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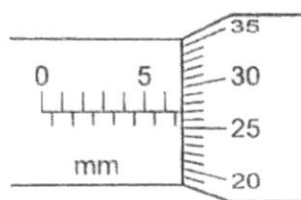
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Answer **all** questions on the Optical Mark Sheet provided.

- 1 Which row shows the average diameter of the Earth and the approximate diameter of a typical atom?

	Earth	atom
A	13 000 km	0.1 nm
B	13 000 km	0.1 μm
C	13 000 Mm	0.1 nm
D	13 000 Mm	0.1 μm

- 2 The diagram shows a micrometer screw gauge.



micrometer screw gauge

What is the reading the micrometer screw gauge?

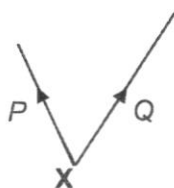
- A** 5.27 **B** 5.77 **C** 6.27 **D** 6.77
- 3 A pendulum of length 20 cm and mass 80 g performs five oscillations in 5 s.
Which statement is most likely to be true?

- A** A pendulum of length 10 cm and mass 100 g has a period of 1 s.
B A pendulum of length 20 cm and mass 100 g has a period of 1 s.
C A pendulum of length 30 cm and mass 100 g has a period of 1 s.
D A pendulum of length 30 cm and mass 80 g has a period of 1 s.

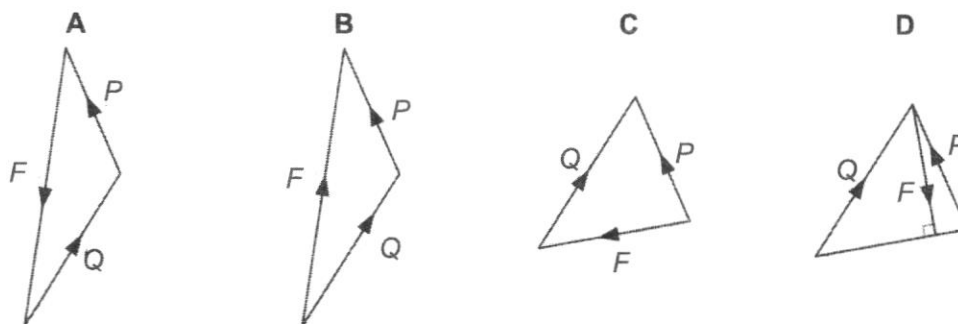
4 Which pair consists of two vector quantities?

- A acceleration and weight
- B density and velocity
- C energy and force
- D speed and work done

5 Two forces P and Q act at a point X as shown in the vector diagram below.



In which of the following diagrams does the vector F represent the force which must be applied at X to maintain equilibrium?



6 A ball is thrown upwards with a velocity of 10 m/s.

The acceleration due to gravity is 10 m/s^2 .

What is the velocity of the ball 0.5 s later?

- A 5 m/s downwards
- B 5 m/s upwards
- C 15 m/s downwards
- D 15 m/s upwards

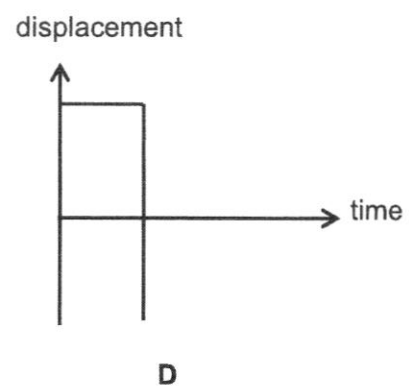
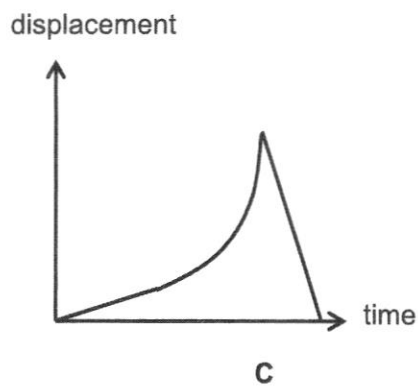
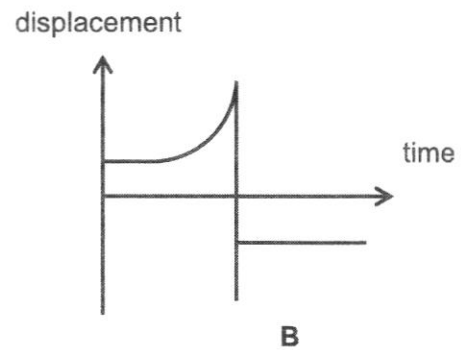
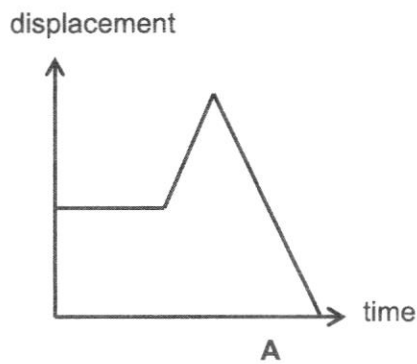
4

- 7 A cyclist travelling at 8.0 m/s presses the brakes and covers a distance of 12 m before coming to a stop.

How long did it take for the cyclist to come to a stop?

- A 0.67 s
 B 1.50 s
 C 3.00 s
 D 4.00 s
- 8 A car moves at constant velocity, followed by increasing velocity, and finally constant velocity in the opposite direction.

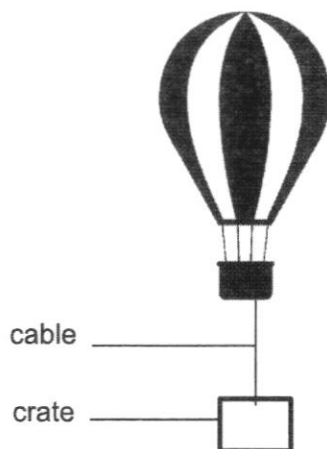
Which displacement–time graph represents the motion of the car?



- 9 An object with mass 1.5 kg is pulled to the right with a force of 6.0 N. The frictional force between the object and the surface it slides across is 8.0 N.

What is the acceleration of the object?

- A -5.3 m/s^2 B -1.3 m/s^2 C 0.75 m/s^2 D 1.3 m/s^2
- 10 Which statement is correct about mass and weight?
- A An object can have weight but no mass.
B An object can have mass but no weight.
C A lighter object will always have more mass and more weight than a heavier object.
D A bigger object will always have more mass and more weight than a smaller object.
- 11 A hot air balloon lifts a crate at a constant speed of 2.0 m/s. The crate is hung from the balloon using a cable.



The mass of the hot air balloon is 2000 kg. The mass of the crate is 100 kg.

The gravitational field strength is 10 N/kg.

What is the tension in the cable?

- A 1000 N B 1200 N C 3000 N D 4200 N

- 12 The table shows the weights of different masses on different planets, A, B, C and D.

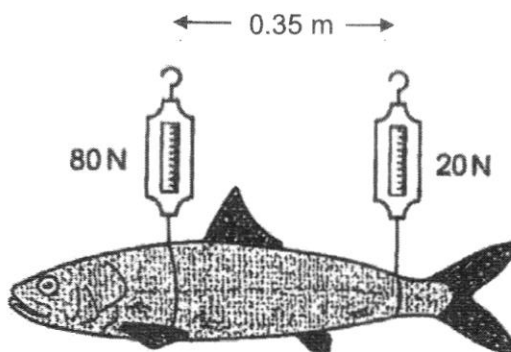
Which planet has the greatest gravitational field strength?

	mass / kg	weight / N
A	10	125
B	15	150
C	20	220
D	25	225

- 13 A metal rod with a density of 8.0 g/cm^3 is cut such that it is 25% shorter.

What is the new density of the rod?

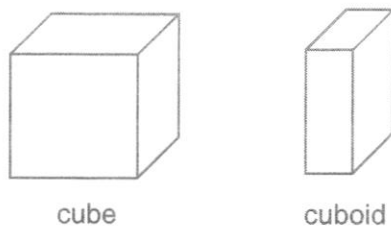
- A** 2.0 g/cm^3 **B** 6.0 g/cm^3 **C** 8.0 g/cm^3 **D** 10.0 g/cm^3
- 14 A fish weighing 50 N is held stationary by two spring balances.



What is the distance from the centre of gravity of the fish to the spring balance on the left?

