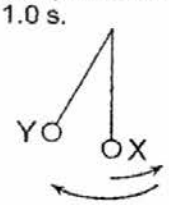
Section A Multiple Choice Questions (35 marks)
Answer **all** the questions in this section on the Multiple Choice Answer Sheet provided.

1. A pendulum started swinging from position X at time $t = 0$ s.
The period of the pendulum is 1.0 s.



A stopwatch is used to record the time t when it starts swinging from position X to position Y. Which of the following is most likely to be the time t?

A 0.5 s B 0.75 s C 1.5 s D 3.0 s

2. Which pair of units both measure the same quantity?

A N and kg.m/s^2
B g/cm^3 and Pa
C m/s and N.m
D W and J

3. Vernier calipers are used to measure the diameter of a ball-bearing.

Diagram 1 shows the calipers when the jaws are closed.
Diagram 2 shows the calipers when the ball-bearing is between the jaws.

diagram 1

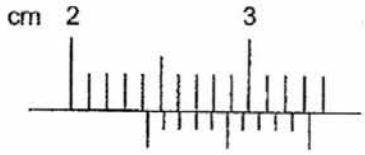
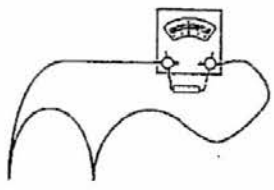


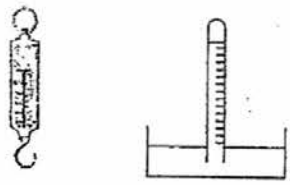
diagram 2

What is the diameter of the ball-bearing?

A 2.31 cm
B 2.41 cm
C 2.43 cm
D 2.45 cm

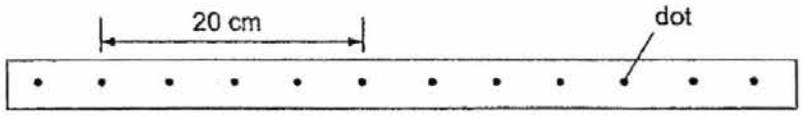
4. How many of the following instrument(s) measure vector quantities?





A 1 B 2 C 3 D 4

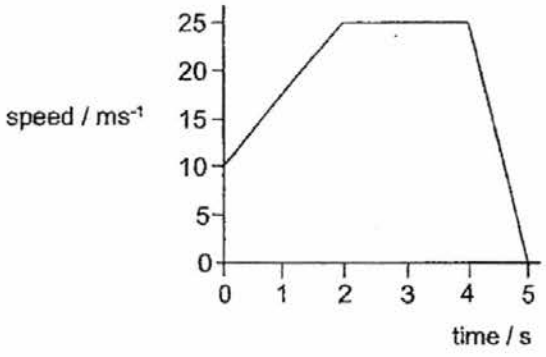
5. A strip of paper tape is pulled at constant speed under a vibrating arm. The arm vibrates regularly, making 50 dots per second.



What is the speed of the tape?

A 0.4 cm/s B 100 cm/s C 200 cm/s D 250 cm/s

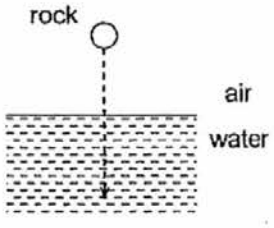
6. The diagram below is a speed-time graph of a car.



What is the acceleration of the car?

A 0 ms^{-2} B 5 ms^{-2} C 7.5 ms^{-2} D 12.5 ms^{-2}

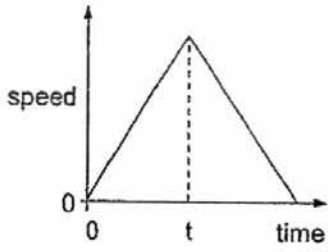
7. A rock is released from air and falls through water.



Which row shows the change in acceleration and velocity of the rock immediately after it enters the water?

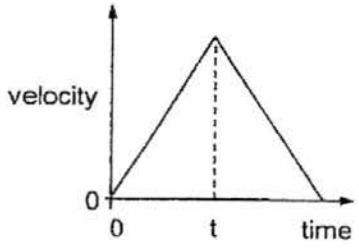
	acceleration	velocity
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

8. A ball is released at a height and hits the ground at time *t*. The ball then bounces up. The diagram below is a speed-time graph of the ball.

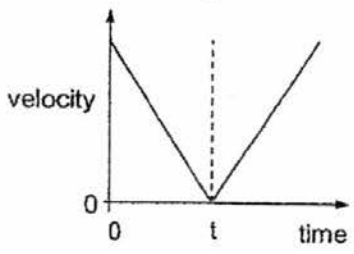


Which of the following is the correct velocity-time graph of the ball?

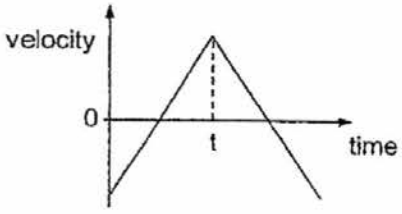
A



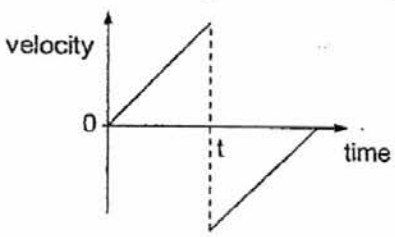
C



B

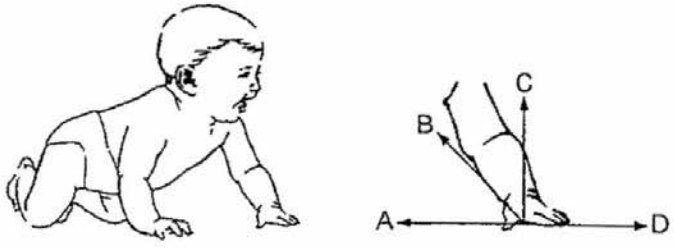


D



9. A baby uses his hands to crawl forward.

Which arrow indicates the direction of the force of friction acting on one of his hand?



10. At lift off, the mass of a small water rocket is 2.5 kg. The rocket experiences an upward thrust of 45 N. The gravitational field strength *g* is 10 N/kg.

Which is the initial acceleration of the rocket?

A $0.055\ ms^{-2}$ B $8\ ms^{-2}$ C $10\ ms^{-2}$ D $18\ ms^{-2}$

11. A parachutist jumps off a plane and falls towards the ground.

At this moment, which statement about the forces acting on him is correct?

A There are no forces acting on the parachutist.
B The upward force on the parachutist is equal to the weight of the parachutist.
C The upward force on the parachutist is lesser than the weight of the parachutist.
D The upward force on the parachutist is more than the weight of the parachutist.

12. When an aeroplane lands, it requires to travel some distance before coming to a stop.

Which property of the aeroplane causes this requirement?

A density
B mass
C pressure
D weight

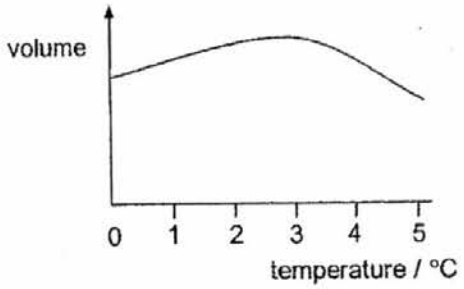
13. A doughnut and bun, of the same thickness and diameter are made from the same dough.

doughnut bun

Compared to the bun, the doughnut has

A the same density but lesser volume and mass.
B the same mass but lesser density and volume.
C the same volume but lesser density and mass.
D lesser mass, volume and density.

