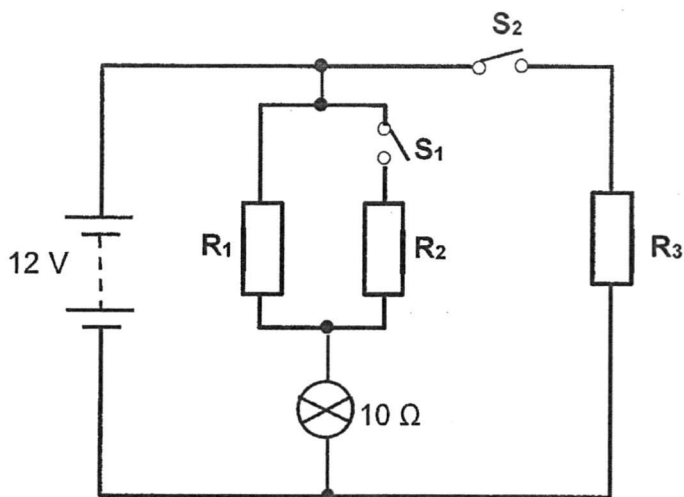

Fig. 12.1

(a) When both switches are left open, the current flows through R_1 and the lamp only.

    (i) Calculate the current through the resistor R_1 and the lamp.

current = ... A [2]

    (ii) Calculate the power of the lamp.

power = ... W [2]

[Turn over

(b) When switch S_1 is closed, R_1 and R_2 are connected in parallel

(i) Calculate the effective resistance of R_1 and R_2.

effective resistance = ... Ω [2]

(ii) State how the brightness of the lamp is affected. Explain your answer.

....

....

....

....

.... [2]

(c) State whether the brightness of the lamp is further affected if the switch S_2 is closed as well. Explain your answer.

....

....

....

.... [2]

End of Paper

MARKING SCHEME
2017 PRELIM 2 EXAMINATIONS
SECONDARY FOUR EXPRESS & 5 NORMAL ACADEMIC

PAPER 1

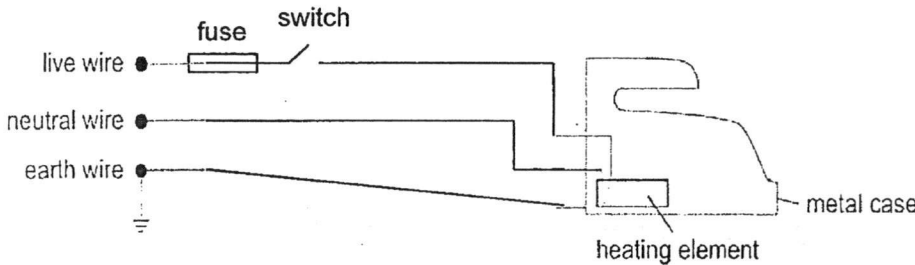| 1	D
2	B
3	A
4	A
5	C
6	A
7	D
8	D
9	D
10	D

11	B
12	C
13	C
14	B
15	D
16	C
17	D
18	D
19	D
20	B
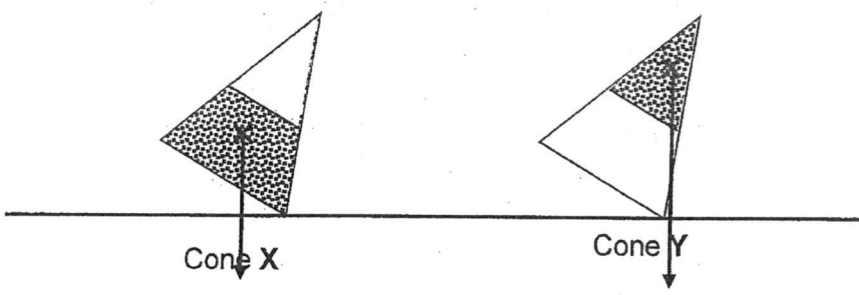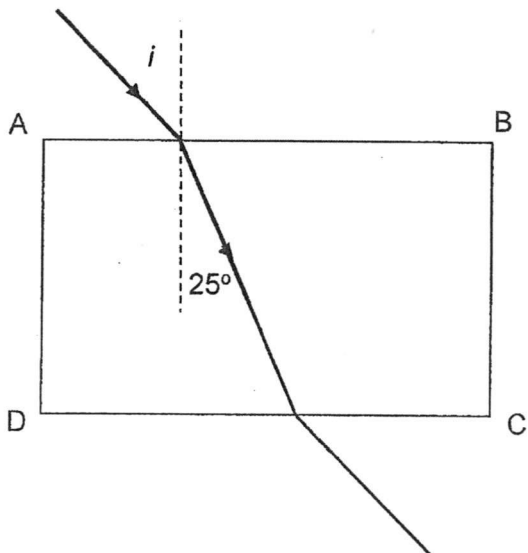
PAPER 2
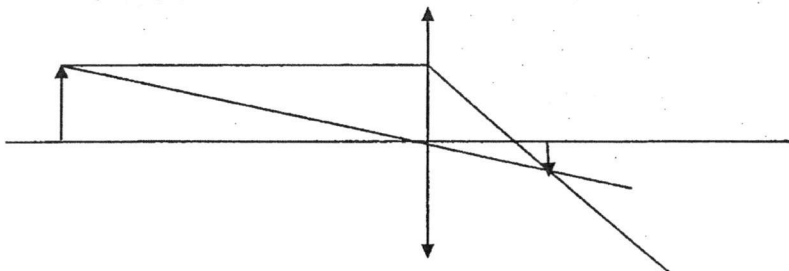
		Marks
1.	(a)	2 (1m for each graph)
	(b) Distance between the cars = (½ x 15 x 60 + 15 x 60) − (½ x 30 x 60) = 450 m	1 1
	(c) $Acceleration = \dfrac{60-0}{30}$ $= 2.0 \, m/s^2$ Net force = 500 x 2.0 = 1000 N	1 1
2.	(a) The air particles have mass and they are being removed.	1
	(b) Density = Mass/ Volume = (145.35 − 144.47) / 1000 = 0.88 / 1000 = 0.00088 g/cm³	1 1