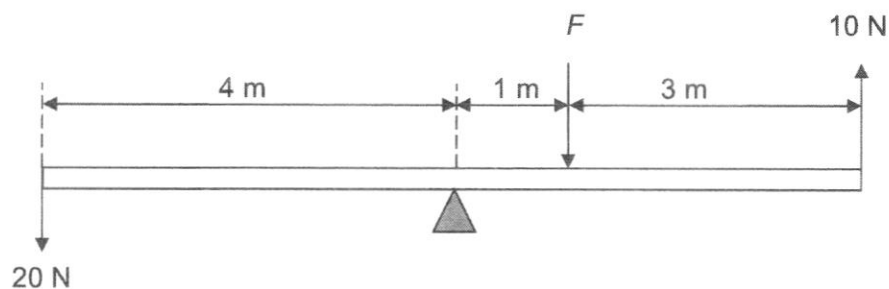
- A** 0.07 m **B** 0.18 m **C** 0.21 m **D** 0.28 m

- 15 The diagram shows a cube and a cuboid.



Why is the cube more stable than the cuboid?

- A** The centre of gravity of the cube is lower as it has a larger weight.
B The centre of gravity of the cube is lower as the base is heavier.
C The weight is distributed over a larger surface.
D The weight is more likely to act within the base during tilting.
- 16 A pivoted uniform bar is in equilibrium under the action of the forces shown.

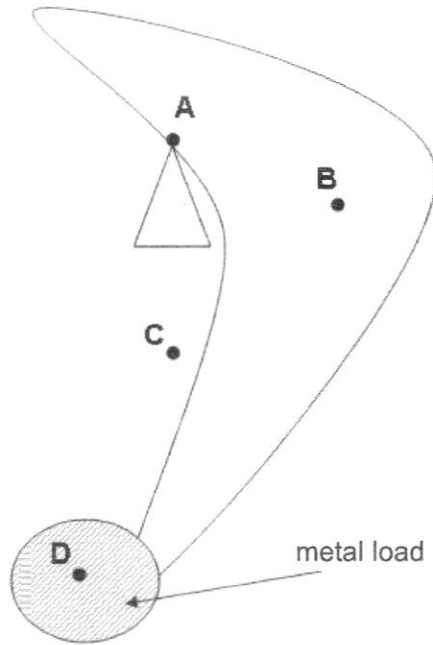


What is the magnitude of the force F ?

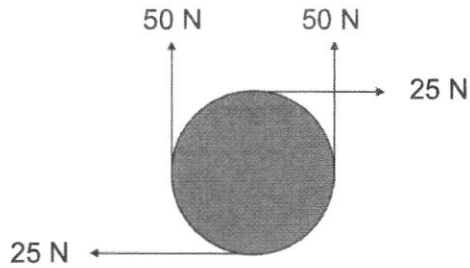
- A** 10 N
B 40 N
C 50 N
D 120 N

- 17 The diagram shows a wooden object with a metal load attached to one end. This object is balanced on a pivot.

Where is the position of centre of gravity of the system made up of the wooden object and metal load?



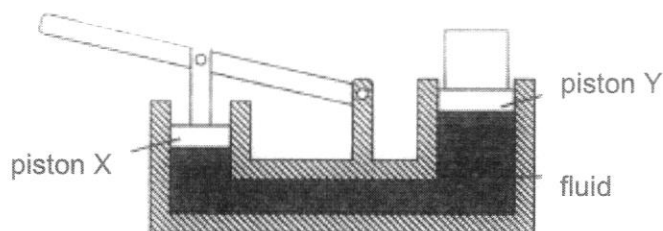
- 18 Four forces are applied to a circular object as shown.



Which of the following gives the correct resultant moment and resultant force on the object?

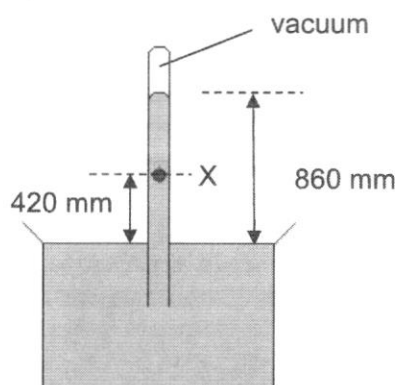
	resultant moment	resultant force
A	zero	zero
B	non-zero	zero
C	zero	non-zero
D	non-zero	non-zero

- 19 The diagram shows a hydraulic press. Piston X exerts a force of 12 N on the fluid.



Given that piston X has an area of 40 cm^2 and piston Y has an area of 65 cm^2 , what is the **maximum** weight that can be lifted by piston Y?

- A 7.3 N B 7.4 N C 19.5 N D 20 N
- 20 The diagram shows a mercury barometer.



What is the pressure at point X?

- A 420 mmHg
 B 440 mmHg
 C 860 mmHg
 D 1280 mmHg

- 21 A thin horizontal plate of area 0.05 m^2 is beneath the surface of a liquid of density 930 kg/m^3 . The force on the plate due to the pressure of the liquid is 465 N.

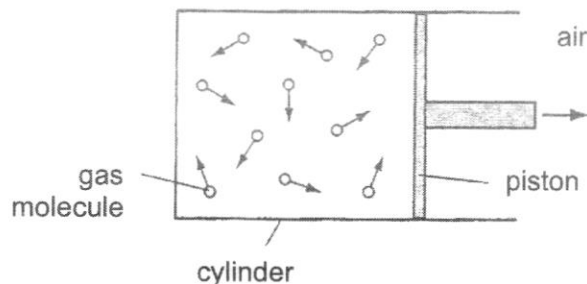
The gravitational field strength g is 10 N/kg .

What is the depth of the plate beneath the surface of the liquid?

- A 1 m B 1.1 m C 1.8 m D 2 m
- 22 Which row correctly states the energy conversion for the scenario described?

	scenario	energy conversion
A	a battery being charged	chemical potential energy to electrical energy
B	a parachutist falling at terminal velocity	kinetic energy to thermal energy
C	a student running up the stairs	kinetic energy to gravitational potential energy
D	an arrow being released from a bow	chemical potential energy to kinetic energy

- 23 Gas inside a cylinder is cooled slowly to a lower temperature and the piston moves inwards.



As the volume decreases, the pressure of the gas remains constant.

How does the speed of the gas molecules and their rate of collisions with the piston compare with their initial values at the higher temperature?

	speed of molecules rate of collision	speed of molecules rate of collision
A	decreases	decreases
B	decreases	stays constant
C	decreases	increases
D	stays constant	decreases

- 24 Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly.

Why is this so?

- A** The smoke particles are bombarded continually by air molecules.
B The smoke particles are supplied with energy by the light illuminating them.
C The smoke particles have a smaller mass when illuminated.
D The smoke particles move about due to convection currents.

- 25 When a thermometer is calibrated, the fixed points are marked.
What are fixed points?
- A All the marks on the temperature scale which cannot be removed.
 - B All the marks of the temperature scale.
 - C The lowest and highest temperatures shown on the thermometer.
 - D Two temperatures of known value which are easily reproduced.
- 26 A thermocouple attached to a voltmeter reads 20.0 mV when one junction is at ice point and the other junction is at steam point.
What is the temperature of an unknown liquid if the voltmeter reads 12.8 mV with one junction at ice point and the other in the liquid?
- A 36 °C B 56 °C C 64 °C D 128 °C
- 27 A person stands barefoot with one foot on marble floor and one foot on carpet.
The marble floor feels colder than the carpet.
Which is the **most** likely explanation for this phenomenon?
- A Air is unable to circulate through the carpet fibres.
 - B The temperature of the marble floor is lower than that of the carpet.
 - C Thermal energy flows from his foot to the marble floor faster than from his foot to the carpet.
 - D Thermal energy flows from the carpet to his foot faster than from the marble floor to his foot.
- 28 Which statement is true about a vacuum flask?
- A The metal body reduces heat loss by conduction.
 - B The plastic stopper reduces heat loss by convection.
 - C The shiny surface reduces heat loss by conduction.
 - D The vacuum reduces heat loss by radiation.