14. The graph shows the variation of volume with temperature for a fixed mass of solid.



From the graph, it can be seen that the density of the solid reaches

A a minimum value at 3 °C.
B a minimum value at 5 °C.
C a maximum value at 0 °C.
D a maximum value at 3 °C.

15. A deep ocean vessel of weight 7.00×10^4 N at the surface of the ocean descends to the bottom of the ocean. The gravitational field strength changes from 9.81 N/kg at the surface to 9.85 N/kg at the bottom.

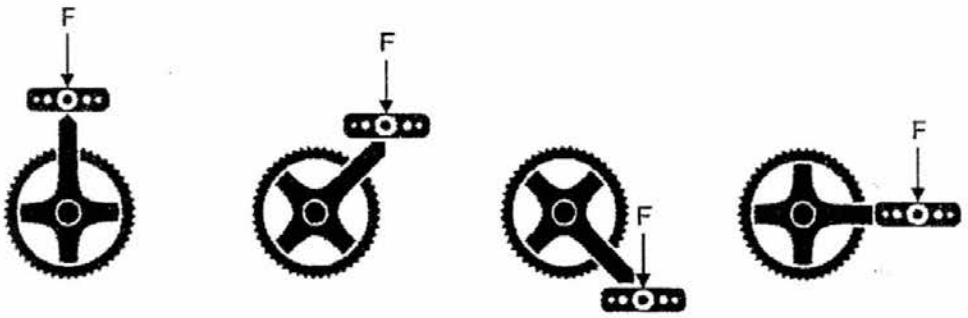
Which are the mass and the weight of the vessel at the bottom of the ocean?

	mass at the bottom / kg	weight at the bottom / N
A	7.11×10^3	7.00×10^4
B	7.11×10^3	7.03×10^4
C	7.14×10^3	7.00×10^4
D	7.14×10^3	7.03×10^4

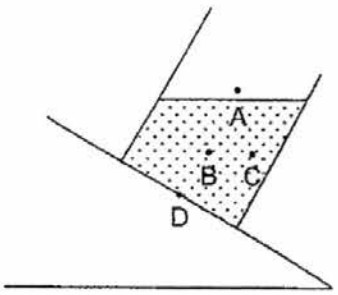
16. Which statement about gravitational fields is **not** true?

A Gravitational fields cause forces on objects because they have mass.
B Only planets and stars have gravitational fields.
C The gravitational field of the Earth acts inwards towards the centre of the Earth.
D The gravitational field strength on the Earth is more than on Moon because the Earth has a larger mass than the Moon.

17. The same amount of force is exerted on a bicycle pedal at four different positions.
At which position is the force exerting the most turning effect on the pedal?



18. A container filled with water is resting on an inclined plane.
Where is most likely to be the centre of gravity of the container?



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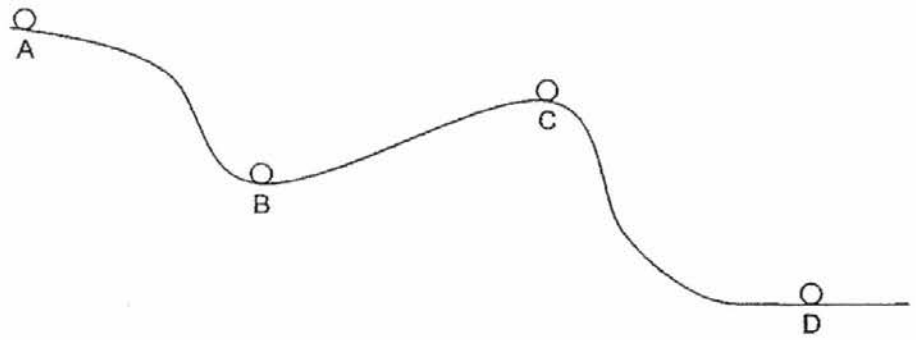
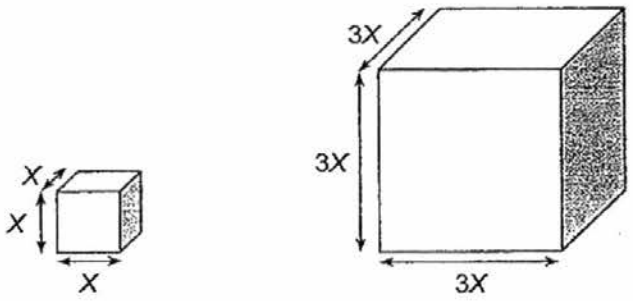
19. Four balls are placed along a track.
Which ball is at stable equilibrium?



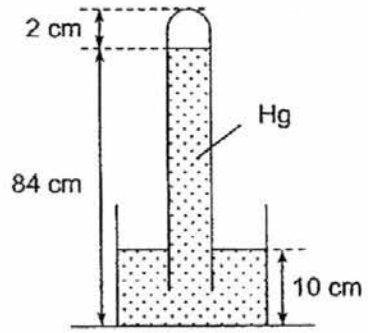
20. A cube of sides X cm each exerts a pressure P on a surface due to its weight.
A larger cube, made of same material, has sides $3X$ cm.



What is the pressure exerted on the surface by larger cube?

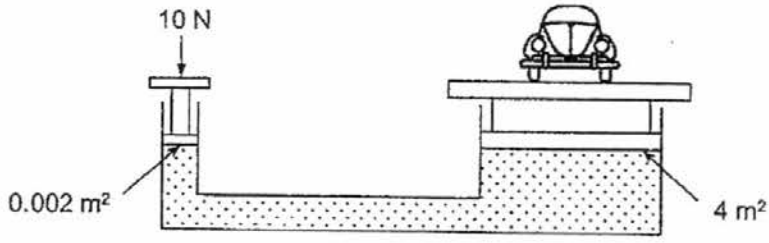
A $\frac{1}{3}P$ B P C $3P$ D $27P$

21. What is the atmospheric pressure measured by the barometer?



A 74 cm Hg B 76 cm Hg C 84 cm Hg D 86 cm Hg

22. A hydraulic press is used to support the weight of a car by applying a 10 N on a 0.002 m^2 piston.



What is the weight of the car?

A 200 N B 2000 N C 20,000 N D 200,000 N

23. A bulb is being powered by a battery.
What is the energy conversion in the bulb?

A chemical potential energy to light and thermal energy
B chemical potential energy to electrical energy
C electrical energy to light and thermal energy
D electrical energy to chemical potential and light energy

24. Which of the following does **not** use kinetic energy to generate electricity?

A hydroelectric dam
B solar panel
C tidal wave turbine
D wind turbine

25. Which of the following is an example where no net work is done?

A A car moving at constant speed in a straight line.
B A man doing push-ups.
C A crane lifting a load.
D A bird lifting off from a tree branch.

26. In a Brownian motion experiment, specks of light are observed and seen to move around randomly.
Which of the following best explains the observation?

