Name: _____ Class: _____ Index No. : _____

**ST JOSEPH'S INSTITUTION**

**SECONDARY 3 (O-LEVEL PROGRAMME)**
**2016 END OF YEAR EXAMINATION**

# PHYSICS

**5059**

**28 September 2016**

**2 hrs 30 min**

**(0800 – 1030)**

Additional Materials: Multiple Choice Answer Sheet

## READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on the cover page of this Question Paper.
Write in dark blue or black pen on the Question Paper.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

**Section A**
Answer **all** questions by indicating your choice on the Multiple Choice Answer Sheet.

Candidates are reminded that all quantitative answers should include appropriate units.
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.
Electronic calculators may be used in this paper.
Unless otherwise stated, take gravitational field strength, g, to be 10 N/kg.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

## Section A (30 marks)

Answer **all** questions in this section. For each question, there are four possible answers A, B, C and D. Shade your choice in pencil on the Multiple Choice Answer Sheet.

1 A pair of vernier calipers is used to measure the outer diameter of a metal ring. Fig. 1.1 shows the jaws closed with no metal ring, and Fig. 1.2 shows the jaws closed around the metal ring.

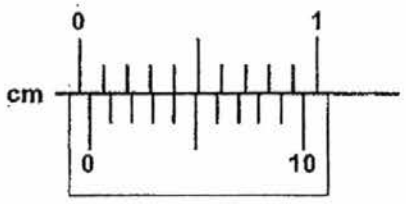



Fig. 1.1

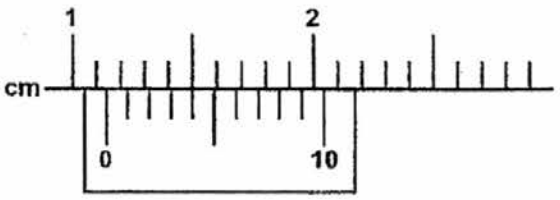
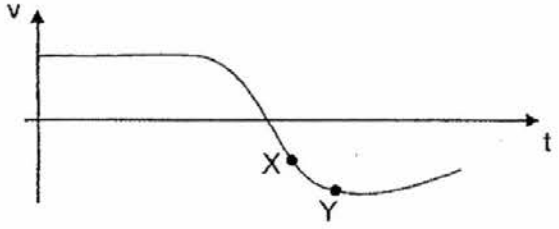



Fig. 1.2

What is the outer diameter of the ring?

**A** 1.00 cm
**B** 1.08 cm
**C** 1.10 cm
**D** 1.18 cm

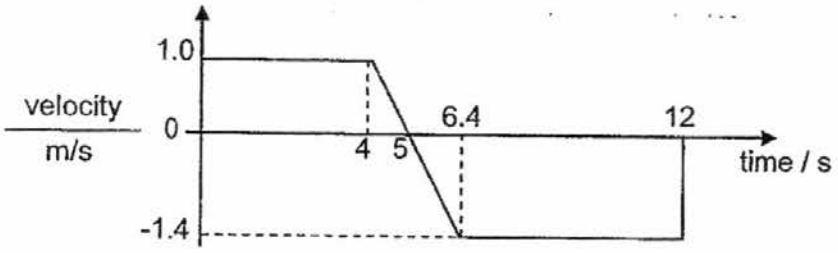
2 The figure shows the velocity-time graph of a body.




In the section XY of the graph, the body is

**A** accelerating with decreasing acceleration.
**B** decelerating with decreasing deceleration.
**C** accelerating with increasing acceleration.
**D** decelerating with increasing deceleration.

3 The figure represents the velocity of a body over time.




What is the average velocity of the body over the 12 seconds period?

**A** - 0.18 m/s **B** - 0.36 m/s **C** 1.08 m/s **D** 1.11 m/s

4 Which of the following statements is true?

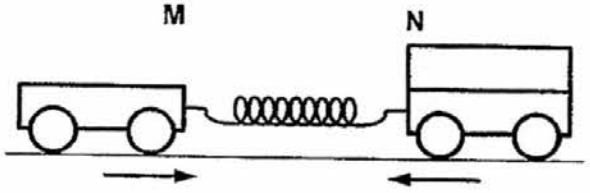
**A** If a body travels at constant speed, its velocity will be constant
**B** If a body is speeding up, its acceleration will be increasing
**C** A body with zero acceleration will be at zero velocity
**D** A body whose acceleration is decreasing, will still be speeding up

5 The figure shows the dots made on a ticker tape that was pulled by a toy car moving towards the right.

Which of the following statements correctly describes the motion of the toy car?