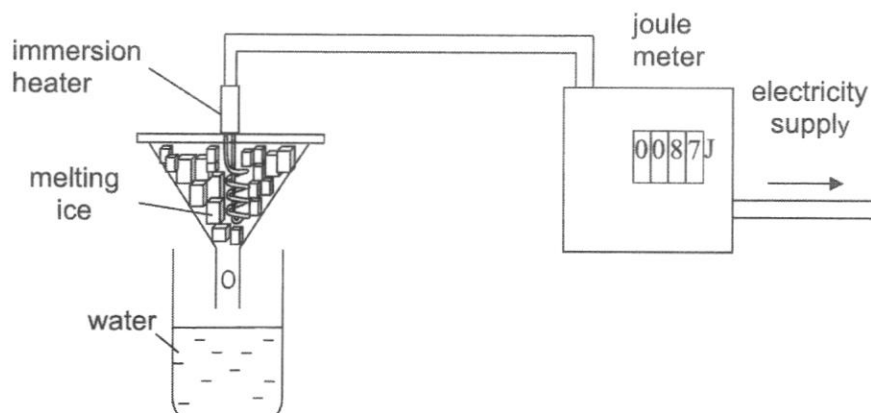
- 29 Which action does **not** increase the rate of evaporation of a liquid?
- A applying an external heat source
- B increasing the amount of air flow in the surroundings
- C increasing the humidity of the air in the surroundings
- D pouring the liquid into a shallow container of the same volume

- 30 A piece of iron of mass m has a specific heat capacity of c .
A piece of aluminium of mass $2m$ has a specific heat capacity of $2c$.

Both of these metals receive the same quantity of heat energy and the temperature of the aluminium rises by $10\text{ }^{\circ}\text{C}$.

What is the temperature rise of the iron?

- A $5\text{ }^{\circ}\text{C}$ B $10\text{ }^{\circ}\text{C}$ C $20\text{ }^{\circ}\text{C}$ D $40\text{ }^{\circ}\text{C}$
- 31 In the experiment shown, the amount of electrical energy used to melt some ice is measured using a joule meter.



To find the specific latent heat of fusion of ice, what must be measured?

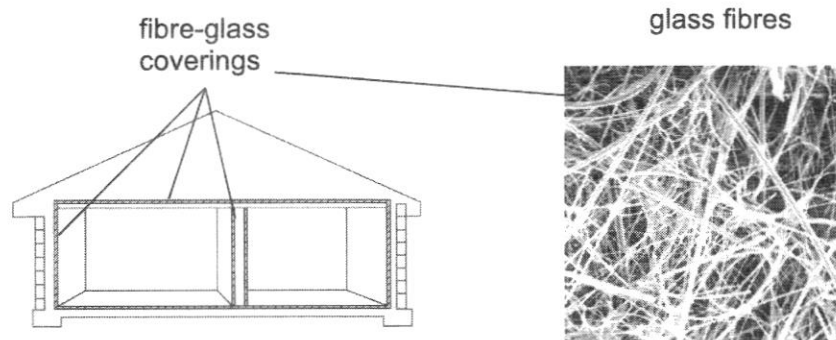
- A the mass of ice melted by the heater
- B the temperature change of the ice
- C the time taken for the ice to melt
- D the voltage of the electricity supply

- 32 A house, built in a country with a cold climate, stays warm in the night.

Which material for the wall and which outside colour keeps the house the warmest?

	wall material	outside colour
A	good conductor	dark
B	good conductor	light
C	poor conductor	dark
D	poor conductor	light

- 33 Fibre-glass consists of a large amount of fine glass fibres. Fibre-glass coverings laid on the floor, walls and ceiling of a house can greatly reduce heat lost to the surroundings.



Three students attempt to explain this and their explanations are stated below.

Student 1: Glass fibres have a low specific heat capacity.

Student 2: The glass fibres with trapped air are poor conductors of thermal energy.

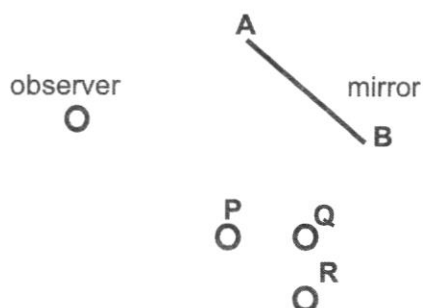
Student 3: Fibre-glass coverings are good absorbers of infra-red radiation.

Which student(s) is/are correct?

- A** 1 only
- B** 2 only
- C** 1 and 2 only
- D** 2 and 3 only

- 34 Which of the following methods will **not** produce convection currents in a container filled with water at 30 °C?
- A floating a piece of ice on the water
 - B lighting a candle beneath the container
 - C dropping a piece of hot metal into the water
 - D placing a 100 W lighted bulb just above the water surface

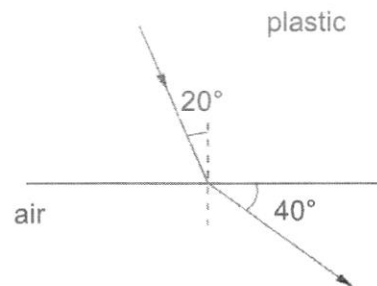
- 35 A plane mirror **AB** is positioned at the corner of a road as shown in the diagram



Which men, **P**, **Q** and/or **R** can be seen by the observer through the mirror?

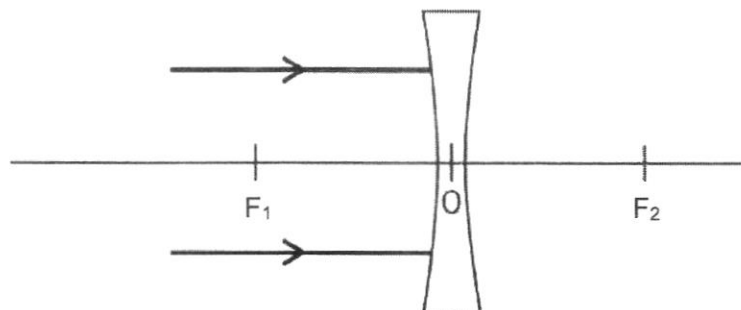
- A **P** and **Q**
- B **P** and **R**
- C **Q** and **R**
- D **P**, **Q** and **R**

- 36 The figure shows a light ray passing from plastic into air.



What is the refractive index of plastic?

- A 0.45
 - B 0.53
 - C 1.88
 - D 2.24
- 37 Two rays of light strike a diverging lens as shown in the diagram.

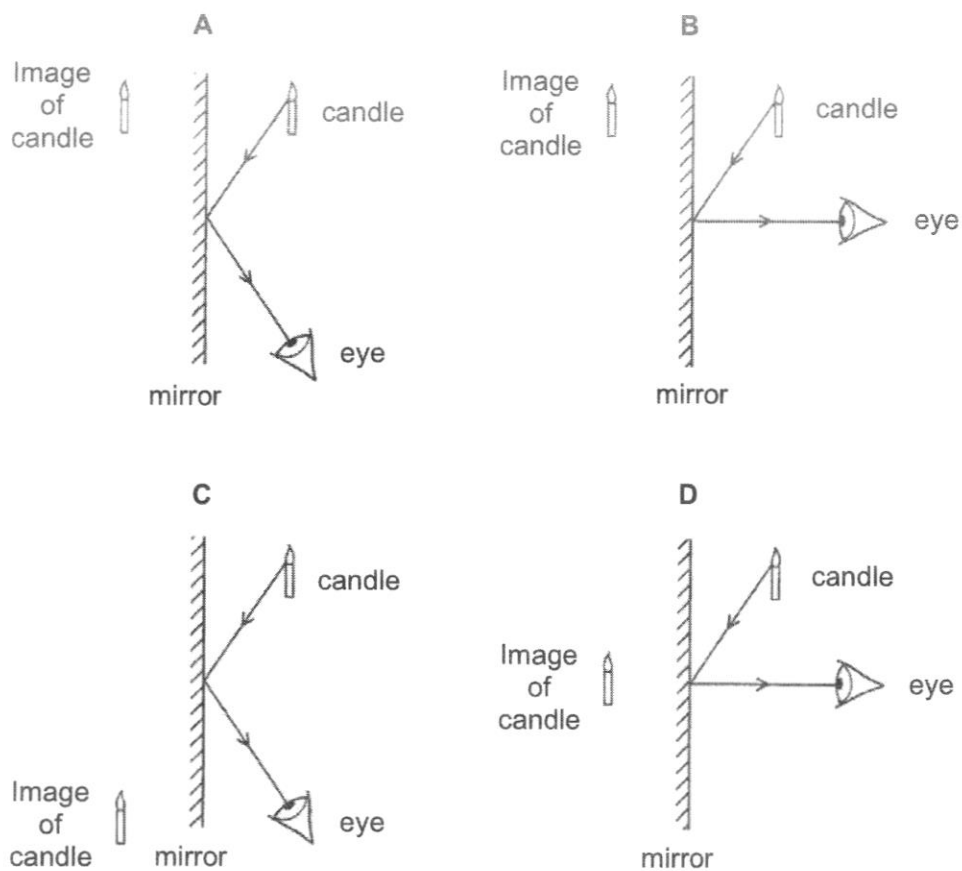


The distance from the centre of the lens, O to F_1 or to F_2 is the focal length of the lens.