A The specks of light are dust particles which are moving randomly on their own.
B The specks of light are air particles which are moving randomly.
C The specks of light are dust particles which absorb the light to move around.
D The specks of light are dust particles which are collided by unseen air particles continuously.

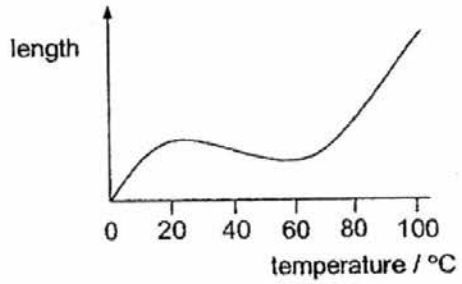
27. Which of the following is **not** suitable as a thermometric property?

A volume of a liquid of fixed density
B pressure of a gas of fixed volume
C resistance of a metal
D e.m.f. across two electrical junctions formed by two different metals

28. A thermometer is used to measure the temperature of a beaker of water which is heated from 30 °C to 100 °C.
What is the final temperature and temperature change in Kelvins?

	final temperature / K	temperature change / K
A	100	70
B	273	343
C	373	70
D	373	343

29. The diagram below shows how the length of an unknown liquid changes with temperature.



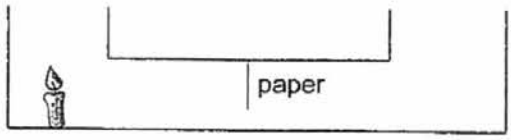
Which temperature range will the length of the liquid be suitable as a thermometric property?

A 0 °C to 40 °C
B 0 °C to 100 °C
C 40 °C to 80 °C
D 80 °C to 100 °C

30. An astronaut suit is white on the outside. This helps the astronaut to maintain his body temperature when the astronaut is exposed directly to the sun.
Which of the following best explains how the suit works?

A White is a poor absorber so the astronaut gains heat slowly.
B White is a poor radiator so the astronaut loses heat slowly.
C White is a good absorber so the astronaut gains heat slowly.
D White is a good radiator so the astronaut loses heat slowly.

31. A chamber with two open ends contains a lit candle and a thin piece of paper suspended in the middle.



After some time, the air in the chamber moves and the paper starts to sway.
Which of the following explains how the paper would sway?

A The paper will sway away from the candle as it heats up.
B The paper will sway away from the candle as air near the candle sinks.
C The paper will sway towards the candle as air near the candle rises.
D The paper will sway to and fro as it continuously heats and cools down.

32. Four bars, all of different masses, are each placed with one end in boiling water.
The times taken for the temperature of the other end to increase by 5 °C are measured.

Which bar has the highest heat capacity?

	mass / kg	time / s
A	2	40
B	4	30
C	5	20
D	10	10

33. Which of the following decreases when a liquid is being cooled above melting point?

A the average kinetic energy of the molecules
B the molecular size
C the molecular mass
D the total number of molecules

34. Which statement describes the boiling of water?

A It occurs at a fixed temperature and only on the surface.
B It occurs at a fixed temperature and throughout the liquid.
C It occurs at any temperature and only on the surface.
D It occurs at any temperature and throughout the liquid.

35. The energy released when steam changes into water at the same temperature is called latent heat of condensation.
What happens when this energy is released?

A Separate water atoms combine into molecules.
B The speed of the water molecules decreases.
C The temperature of the water molecules decreases.
D The water molecules become closer to one another.

Section B (35 marks)
Answer **all** the questions in this section in the spaces provided.

1 A motorised gear is used to run a conveyor belt as shown in Fig. 1.1.

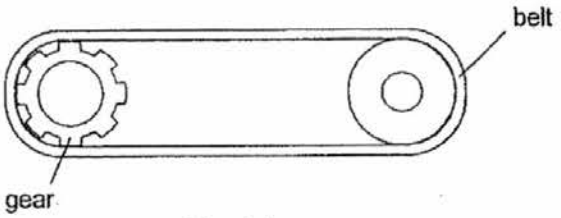


Fig. 1.1

Whenever the gear rotates 360°, it makes a click sound and the gear completes one revolution.

(a) An accurate value for the average time for one complete revolution is obtained.

Describe what measurements are taken and how they are used to find the average time for one complete revolution.

_____

_____

_____

_____

_____ [3]

(b) A student calculates the average power of the gear.

(i) Apart from the measurement in **(a)** and distance travelled for one revolution, state the other measurement that is needed.

_____ [1]

(ii) State, **in words**, the equation needed to calculate the average power of the gear.

_____

_____

_____ [2]

(c) The gear rotates at a fixed rate which is very fast. Thus it is not accurate to measure the distance travelled by the belt directly. Suggest a more accurate method to determine the distance travelled.

_____

_____ [1]

2 In space, a rock moves in a straight line at constant speed. However, the motion of the rock changes as it approaches Earth as shown in Fig. 2.1.

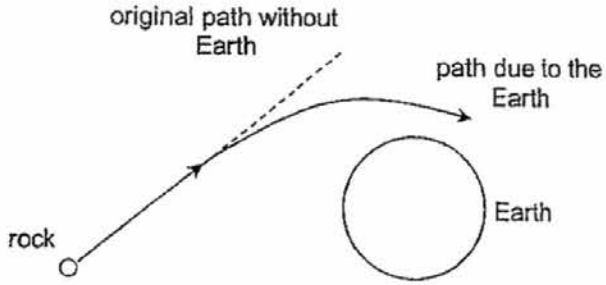


Fig. 2.1 (not to scale)

(a) The gravitational field strength of Earth causes the motion of the rock to change.

(i) State what is meant by the ***gravitational field strength*** of Earth.

_____

_____ [1]

(ii) Describe, in terms of forces, how the gravitational field strength of Earth cause the motion of the rock to change.

_____

_____ [1]

(iii) As the rock approaches Earth, it enters the atmosphere. The rock experiences the effects of air resistance and no longer gains speed.

State the energy change that occurs and explain, using ideas about conservation of energy, why the rock no longer gains speed as it falls through the atmosphere.

_____

_____

_____ [2]

(b) The rock eventually landed on Earth and found to be spherical in shape. Its mass and diameter are measured to be 0.5 kg and 4.95 cm respectively.

(i) Calculate the density of the rock. Give your answer in g/cm^3.
(Volume of a sphere = 4/3 πr^3)

density = _____ g/cm^3 [2]

(ii) The mass of pure iron of the same volume as the rock is 0.495 kg.
State and explain whether the rock is made of pure iron.

_____

_____

_____ [1]

3 A 50 N cat sits in the middle of a 2 m plank supported by two pivots A and B as shown in Fig. 3.1. The plank is of negligible weight.

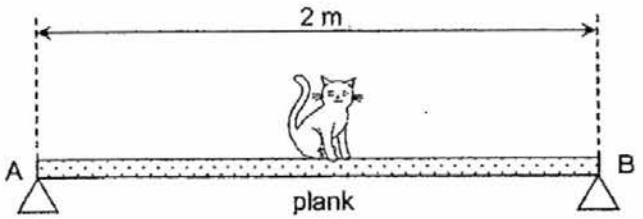


Fig. 3.1 (not to scale)

(a) (i) Determine the moment acting on the bridge by the weight of the cat about the pivot A. Also, indicate the direction of this moment.

moment = _____ N.m [2]

direction of moment = _____ [1]

(ii) There is an upward force acting on the bridge by pivot B.
Determine this force and state any law or principle you used.

upward force = _____ N [2]

(b) The cat then walks along the plank towards pivot B.
Explain the change, if any, to the force calculated in (a)(ii).