**A** It accelerates then moves at constant speed.
**B** It decelerates than moves at constant speed.
**C** It moves at constant speed then accelerates.
**D** It moves at constant speed then decelerates.

6 Two toy cars, M and N, are joined by a stretched spring. Car N has twice the mass of car M.




When the cars are released, car N accelerates to the left at 2.0 m/s$^2$. What is the initial acceleration of car M to the right?

**A** 1.0 m/s$^2$
**B** 2.0 m/s$^2$
**C** 3.0 m/s$^2$
**D** 4.0 m/s$^2$

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7 A tennis ball, with a mass of 0.060 kg, is thrown vertically upwards with a force of 20 N. At a particular point in time, the ball is travelling with an acceleration of -15 m/s$^2$.

What is the total air resistance acting on the ball at that instance?

**A** 0.30 N
**B** 1.5 N
**C** 19.7 N
**D** 20.3 N

8 The mass of an object A is 200 g and its volume is 60 cm$^3$. A molten substance B has a density of 2.5 g/cm$^3$. Object A is melted down, and is mixed with 0.10 kg of substance B.

What is the density of the resulting mixture, assuming that there is no substantial change in volume as a result of melting or solidification?

**A** 0.97 g/cm$^3$ **B** 1.9 g/cm$^3$ **C** 2.9 g/cm$^3$ **D** 3.0 g/cm$^3$

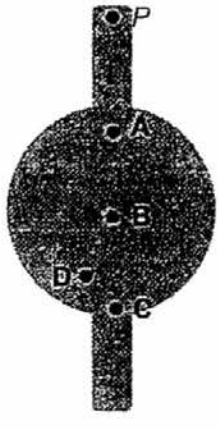
9 Which of the following quantities will change when the gravitational field strength changes?

(I) Mass (II) Weight (III) Inertia (IV) Acceleration of free fall

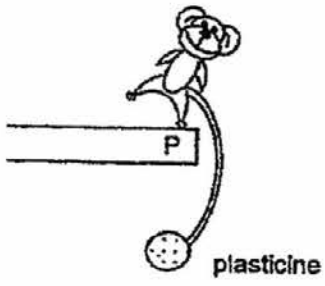
**A** (I) and (II)
**B** (II) and (III)
**C** (II) and (IV)
**D** (II), (III) and (IV)

10 An irregular shaped lamina is suspended from a pivot point P as shown. The object is at rest.

Which of the following points is its centre of gravity (CG)?



11 The figure shows a toy monkey left on the edge of a table, by a girl, at point P. By attaching a lump of plasticine at the end of its tail, the girl is able to balance the toy. When displaced, it oscillates and comes to rest at this position.




How does the plasticine help the toy to attain this state of equilibrium?

**A** It increases the weight of the toy.

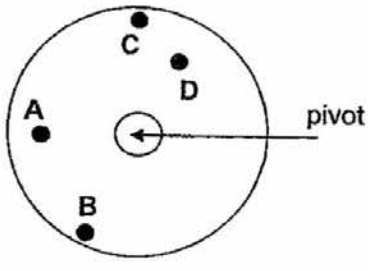
**B** It moves the centre of gravity to be located exactly at P.

**C** It moves the centre of gravity directly above P.

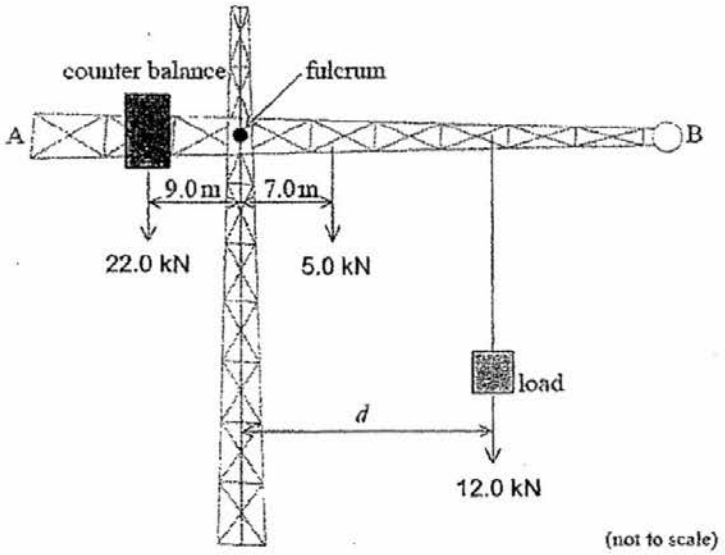
**D** It moves the centre of gravity to be directly below P.