Which statement about the rays after they have passed through the lens is correct?

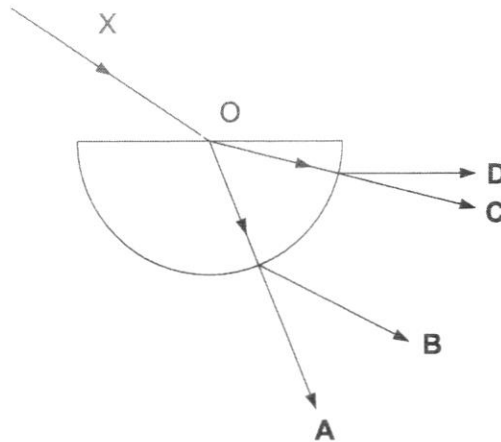
- A They meet at F_2 .
- B They appear to come from F_1 .
- C They appear to come from O.
- D They appear to come from F_2 .

- 38 Which diagram shows how the light from a candle is reflected by a mirror, and shows the position of the image formed?

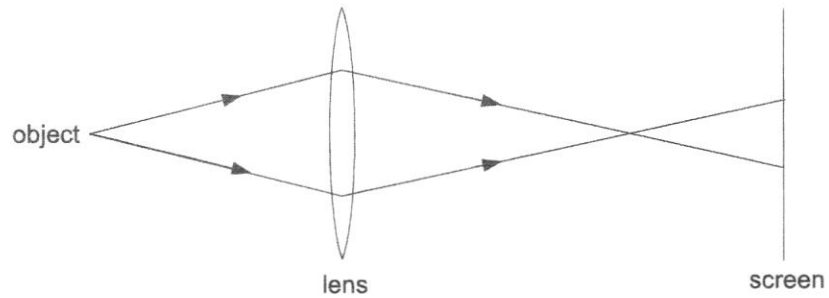


- 39 The figure below shows a ray of light X striking the centre O of a semicircular glass slab.

Which path shows the subsequent path of the refracted ray?



- 40 A lens forms a blurred image of an object on a screen.



How can the image be made sharp and in focus on the screen?

- A By using a brighter object at the same position.
- B By moving the object away from the lens and screen.
- C By moving the screen away from the lens and object.
- D By using a lens of longer focal length at the same position.

END OF PAPER

SECTION A [50 marks]
Answer all questions in this section.

*For
 examiner's
 use*

1 Fig. 1.1 shows a crate lying on a wooden pallet.

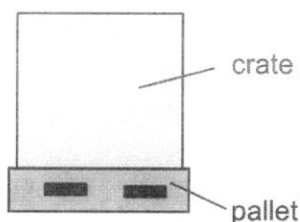


Fig. 1.1

Fig. 1.2 shows two of the forces acting on the crate due to the interaction between three bodies: the crate, the pallet and the earth.

The weight of the pallet is considered to be negligible.

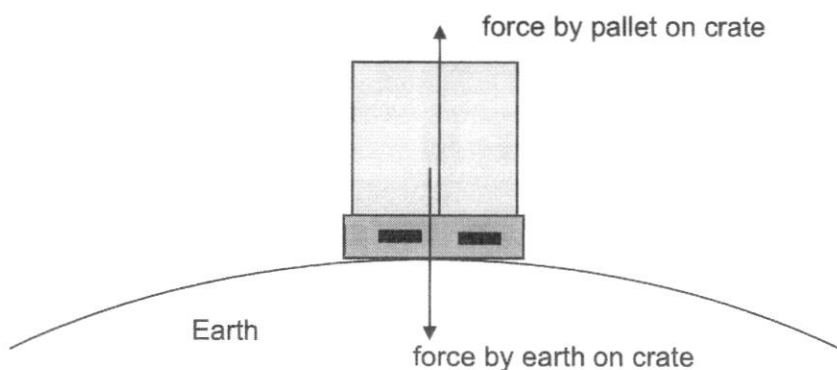


Fig. 1.2

- (a) (i) State the reaction force for the two forces,
 Force by pallet on crate:

 Force by earth on crate:
 [1]
- (ii) On Fig. 1.2, draw and label the reaction force. [1]

3

- (b) The mass of the crate is 200 kg.

Calculate the weight of the crate. The gravitational field strength is 10 N/kg.

weight = [2]

- (c) State and explain how the weight of the crate be different if it was measured on the moon instead.

The gravitational field strength on the moon is 1.6 N/kg.

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

For
examiner's
use

- 2 Fig 2.1 shows a ball of weight 20 N and radius of 10 cm on a section of stairs. The steps of the stairs are uniform and has a height and width of 10 cm each. A force, F is applied on the ball as shown to move it up the flight of stairs.

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examiner's
use

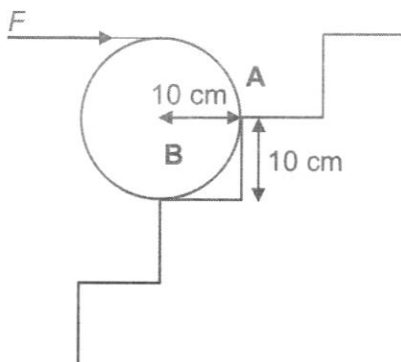


Fig. 2.1

- (a) Define moment about a point.

.....
 [1]

- (b) Using principle of moments, calculate force F .

force $F = \dots\dots\dots$ [2]

- (c) A student claims he can push the ball with a lesser amount of force found in (b).

- (i) Label this new force, R on Fig. 2.1 [1]

- (ii) Calculate R

$R = \dots\dots\dots$ [2]

- 3 An unknown solid is placed in an insulated beaker and is then heated up. The graph in Fig. 3.1 shows how its temperature varies with time. You may assume that the rate of heat supplied to the solid is constant.

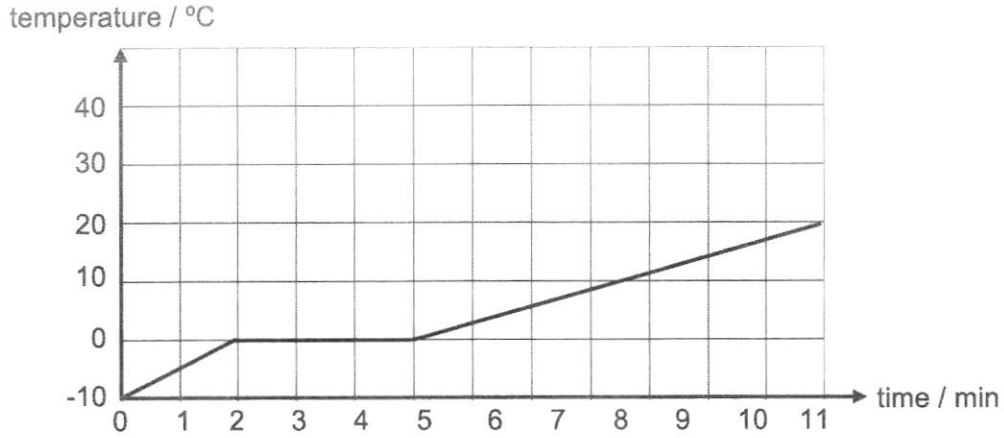


Fig. 3.1

- (a) Using kinetic model, explain why the temperature did not increase from $t = 2$ min to $t = 5$ min.

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

- (b) (i) State if the substance has a higher specific heat capacity in solid form than in liquid form.

..... [1]

- (ii) Using the graph in Fig. 3.1, explain your answer to (b)(i).

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

- 4 Fig. 4.1 shows the speed-time graphs of two cars A and B moving in a straight line from the same starting point.