_____

_____

_____ [2]

4 A car has four tyres which support the weight of the body. One tyre of the car is as shown in Fig. 4.1.

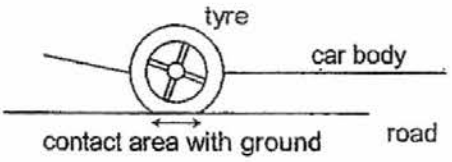


Fig. 4.1

Fig. 4.2 shows the contact area of one tyre with the ground at different air pressure inside the tyre.

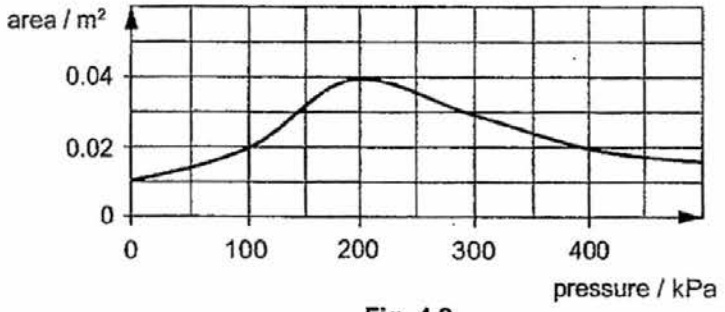


Fig. 4.2

(a) (i) On a particular day, all four tyres of the car are each inflated with an air pressure of 200 kPa. Determine the weight of the car.

weight = _____ N [2]

(ii) The contact area of the tyres has found to decrease after the car travelled a long distance. Suggest a possible reason for this.

_____

_____

_____ [1]

(b) A manometer filled with mercury is used to measure the pressure of one tyre when the contact area of that tyre is 0.02 m² as shown in Fig. 4.3.

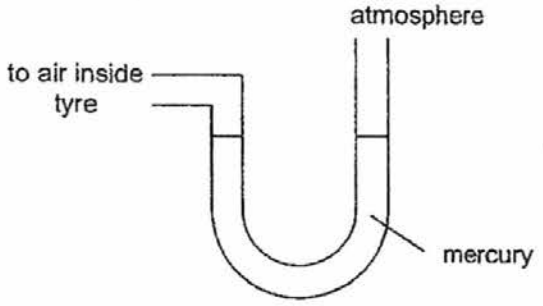


Fig. 4.3

Some air is released from the tyre.
The air pressure inside the tyre now becomes 98,640 Pa.

(i) Using Fig. 4.2 and 4.3, state the atmospheric pressure.

atmospheric pressure = _____ Pa [1]

(ii) Determine the height difference in the mercury levels in both arms.
The density of mercury is 13,600 kg/m^3.

height difference = _____ cm [2]

(iii) On Fig. 4.4 below, draw (to scale) the mercury levels in both arms.

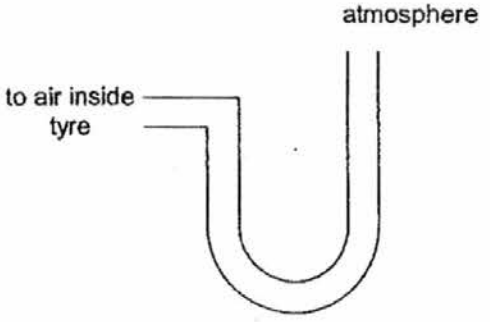


Fig. 4.4 [1]

5 A game at a fun fair requires the participant to use a hammer to exert a force on a lever to elevate a mass vertically, in order to hit the bell as shown below in Fig. 5.1a. The mass is 10.0 kg and the bell is 4.0 m above the mass.

Fig. 5.1b shows the enlarged view of the lever.

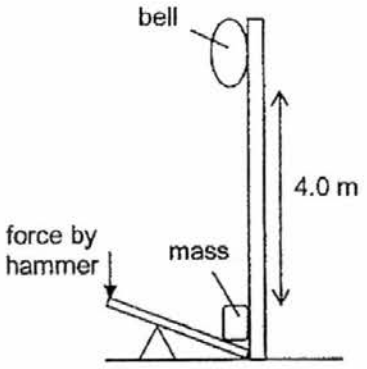


Fig. 5.1a (not to scale)

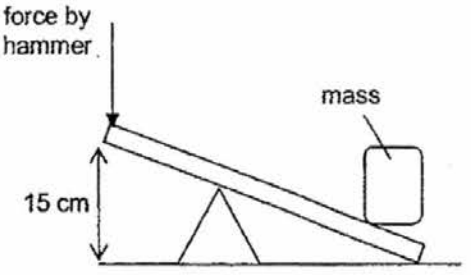


Fig. 5.1b (not to scale)

A man uses the hammer to exert a force of 3000 N on the edge of the lever and the mass start to rise vertically.

(a) (i) Determine the work done by the man on the lever.

work done = _____ J [1]

(ii) State the amount of energy gained by the mass when the hammer just struck the lever.

energy gained = _____ J [1]

(b) (i) The mass rises and hits the bell.
Determine the amount of kinetic energy that the mass has just before hitting the bell. State any principle used in your calculation.

kinetic energy = _____ J [3]

(ii) After hitting the bell, the mass is instantaneously at rest. It then falls back to the lever.
Determine the falling speed of the mass just before reaching the lever.

speed = _____ ms^{-1} [2]

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Section C (30 marks)
Answer **all** the questions in this section in the spaces provided.
Answer only one of the two alternative questions in **Question 8.**

6 Two identical chambers are filled with unknown gases X and Y as shown in Fig. 6.1a and Fig. 6.1b. The chambers are supporting identical weights through movable pistons.

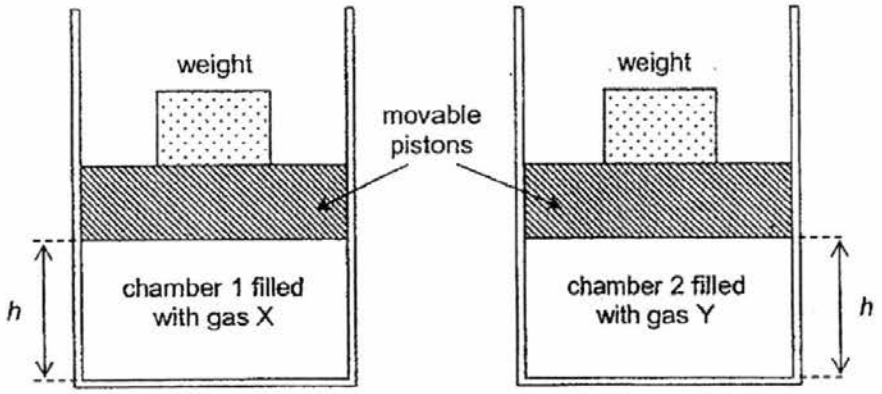


Fig. 6.1a (not to scale)

Fig. 6.1b (not to scale)

Gas X has a higher relative molecular mass than gas Y.