	(c) Not all the air particles have been evacuated as they cannot be seen.	1	
3.	(a) Either air resistance or friction between the tyres and the ground	1	
	(b) The net or resultant force is zero. Since F = m x a, acceleration = 0 and the speed is constant	1 1	
	(c) The net or resultant force opposes the motion. So, the car is decelerating or speed is decreasing.	1 1	
	(d) F = m x a (5000 − 3000) = 1000 x a a = 2 m/s²	 1 1	
4.	(a) GPE = m x g x h = 500 x 10 x 30 J = 150000 J	 1	
	(b) GPE = m x g x h = 500 x 10 x 10 J = 50000 J Loss in potential energy = Gain in kinetic energy = (150 000 − 50 000) = 100 000 J	 1 1	
	(c) 100 000 = ½ x 500 x v² (100 000 x 2) / 500 = v² v = 20 m/s	1 1	
5.	(a) Air particles are very far apart. Energy cannot be transferred from particle to particle.	1 1	
	(b) When the air around the heating element is heated, it becomes less dense. It rises and does not sink to the food.	1 1	
	(c) The shiny material is a poor absorber of infrared radiation. So, less heat is lost.	1 1	
6.	(a) speed = distance travelled/time taken = 200 m/0.625s = 320 m/s	 1	
	(b) distance travelled = speed x time = 320 x 3.125 = 1000 m Distance to the wall = 1000 / 2 = 500 m	 1 1	

7.	(a) The wave is a longitudinal wave because the particles are vibrating parallel to the direction in which the sound wave is travelling.	1 1
	(b) Wavelength is the distance between two consecutive particles that are in phase. Amplitude is the maximum displacement from the rest position.	1 1
	(c) Wavelength = 8.0 cm Amplitude = 0.8 cm	1 1
8.	(a) Live wire – [1/2] Neutral wire – [1/2] Earth wire – [1/2] Switch [1/2] and fuse [1/2] Place on the live wire –[1/2] 	3
	(b) E = P x t = 1.1 kW x 2 x 30 hr = 66 kWh Cost = 66 X 30 = $19.80	1 1
9.	(a) North	1
	(b) Q will be attracted to R. When the switches are open, the steel core is permanently magnetized but the iron core loses its magnetism.	1 1
10.	(a) Anticlockwise moments = clockwise moments (2000)(0.5) = T(3.0) + (550)(1.6) 1000 = 3.0 T + 880 T = 40 N	 1 1 1
	(b) If the rope is suddenly detached, the anticlockwise moment is greater than clockwise moment. The barrier will turn anticlockwise.	1 1

8.	(c)	½ (each)
	Cone X Cone Y	
	(d) When the force is released, the weight that acts on a lower centre of gravity falls within the base. An anticlockwise turning effect will bring it back to its original positon.	1 1
	(e) When the force is released, the weight acts on a higher centre of gravity will fall outside the base. A clockwise turning effect that will topple it.	1 1

11.	(a) 1.58 $= \sin i°/\sin 25$
	          r $= \sin^{-1}(1.58 \times \sin 25°)$
	                    $= 41.9°$
		1
		1

	(b)	1
	(c) The ray undergoes total internal reflection. The angle of incidence must be greater than the critical angle.	1 1

	(d) (i) Ray through centre of lens –[1] Ray parallel to principal axis and passing through focal point – [1] Image – [1] 	3
	(ii) The image is real, inverted and diminished. (any 2)	½ (each)
	(iii) Change 1 – It is magnified Change 2 – It gets further away from the lens.	½ (each)
12.	(a) (i) Current = V / R = 12 / (10 + 20) = 0.4 A	 1 1
	(ii) P = Current² x R = 0.4² x 10 = 1.6 W	 1 1
	(b) (i) R = (1/20 + 1/20)⁻¹ = 10 Ω	1 1
	(ii) The total resistance is (10 + 10) Ω which is lower. So, the current is increased The power is also increased. So, the brightness is increased.	1 1
	(c) The current is unchanged. So, the power is unchanged and the brightness is unchanged.	1 1