For
examiner's
use

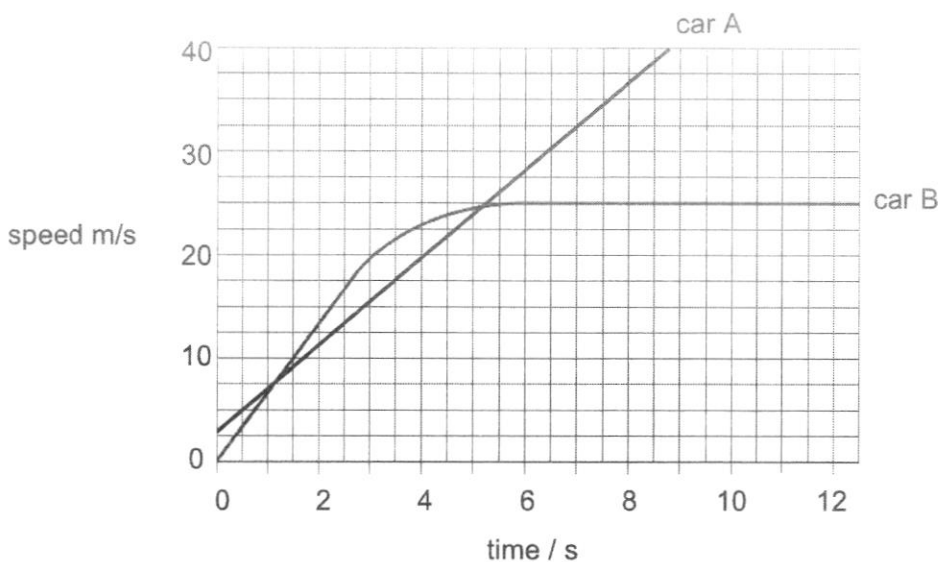


Fig. 4.1

- (a) Compare the acceleration of the cars from 0 s to 2 s.
Give a reason for your answer using information from the graph in Fig. 4.1.

.....

 [2]

- (b) The air resistance acting on the cars increases as speed increases.

Using Newton's laws of motion, explain how the resultant force on car B changes over time. The driving force of car B remains constant from 0 s to 12 s.

.....

 [3]

- (c) Estimate the time at which car A overtakes car B.

time = [1]

- 5 Fig. 5.1 shows a stone supported by two strings. The tensions in the two strings are 2.6 N and 4.0 N respectively.

For
examiner's
use

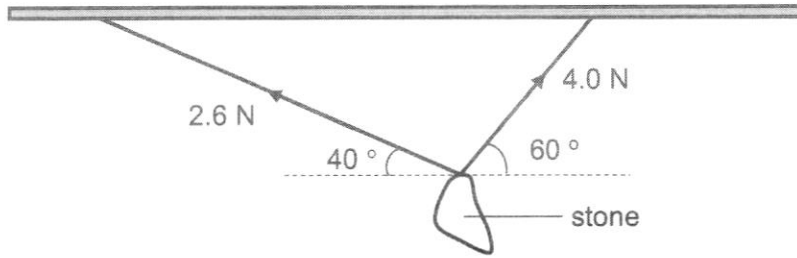


Fig. 5.1

Draw a vector diagram to determine the weight of the stone.

weight = [4]

- 6 Fig. 6.1 shows two identical balls A and B, each of mass 8.0 kg and suspended by a piece of rope. Ball A is on the Earth and ball B is on the Moon.

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use



Fig. 6.1

- (a) The volume of each ball is 0.0030 m³.

Calculate the density of each ball.

density = [2]

- (b) State the difference (if any) in the force needed to displace ball A and B sideways.

Explain your answer.

.....

 [2]

- (c) Are balls A and B in stable, unstable or neutral equilibrium?

Explain your answer.

.....

 [2]

For
examiner's
use

- 7 (a) Describe the experimental set-up to check that the upper fixed point of a liquid-in-glass thermometer has been calibrated correctly.

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

- (b) The length of the mercury column is 16.5 cm when the temperature is 100 °C and 4.3 cm when the temperature is 0 °C.

Calculate the length of the mercury column when the temperature is 30 °C.

length = [2]

- 8 Fig. 8.1 shows 3 light rays incident on a spherical air bubble trapped inside a glass block.

For
examiner's
use

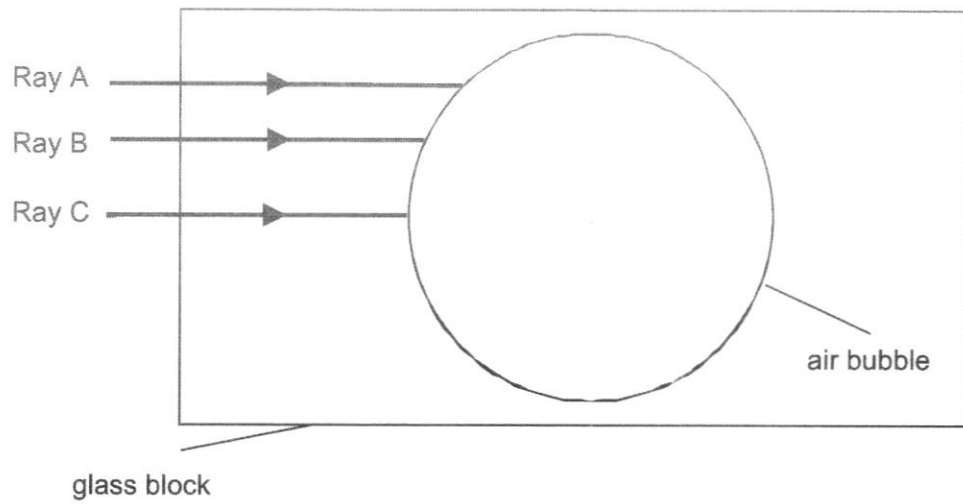


Fig. 8.1

- (a) Ray B refracts at a tangent to the spherical air bubble. The refractive index of the glass block is 1.5

Draw out the path of ray B. Label your ray B.

[1]

- (b) Calculate the angle of incidence of ray B.

angle of incidence = [2]

- (c) Draw out the paths of ray A and ray C until they emerge from the air bubble. Label your rays A and C respectively.

[2]

For
examiner's
use

9 A driver drives a car of mass 3000 kg with a maximum driving force of 40 kN. The constant frictional force acting on the car is 1000 N.

(a) Complete the free body diagram in Fig. 9.1 by drawing and labelling the forces acting on the car.

[1]

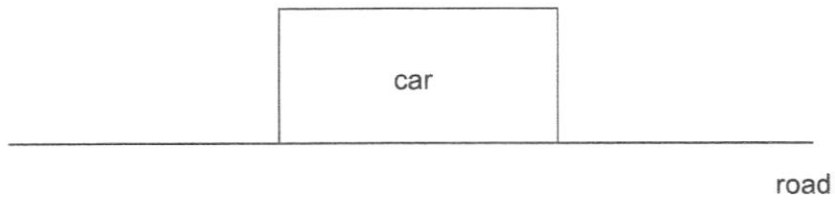


Fig. 9.1

(b) At one instant, the acceleration of the car is 5.0 m/s^2 . Determine the force due to the air resistance acting on the car at this instant.

force due to air resistance = [2]

(c) Explain why the velocity of the car increases at a decreasing rate, even though the driving force is maximum.

.....

.....

..... [2]

- 10 A golf ball rises from the ground at A to a vertical height of 16 m at B before landing on the ground at C, as shown in Fig. 10.1. You may assume that there is no air resistance as the ball travels from A to B to C.

For
examiner's
use

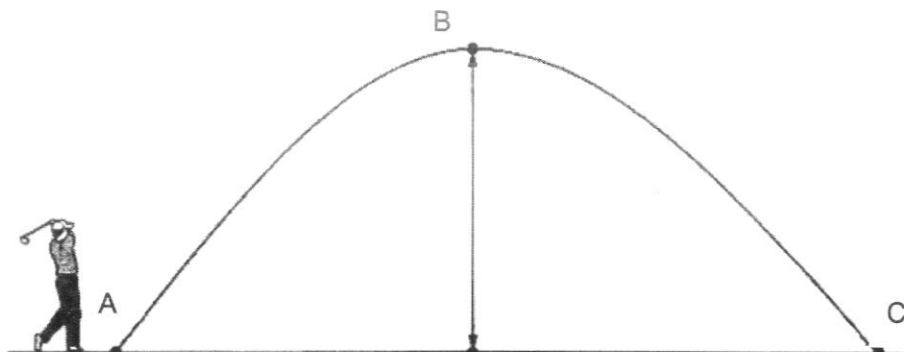


Fig. 10.1 (not to scale)

The mass of the ball is 0.045 kg. The gravitational field strength g is 10 N / kg.