(a) The temperatures of the chambers are slowly increased.
The height of the piston of each chamber *h* is measured at various temperatures.
Fig. 6.2 shows the readings obtained.

temperature / °C	h / cm	
	chamber 1	chamber 2
0	0.5	0.5
100	1.0	1.5
200	1.5	2.5
300	2.0	3.5
400	2.7	4.7
500	3.6	6.0
600	4.3	6.0
700	4.3	6.0

Fig. 6.2

(i) Using data from Fig. 6.2, describe the relationship between the temperature and the height of the piston of chamber 1.

1. for 0 °C to 300 °C, _____

_____

2. for 400 °C to 700 °C. _____

_____ [2]

(ii) The data in Fig 6.2 provides some evidence of a relationship between the relative molecular mass of the gas and the maximum pressure exerted by the gas. State this possible relationship.

_____

_____ [1]

(iii) At the same temperature (except for 0°C), in terms of kinetic model of matter, explain why the pressure exerted by each gas is different.

_____

_____

_____ [2]

(b) The experiment is repeated with smaller chambers filled with the same amount of gases. Fig. 6.3 shows the new readings obtained at low temperatures.

temperature / °C	*h* / cm	
	chamber 1	chamber 2
0	0.7	0.6
100	1.3	1.8

Fig. 6.3

(i) Explain why the values of *h* at the same temperature are higher in Fig 6.3 than in Fig 6.2.

_____

_____

_____

_____ [2]

100

(ii) Suggest one other difference that is seen when the readings at values of temperature greater than 100°C are compared to those in Fig. 6.2.

_____

_____ [1]

(c) Explain how the extremely small particles of the gases in the chambers are able to support the weights.

_____

_____

_____ [2]

7 For an event during the National Day Parade, a helicopter flies past near the stadium with a flag attached via a cable as shown in Fig. 7.1. The helicopter and the flag move in a straight line at a constant altitude with a constant speed of 240 km/h.

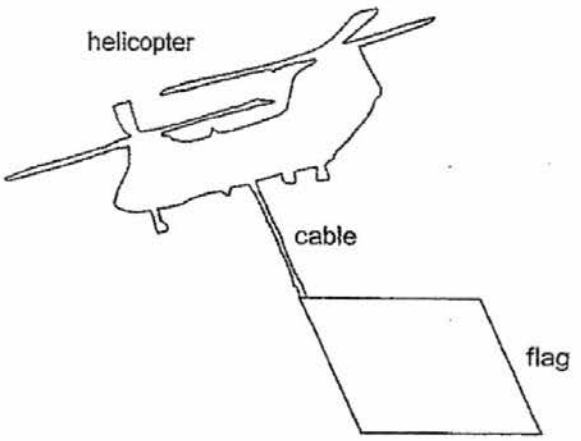


Fig. 7.1

(a) One force, the tension on the flag by the cable, is shown on Fig. 7.2.
The tension is 40,000 N and is 115° from the horizontal.
(The diagram is **not** drawn to scale.)

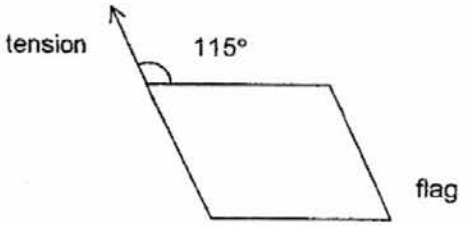


Fig. 7.2

(i) On Fig. 7.2, draw and label two other forces acting on the flag. [2]

(ii) By considering the forces on the flag, explain why the speed of the flag remains constant.

_____

_____

_____

_____ [2]

(iii) In the space below, by means of a scale diagram, determine the magnitude of the two other forces you have drawn in (i).

The magnitudes of the forces are _____ N and _____ N. [4]

(b) Describe the force that is the part of the action-reaction pair with the tension on the flag by the cable, and state the body on which it acts.

_____

_____ [2]

8 Either

A metallic metre rule is held firmly at the 0 cm mark by a metal clamp while the 95 cm mark is being heated constantly as shown in Fig. 8.1. The temperature of the rule is measured at various positions along the rule.

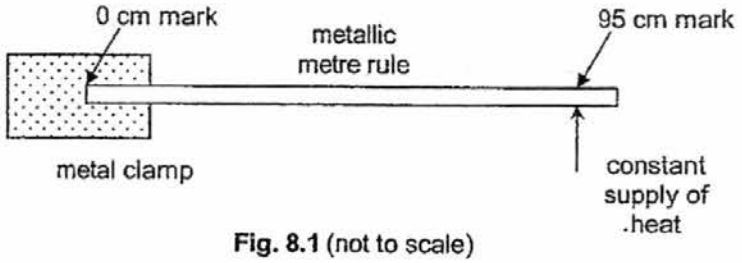


Fig. 8.1 (not to scale)

Fig. 8.2 shows the temperature-position graph of the metre rule with four main points plotted.

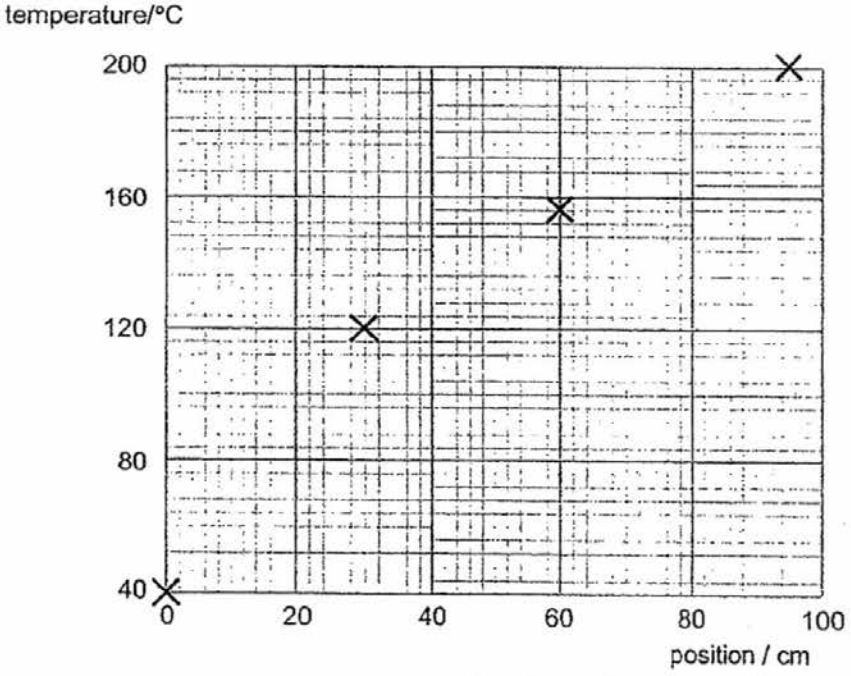


Fig. 8.2

(a) (i) On Fig. 8.2, draw a line to complete the temperature-position graph for position = 0 cm to position = 95 cm. The line passes through all four points. [2]

(ii) State the mode(s) that thermal energy is lost to the surroundings at the 50 cm mark.

_____

_____ [1]

(iii) The rate of heat lost at 0 cm is much greater than that at 50 cm mark. Suggest a possible reason.

_____

_____

_____ [2]

(b) The metre rule is then removed and immersed completely into a pail of water to cool down.