- (a) Calculate the increase in gravitational potential energy of the ball between A and B.

increase in potential energy = [2]

- (b) At B, the kinetic energy of the ball is 2.5 J.

Calculate the kinetic energy of the ball at A.

kinetic energy = [1]

- (c) Calculate the speed of the golf ball just before it lands at C.

speed = [2]

Section B [30 marks]Answer **all** questions from this section.For
examiner's
use

- 11 Student A and student B are cyclists. They are physically similar and ride identical bicycles along a straight road as shown in Fig. 11.1.

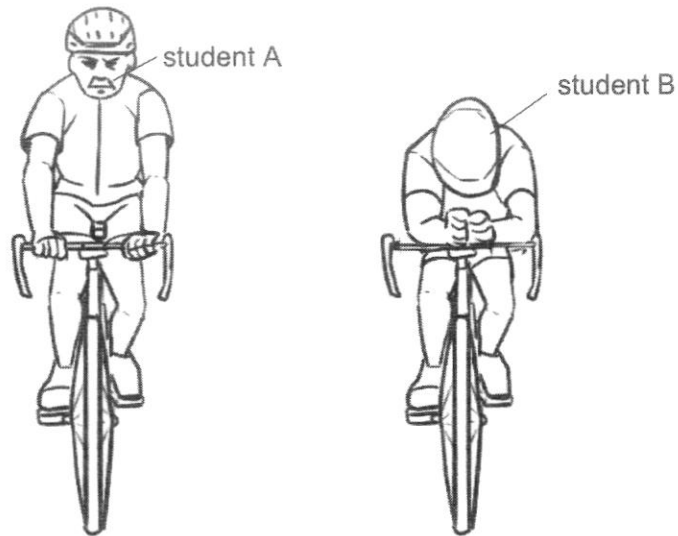
**Fig. 11.1**

Table 11.2 shows the power, P , that they exert on their bicycles measured against the velocity, v , they attain.

P / W	student A	student B
	$v / m/s$	$v / m/s$
10	1.5	1.5
20	3.0	3.0
40	4.5	4.6
75	6.0	6.3
150	8.0	8.6
225	9.5	10.5
300	10.8	12.4
375	11.7	13.7

Table 11.2

(a) Using the data given in Table 11.2,

(i) state which cyclist is more efficient at higher speeds.
Explain your answer.

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

(ii) suggest why both cyclists attain identical velocities for power inputs of less than 20 W.

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

(b) On Fig. 11.3, plot the velocity-power graph for student B. [2]

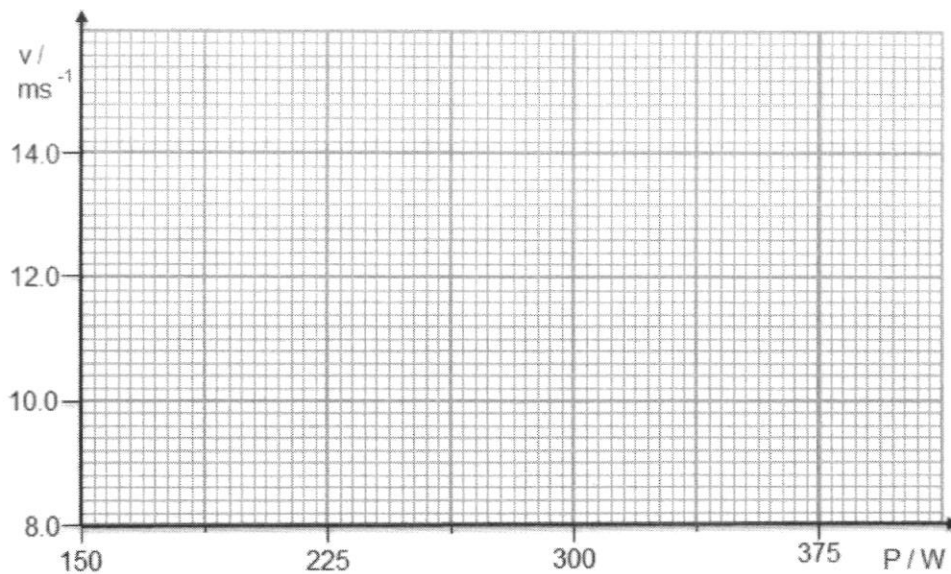


Fig. 11.3

*For
examiner's
use*

- (c) Compare the riding position of both cyclists to explain the difference in their ability to ride fast.

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

- (d) After some time, the straight road begins to slope downwards. Both cyclists stop pedalling, yet they continue moving at constant speed.

Explain why both cyclists need not pedal to continue moving at constant speed.

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

- 12 The specific heat capacity of a liquid X is measured by using a low-voltage immersion heater as shown in Fig. 12.1. The energy transferred through the heater is measured by a joulemeter. The heater is switched on for 300 s and then switched off. The variation of the temperature of liquid X with time is shown in Fig. 12.2.

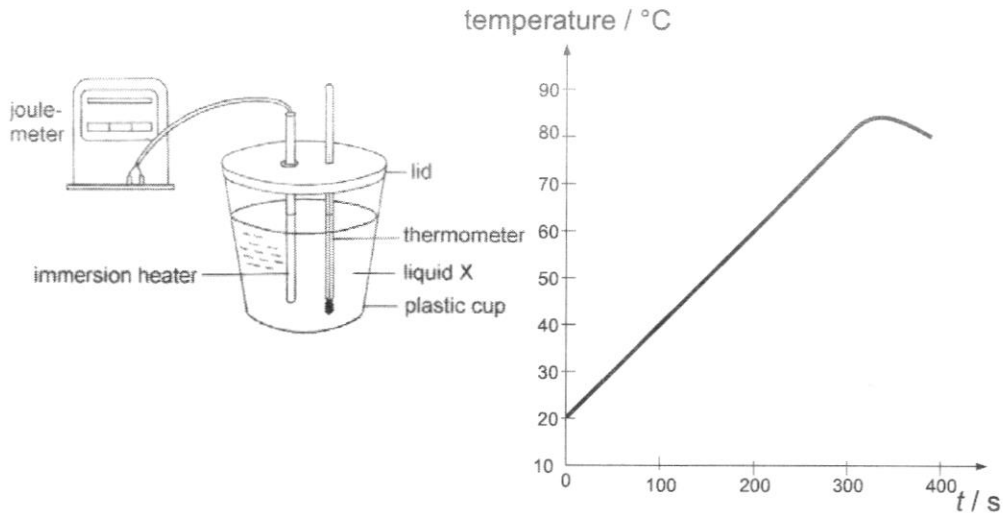


Fig.12.1

Fig. 12.2

- (a) Explain why the temperature of X continues to rise for a while after the heater is switched off.

.....

 [1]

- (b) (i) The mass of liquid X is 0.50 kg and the initial and final joulemeter readings are 64 500 J and 76 400 J respectively.

Calculate the specific heat capacity of liquid X as found from the experiment.

specific heat capacity = [2]

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use

(ii) Is the result obtained in part (b)(i) higher or lower than the true value of the specific heat capacity of liquid X? Explain your answer.

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

(c) Sketch, on Fig. 12.2, the graph from $t = 0$ s to $t = 300$ s if a liquid of twice the specific heat capacity of X is used instead.

Label the graph Y. [1]

(d) Liquid X is contained in a plastic cup and a lid is placed over the cup in the experiment.

Explain why

(i) a plastic cup, instead of a copper cup is used

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

(ii) a lid is placed over the cup in the experiment.

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

13 The camera makes use of a converging lens for it to capture image. A lens with focal length of 2.0 cm is used in a simple camera.

- (a) An object of height 2.0 cm is placed 5.0 cm from the optical centre of the lens. Draw a ray diagram for the simple camera on Fig. 13.1 and label the image I. [2]

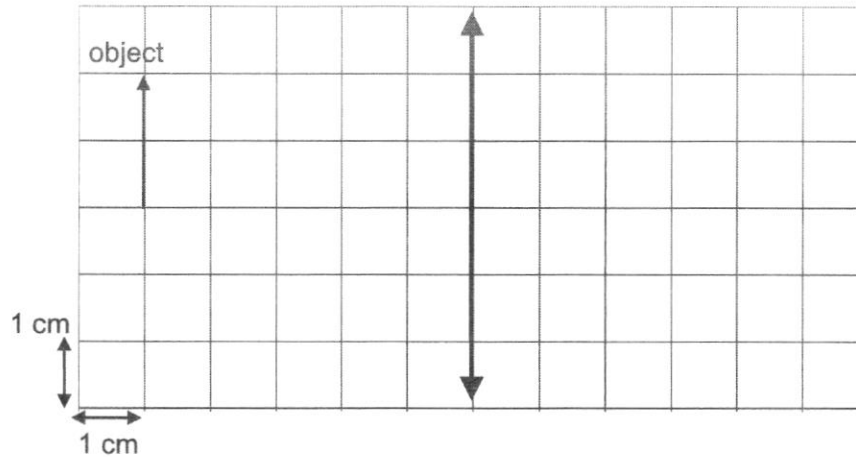


Fig. 13.1

- (b) Calculate the magnification factor of the lens.

magnification factor = [1]

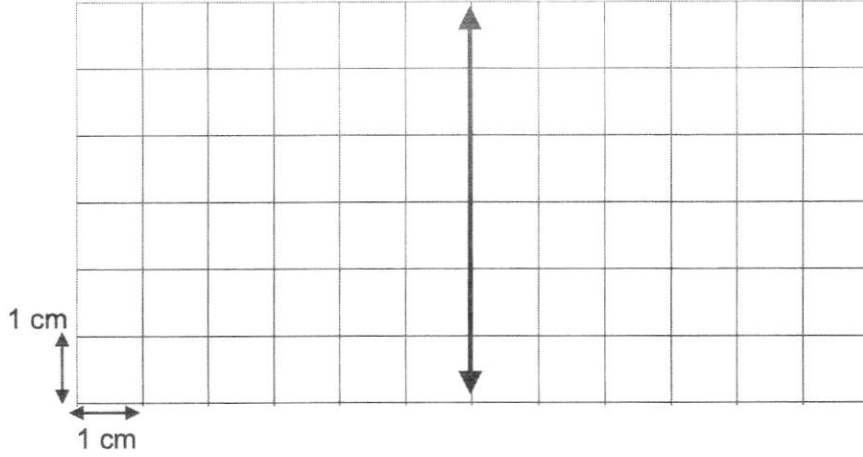
- (c) State one characteristic of image formed by the camera.

..... [1]

- (d) A student drops his simple camera and caused the image distance from the lens to be at $2F$.

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examiner's
use

Explain, using a ray diagram if his camera is still fully functional.



.....

.....

.....

..... [2]

- (e) Optical fibres have taken the place of wires in telecommunications. A length of a glass optical fibre carrying a ray of light is shown in Fig. 13.2 below. In this situation, the glass has a refractive index of 1.5.

For
examiner's
use

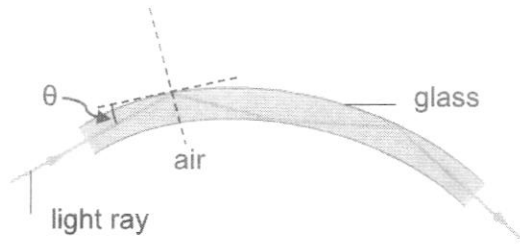


Fig. 13.2

- (i) Calculate the maximum angle θ , such that the light ray does not escape through the walls of the optical fibres.

maximum $\theta = \dots\dots\dots$ [2]

- (ii) State two advantages of the use of optical fibre in telecommunications as compared to using copper wires.

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

END OF PAPER

BEDOK GREEN SECONDARY SCHOOL
SCIENCE DEPARTMENT
MARKING SCHEME
YEAR (2022)

SUBJECT: Physics
EXAM: EOY
LEVEL: Sec 3E
SETTER: Mr Lloyd Goh

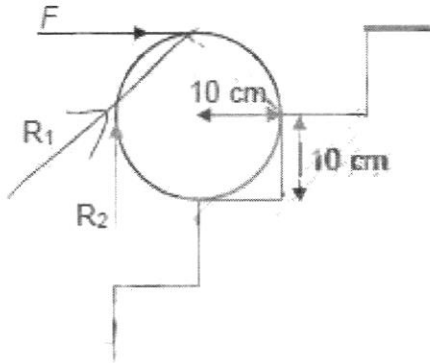
PAPER 1: 40 marks

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

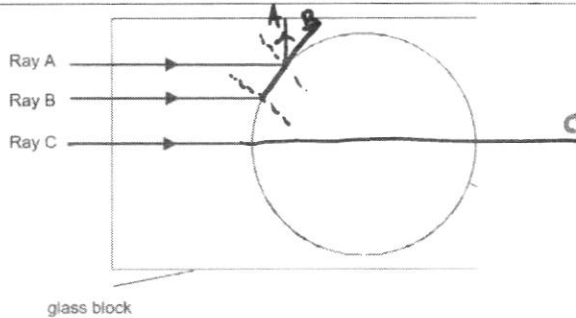
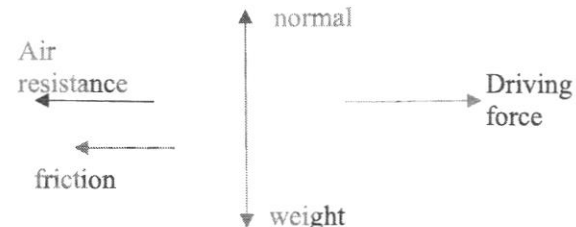
PAPER 2

Section A: 50 marks

Qn. No.	Scoring points	Marks	Max. Marks
1ai	1) force on crate by pallet 2) force on earth by crate	1	1
1aii		1	1
1b	$W = mg$ $W = 200 \times 10$ $W = 2000 \text{ N}$	1 1	2
1c	The weight will be lesser. Since $W = mg$ and mass is a constant, the weight of the object will be lesser when measured on moon since it has a lower gravitational field strength.	1 1	2

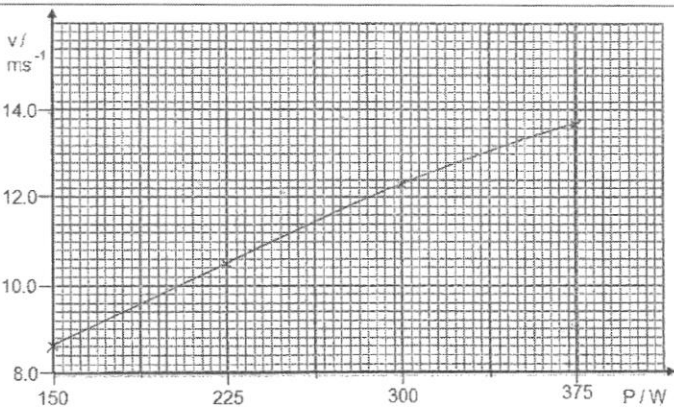
2a	Moment about a point is defined as the product of the force acting at a point and the perpendicular distance from the line of action of force about the same pivot.	1	1
2b	By taking moments about A, Using the principle of moments, Sum of anti-clockwise moments = sum of clockwise moments $F \times 0.1 = 20 \times 0.1$ $F = 20 \text{ N}$	1 1	2
2ci	 <p>R_1 or R_2 are both possible answers. Accept also other possible answers.</p>	1	1
2cii	For R_1 , Using Pythagoras theorem, $(0.1^2 + 0.1^2)^{1/2} = 0.141$ $R \times (0.141) = 20 \times (0.1)$ $R = 14.2 \text{ N}$ For R_2 , $R \times (0.2) = 20 \times (0.1)$ $R = 10 \text{ N}$	1 1 1 1	2
3a	The substance is undergoing a state change. During this period, the energy gained is used to overcome the forces of attraction instead of increasing its kinetic energy. Since kinetic energy is directly proportionate to temperature, the temperature remains constant.	1	1
3bi	The object has a higher specific heat capacity in liquid form.	1	1