A student then collects the following data to estimate the final temperature of the water as shown in Fig. 8.3.

time taken for temperature of metre rule to become constant	2 minutes
rate of heat lost by metre rule	3500 J/s
heat capacity of the metre rule	900 J/°C

initial temperature of water	30 °C
specific heat capacity of water	4200 J/(kg °C)
mass of water in pail	25 kg

Fig. 8.3

(i) Determine the final temperature of the water.

final temperature = _____ °C [3]

(ii) Explain if the actual final temperature of the water will be higher or lower than the value calculated in (b)(i).

_____

_____

_____ [2]

8 OR

A car slows down as it approaches a traffic light as shown in Fig. 8.4.
The values of the time t when the car passes points A, B, C and D are marked on Fig. 8.4.

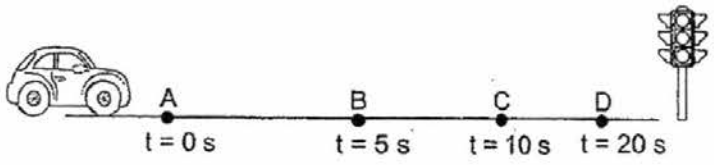


Fig. 8.4 (not to scale)

Fig. 8.5 shows the velocity-time graph of the motion with four main points plotted.

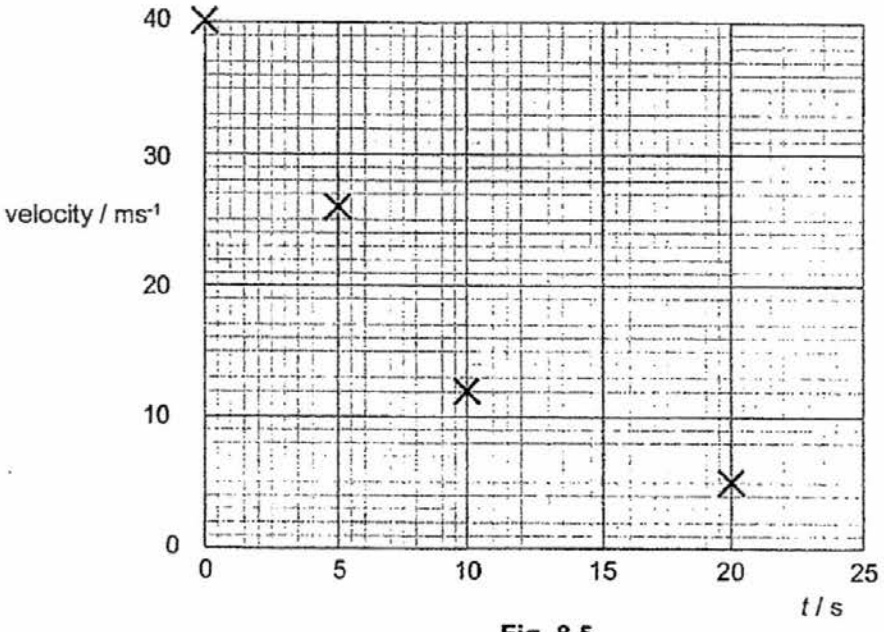


Fig. 8.5

Between A and C there is uniform deceleration. After D, the velocity of the car is constant.

(a) On Fig. 8.5, draw a line to complete the velocity-time graph from t = 0 s to t = 25 s. [1]

(b) Calculate the average distance between

(i) points A and B,

average distance = _____ m [2]

(ii) points B and C.

average distance = _____ m [1]

(c) The distance between A and D is 350 m. The displacement of the car is zero at point A.

(i) On Fig. 8.6, draw a displacement-time graph for the motion. [1]

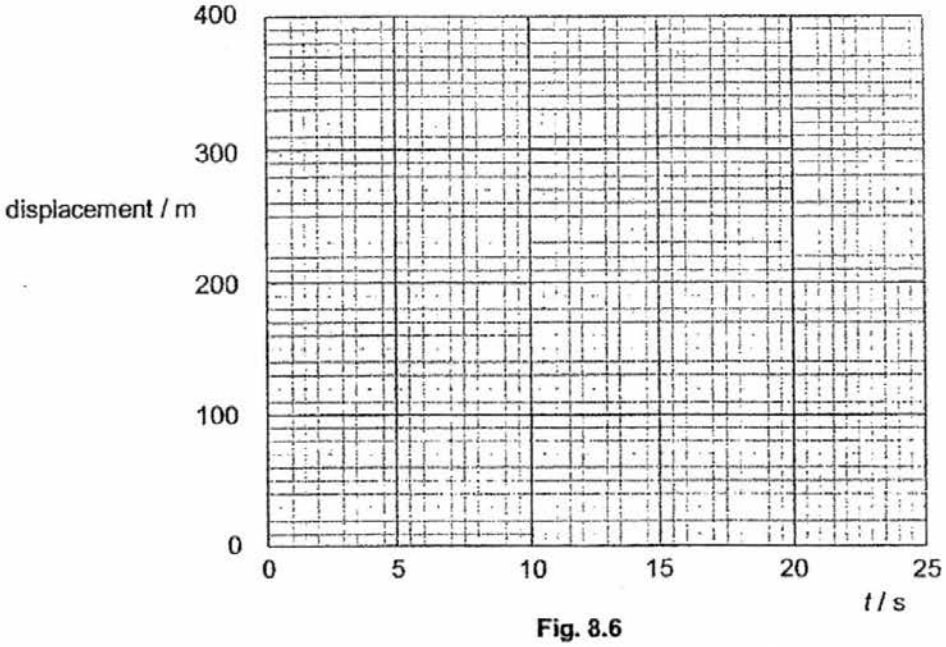


Fig. 8.6

(ii) Explain how your displacement-time graph shows that there is deceleration before D.

_____

_____

_____ [2]

(d) The distance between A and the traffic light is 400 m.

(i) Determine the time t where the car will reach the traffic light.

time t = _____ s [2]

(ii) Hence, or otherwise, determine the average speed of the car from A to the traffic light.

average speed = _____ m/s [1]

End of Paper

Marking Scheme for EOY 2016 Sec 3E Physics

Section A (30 marks)