3bii	Since the gradient of the graph during liquid form is gentler than when in solid, it also means the substance requires more energy to gain temperature when it is in liquid form.	1	1
4a	Car B has a higher constant acceleration compared to car A. This can be seen through the gradient as car B has a steeper gradient.	1 1	2
4b	Since the acceleration of A is constant, by Newton's 2 nd Law ($F=ma$), the resultant force acting on A is constant. Resultant force = Driving force – Air Resistance. Since the air resistance acting on A increases, the driving force on A also increases to ensure that resultant force remains constant.	1 1 1	3
4ci	7 – 7.5 s	1	1
5	Weight = 5.1 ± 0.1 N	tension 1m triangle or parallelogram used 1m resultant force 1m logical scale 1m	4
6a	$D = m/V = 8.0 / 0.0030$ $= 2666.7 = 2700 \text{ kg/m}^3$ (2 s.f.)	1 1	2
6b	Equal to. The balls have the <u>same mass</u> and thus the <u>same inertia</u> , so the same force is required to change their state of rest. OR Equal to. The balls have the <u>same mass</u> , so by Newton's 2 nd Law ($F=ma$), the same force is required to cause the <u>same acceleration</u> .	1 1 1 1	2

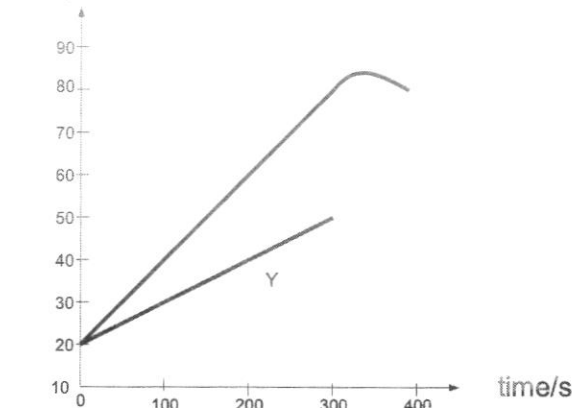
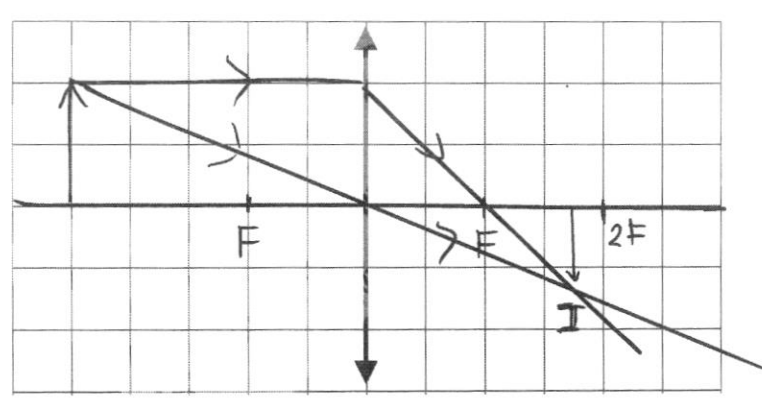
6c	Stable equilibrium. They return to original position after displacement.	1 1	2
7a	Position the bulb of the thermometer <u>above</u> the surface of <u>pure boiling water</u> such that it measures the temperature of <u>pure steam</u> . The <u>liquid level</u> should coincide with the <u>100°C</u> marking once it reaches <u>steady</u> state.	1 1	2
7b	$\theta = (L_{\theta} - L_0) / (L_{100} - L_0) \times 100$ $30 = (L_{\theta} - 4.3) / (16.5 - 4.3) \times 100$ $L_{\theta} = 7.96 = 8.0 \text{ cm (2 s.f.)}$	1 1	2
8a,c	 Ray A Ray B Ray C glass block	1 for B 1 for A 1 for C	1+2
8b	$n = 1/\sin c$ $c = \sin^{-1}(1/1.5)$ $c = 41.8^\circ$	1 1	2
9a	 normal weight Driving force Air resistance friction	1	1
9b	$F = ma$ $F = 3000 \times 5 = 15000 \text{ N}$ Air resistance = $40000 - 1000 - 15000$ Air resistance = 24000 N	1 1	2
9c	The car accelerates, velocity increases and air resistance increases. since The driving force is constant and the resultant force decreases which causes the acceleration decreases.	1 1	2

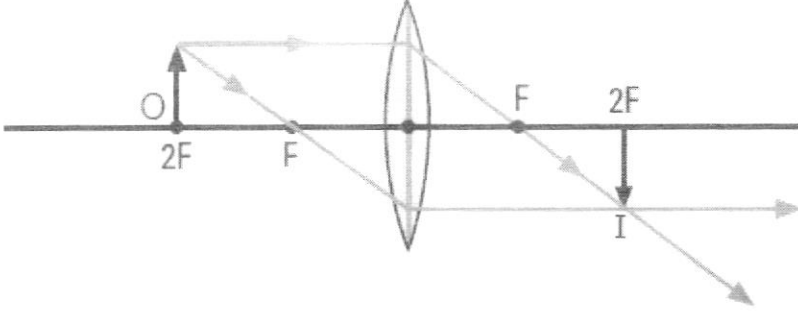
10a	GPE = mgh GPE = 0.045 x 10 x 16 GPE = 7.2 J	1 1	2
10b	KE = 7.2 + 2.5 = 9.7 J	1	1
10c	KE = 7.2 $V = \sqrt{((9.7 \times 2) / 0.045)}$ V = 20.7 m/s	1 1	2

SECTION B: 30 Marks

Qn. No.	Scoring Points	Marks	Max. Marks
11ai	Student B is more efficient. With power inputs of 40 W and above, he has consistently achieved a higher velocity for the same power input compared to student A.	1 1	1
11aii	At these low velocities ie. Below 3 m/s, air resistance experienced by both cyclists is <u>about the same / amount</u> of air resistance is <u>not significant</u> , OR the resultant force experienced by both cyclists are the same, hence they have identical velocities.	1 1 OR 1 1	2
11b		[1] for all point plotted correctly [1] for best-fit line drawn	2

11c	<p>Student B's body is lower on his bicycle, making his surface area against the wind / facing front smaller than student A's.</p> <p>For a given power input, due to student B's smaller surface area, he experience a less air resistance. Hence, student B experiences a greater resultant force, which enable him to accelerate and gain higher velocity.</p> <p>OR</p> <p>Hence, more work done by student B is converted to kinetics energy, which allows him to gain higher velocity. Hence, less work done by student B is used to overcome the air resistance, allows him to gain higher velocity.</p>	<p>1</p> <p>1</p> <p>1</p> <p>OR</p> <p>1</p> <p>1</p>	3
11d	<p>Forward force is balanced by friction or air resistance. By Newton's first law, they continue to move at constant speed.</p> <p>OR</p> <p>When they move down the slope, the lost in gravitational potential energy is converted to kinetic energy at the same rate thermal energy is generated. Since there is no gain in kinetic energy, they move at constant speed.</p>	<p>1</p> <p>1</p> <p>OR</p> <p>1</p> <p>1</p>	2
12a	<p>The heater is still hot and continues to give out heat to liquid X, as X is of a lower temperature than the heater.</p>	<p>1</p>	1
12bi	$Q = mc\Delta\theta$ $c = \frac{Q}{m\Delta\theta}$ $= \frac{76400 - 64500}{0.5(60)}$ $= 397 \text{ J / (kg } ^\circ\text{C)}$	<p>1</p> <p>1</p>	2
12bii	<p>Value obtained in part (b)(i) is higher than the true value of the specific heat capacity of liquid X. Heat is lost to the surroundings and thus heat absorbed by water to raise its temperature by 60°C is lesser than that used in part (b)(i).</p>	<p>1</p> <p>1</p>	2

12c	<p style="text-align: center;">Temperature/°C</p> 	1	1
12di	Plastic is a poor conductor of heat compared to copper. This will reduce heat lost through conduction to the surroundings.	1 1	2
12dii	Having a lid over the cup prevents the hot air and water vapour in the cup from escaping. This will reduce heat loss to the surroundings by <u>convection</u> and <u>evaporation</u> .	1 1	2
13a		1 for each ray -1 if no labels	2
13b	Magnification factor = $\frac{\text{Height of image}}{\text{height of object}} = \frac{1.67}{2} = 0.835$	1	1
13c	Real OR inverted OR diminished	1	1

13d	 <p>Only an image that has the same size as an object placed at 2F can be formed.</p>	1 for diagram 1	2
13ei	$n = 1/\sin c$ $c = 41.8^\circ$ $\text{angle} = 90^\circ - 41.8^\circ = 48.2^\circ$	1 1	2
13eii	it is cheaper it is lighter it can transmit data faster (any 2)	1 1 1	2