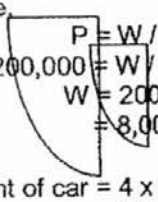
Paper 1	Solution	Answer
1.	1 complete oscillation would be from X to Y and back to X. The number of oscillation in the question is ¾.	B
2.	F = m a [N] = [kg][ms^{-2}]	A
3.	Zero error = – 0.02 cm Measurement = 2.43 cm Diameter = 2.43 – (– 0.02) = 2.45 cm	D
4.	Only the spring balance/force meter measures a vector (force). Stopwatch (time) Thermocouple (temperature) Barometer (pressure)	A
5.	time taken for 1 spacing = 1/50 time taken for 4 spacings = 4/50 speed = dist/time = 20/(4/50) = 250 cm/s	D
6.	Acceleration = +ve grad. of s-t graph = (25 – 10) / (2 – 0) = 7.5 ms^{-2}	C
7.	In water, the resistive force is higher thus the acceleration will decrease. However it is still an acceleration, not deceleration. Thus the velocity will still increase but lesser.	B
8.	After time t, the ball is moving in the opposite direction with maximum speed decreasing to zero.	D
9.	For baby to crawl forward, his hands must be pulling (backwards) the ground. Thus the friction will be in the opposite direction.	D
10.	net F = m a upward F – W = m a 45 – 2.5(10) = 2.5 x a a = 8 ms^{-2} (most student will forget about the weight -> 18 ms^{-2})	B
11.	The parachutist has just started falling so he could not have reached terminal velocity.	C
12.	Inertia (dependent on mass) is the property that causes an object to be reluctant to change its state of motion.	B
13.	Both objects are made of same material so the densities would be the same.	A
14.	Density is inversely proportional to volume, more volume, less dense. At 3 °C, the volume is at maximum thus the density is at minimum.	A
15.	Mass = W / g = 7.00 x 10^4 / 9.81 = 7.14 x 10^3 kg (remains constant) At the bottom, W = m g = 7.14 x 10^3 x 9.85 = 7.03 x 10^4 N	D
16.	Any object with mass will have a gravitational field.	B
17.	For the most turning effect with the same applied force, the perpendicular distance from the pivot must be the longest.	D
18.	Since the container is not toppling, the weight has to be causing an anti-clockwise moment. The C.G. should be around the centre of the water since it has more mass than the container.	B
19.	For stable equilibrium, the ball would return to its original position when slightly displaced.	B
20.	Big cube can be made up of 27 small cubes P = F / A = 27 / (3 x 3) = 3 *P* OR, there are 3 small cubes stacked up for every X^2 of the big cube.	C

21.	Patm = level of Hg above the level of Hg in the basin = 84 – 10 = 74 cm Hg	A
22.	$P_1/A_1 = P_2/A_2$ 10/0.002 = W/4 W = 20,000 N	C
23.	Main function of bulb is to convert electrical energy to thermal energy and light energy.	C
24.	All turbines (including hydroelectric dam) uses kinetic energy as input.	B
25.	Work is done only if there is a change in state of motion (or acceleration)	A
26.	Recall, KMT.	D
27.	The liquid should have fixed mass, not density as both volume and mass will need to change with temperature so that the density will remain constant.	A
28.	Final temperature = 100 + 273 = 373 K Change in temperature = 373 – 303 = 70 K	C
29.	The change in length has to be linear (straight line) in order for the change in length to be appropriate as a thermometric property.	D
30.	Heat transfer is from Sun to astronaut. Thus the white serves to prevent this heat transfer from Sun to astronaut.	A
31.	Air near the lit candle becomes heated, less dense and rise. So cool air from the right opening will flow in and cause the air in the chamber to move from right to left.	C
32.	$Q = C\Delta\theta$ $Pt = C\Delta\theta$ $C = Pt/\Delta\theta$ The one that takes the longest will have the highest heat capacity regardless of the mass. OR the one that is the most difficult to heat up.	A
33.	No change in state, thus only speed and spacing (only very slightly) will change.	A
34.	Recall.	B
35.	State change, only spacing will change.	D

Section B (35 marks)

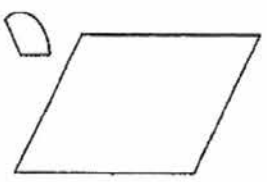
No.	Solution	Marks
1	a) Using stopwatch, time for at least 10 complete revolutions (by start timing when the 1st click is heard and stop timing when the 11st click is heard.) Take the average of the timing (by dividing 10) to find the average time for one complete revolution. (b)(i) Force of gear (by motor)	A1 – instrument A1 – at least 10 oscillations for accurate value A1 – processing of data A1

	(ii) Average power is calculated by dividing the product of force and distance travelled by the average time. c) Determine the circumference of the gear from measuring the diameter of the gear. It will be the distance travelled by the belt for one complete revolution. (Accept any other logical suggestion.)	A1 – product of F and D A1 – division by t A1
2	a)(i) It is a region where a unit mass will experience a (gravitational) force. (ii) The gravitational field causes the rock to experience a net force. (since the net force on the rock was initially zero) (Accept rock experiences weight due to effect of gravitational field which changes the initial net force) (iii) As the rock falls, it loses gravitational potential energy which converts to thermal energy instead of kinetic energy. Since the kinetic energy remains unchanged, the speed remains unchanged. b)(i) Volume of a sphere = $4/3\ \pi r^3$ $= 63.5\ (63.51)\ cm^3$ density = mass / volume = 0.5 x 1000 / 63.5 $= 7.87\ (7.874)\ g/cm^3$ (ii) The rock is mostly likely made of pure iron within limits of experimental (measurement) error. $0.495 \approx 0.5$ kg (1 s.f.) (Accept any other logical explanation)	A1 A1 A1 A1 A1 A1 A1
3	a)(i) $M = F \times \perp d$ = 50 x (2 / 2) = 50 N.m Direction is clockwise. (ii) By principle of moment, sum of anti-clockwise moment = sum of clockwise moment $F_B \times 2 = 50$ N.m $F_B = 25$ N OR since the cat is at the middle, $F_A = F_B$ Then by Netwon's 1st Law, since the plank is not moving, net force on plank = 0 $F_A + F_B - W_{cat} = 0$ $F_B = 25$ N b) When the cat moves towards B, the clockwise moment (about A) increases. This causes the anti-clockwise (about A) to increase in order to balance the clockwise moment. Thus F_B will increase.	A½ A½ A1 A1 A1 A1 A1 A½

		A½
4	a) (i) When P = 200 kPa, A = 0.04 m^2 For one tyre,  P = W / A 200,000 = W / 0.04 W = 200,000 x 0.04 = 8,000 N Weight of car = 4 x 8,000 = 32,000 N (ii) After travelling some distance, the air will have been heated and exerts a larger pressure. (expansion of air will be much more than the tyre) Using Fig. 4.2, with higher pressure, the contact area becomes lesser. b)(i) Based on Fig. 4.2, P_{air} = 100 kPa Using Fig. 4.3, $P_{atm} = P_{air}$ = 100 kPa (ii) Since the air in tyre is exerting less pressure than P_{atm}, the mercury level will be higher in the left arm. $P_{air} + P_{Hg} = P_{atm}$ 98,640 + (h)(13,600)(10) = 100,000 h = 0.01 m = 1 cm c)	A½ A½ A½ A1 A½ A½ B1 A½ A½ A½ A½ A½ – 1 cm height difference A½ – higher in the left arm
5	a)(i) W.D. = F x //d = 3000 x (15/100) = 450 J (ii) 450 J b)(i) By principle of conservation/conversion of energy, KE + GPE at the bottom = KE + GPE at the top 450 J + 0 J = KE + mgh 450 = KE + (10)(10)(4)	A½ A½ B1 A1 A1

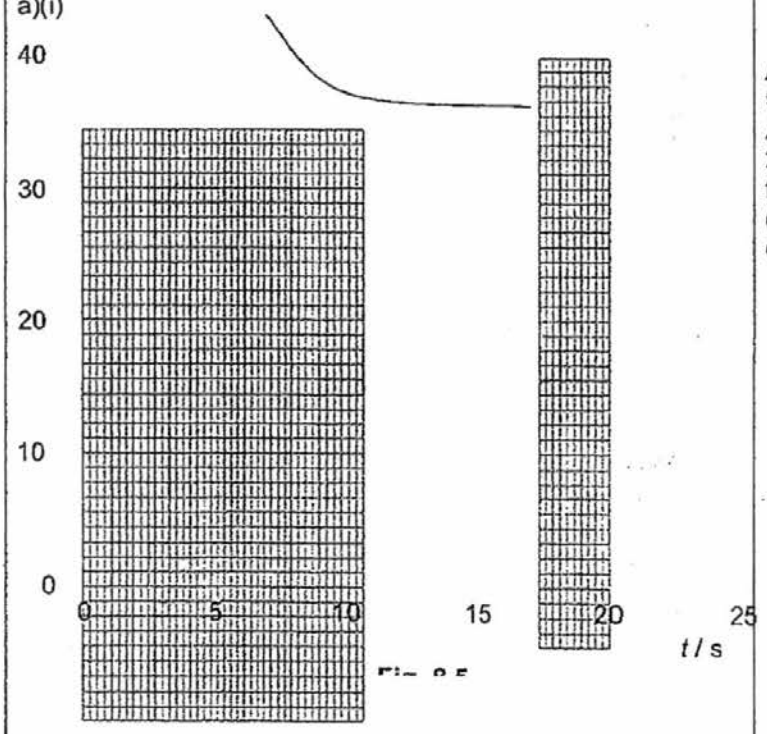
	KE = 50 J	A1
	(ii) KE + GPE at the top = KE + GPE at the bottom 0 + 400 = KE + 0 ½ mv^2 = 400 v^2 = 80 v = 8.94 (8.944) ms^{-1}	 A1 A½ A½ (3 s.f.)

Section C (20 **marks)**

No.	Solution	Marks
6	a)(i) 1. The height increases uniformly with temperature. 2. The height <u>increases at non-uniformly</u> and reaches a <u>maximum value from 600 °C onwards</u>. (ii) The lesser the relative molecular mass of the gas, the higher the maximum pressure exerted. (Having a maximum pressure at lower temperature does not answer the question of the relationship between mass and pressure.) (iii) With the same amount of kinetic energy (at the same temperature), having higher mass means the <u>gas X particles (in chamber 1) will move at lower speed</u>. This causes the <u>amount of impact/force exerted by particles (in chamber 1) per unit area to be less. Or less frequent.</u> b)(i) Given lesser space (volume) the <u>frequency of collision on the walls of chamber by particles increases</u>. This causes the <u>am ount of average impact/force per unit area(on the walls) to increase</u>. (ii) Amount of maximum height (pressure) will be higher. OR the maximum height (pressure) will be attained at lower temperatures. (b) There are <u>many particles</u>. Thus the <u>high frequency of the collisions</u> adds up/attribute to a sizable amount of force.	 A1 A½ A½ A1 A1 A1 A1 A1 A1 A1
7	a)(i) 	A½ – weight from approximate position of C.G. A½ – label A½ - air resistance

	weight (ii) All three forces balanced out. The net force acting on the flag is zero. Thus the acceleration on the flag is zero. (iii) suitable scale (at least 1cm : 10,000 N) Either OR Weight = 36,000 N (35,000 to 37,000) Air resistance = 17,000 N (16,000 to 18,000) (b) Tension on cable by flag is of same amount but of opposite direction.	touching any part of the flag, preferably C.G. A½ – label A1 A1 A½ A1 - label all 3 forces (A½ if 2 out of 3) A½ – right angle triangle/rectangle A1 – direction of all 3 forces (A½ if 2 out of 3) A½ A½ A1 A1
8E	a)(i) temperature/ °C 2 0 2 4 6 8 1 0 position /	A1 – curve between 0 cm to about 10 cm A1 – straight line between about 20 cm to 100 cm

Fig. 8.2

	(ii) Conduction and radiation (to surroundings/air)	A½, A½
	iii) The rule is in contact with the metal clamp at 0 cm mark. Since metal is a good conductor thus it helps to increase the rate of heat loss.	A1 A½ A½
	b)(i) By principle of conservation of energy, heat lost by rule = heat gained by water $P\,t = mc\Delta\theta$ $3500 \times (2 \times 60) = 25 \times 4200 \times (\theta - 30)$ $\theta = 34\ ^\circ C$	A1 A1 A1
	(ii) The final temperature will be lower as there is also heat lost to the surroundings.	A1 A1
8OR	a)(i)  Fig. 8.5	A½ - straight line from 0 to 10 s A½ - curve from 10 to 20 s and straight line from 20 to 25 s. (more guided so less credit compared to 8E)
	b)(i) average distance = area under v-t graph $= ½ (40 + 26)(5 - 0)$ $= 165$ m	A1 A1

(ii) average distance = ½ (26 + 12)(10 – 5)
= 95 m

A1

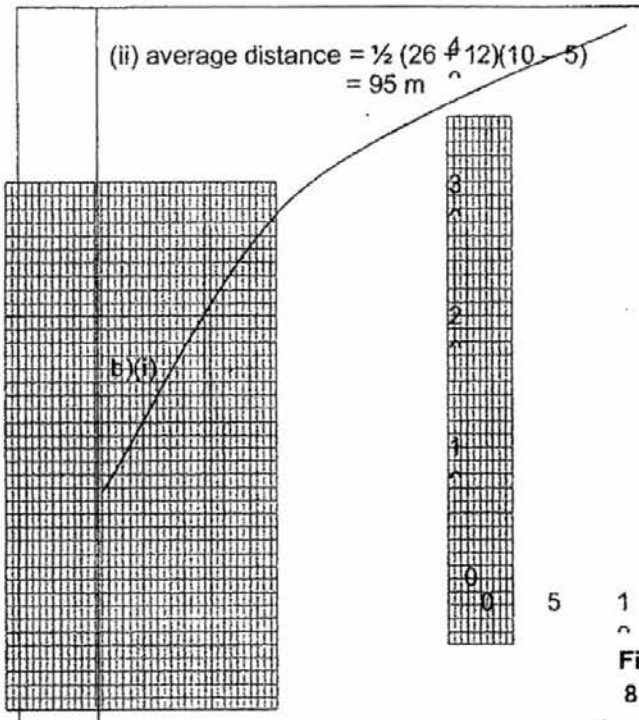


Fig. 8.6

Allow e.c.f. for t = 5 and 10 s.

A½ – all points correctly potted including 0 s and 20 s. (Allow e.c.f. for t = 5 and 10 s)
A½ – curve around 5 s and straight line around 20 s

(ii) The line/graph is a curve with decreasing gradient.
Since the gradient of d-t graph represents the velocity, the velocity decreases.

A1
A1
(max A1 if only mention change but not decrease)

d)(i)
From Fig. 8.5, velocity at d (t = 20 s) = 5 ms^{-1}
From Fig. 8.6, displacement at D = 350 m

Displacement/distance between D and traffic light = 400 – 350
= 50 m

A½

Since velocity after D is constant,
displacement/distance = velocity x time
50 = 5 x time
time = 10 seconds

A1

	t = 20 + 10 = 30 s Students can use gradient from Fig. 8.6 at t = 20 s to find the uniform speed. (but it should be 5 ms^{-1} since it is already given in Fig. 8.5.) (No credit if student extend line outside graph area in Fig. 8.6 to find directly) (ii) average speed = total distance / total time = 400 / 30 = 13.3 ms^{-1}	A½ (max A1 if grad. is far off from 5 ms^{-1}) A1 Allow e.c.f. from (i)