12 The figure shows a CD-ROM pivoted at the centre so that it stays at rest in a vertical plane.

At which position can a piece of plasticine be attached to the CD-ROM to generate the greatest turning effect about the pivot?



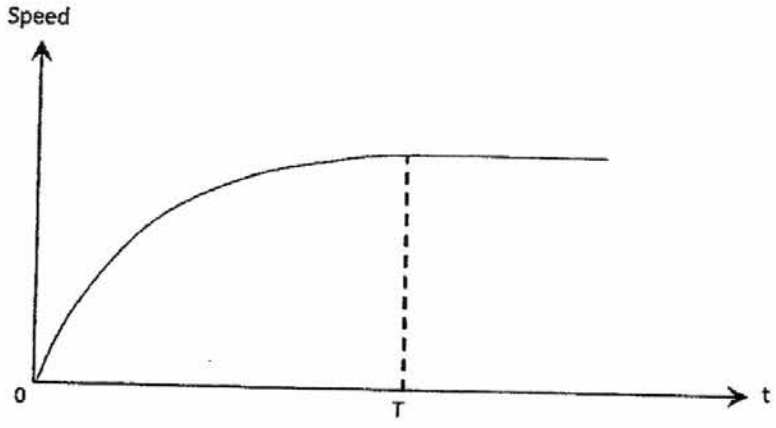
13 The figure shows a crane that can carry a heavy load. The jib (horizontal section AB) of the crane has a weight of 5.0 kN, and its centre of gravity is 7.0 m from the fulcrum (pivot). The weight of the counterbalance is 22.0 kN, and it is 9.0 m from the fulcrum. The counterbalance keeps the load and the weight of the jib of the crane in equilibrium.




What is the distance, d, of the load from the fulcrum?

**A** 13.6 m
**B** 16.5 m
**C** 16.8 m
**D** 19.4 m

14 The diagram shows the variation of the speed of a ball falling through air with time.




Which of the following statements best describes the relationship between the change in gravitational potential energy, kinetic energy and work done against air resistance as the ball falls?

A The loss in gravitational potential energy is more than the gain in kinetic energy.
B The loss in gravitational potential energy is equal to the gain in kinetic energy.
C The loss in gravitational potential energy is the work done against air resistance.
D The loss in gravitational potential energy is less than the work done against air resistance.

15 A motor takes 8 minutes to raise a 3500 kg load through a height of 5 m. Which of the following gives the power of the motor in watts?

A $\frac{3500 \times 5}{8}$

B $\frac{3500 \times 10}{8 \times 60}$

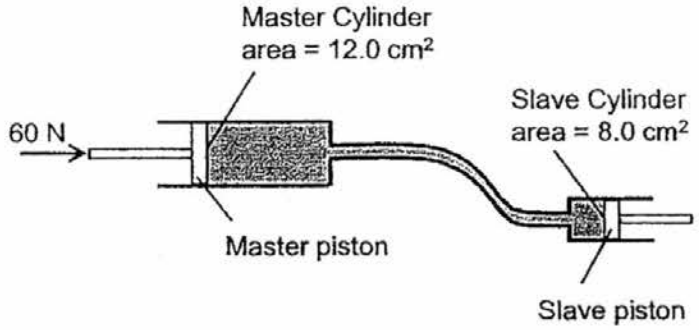
C $\frac{3500 \times 10 \times 5}{8}$

D $\frac{3500 \times 10 \times 5}{8 \times 60}$

16 A ball is thrown vertically downwards, with an initial velocity of 3 m/s from a height of 24 m. Applying the principle of conservation of energy, what is the velocity of the ball just before it reaches the ground, assuming negligible air resistance?

A 11.1 m/s
B 15.6 m/s
C 21.7 m/s
D 22.1 m/s

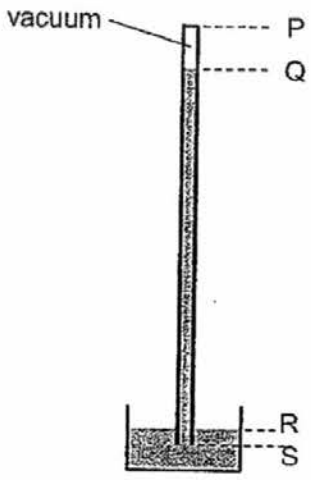
17 The diagram shows a hydraulic system, where the cross-sectional area of the master cylinder is 12.0 $cm^2$ and that of the slave cylinder, 8.0 $cm^2$. A 60 N force is applied to the master piston.




What is the force experienced by the slave piston and the pressure experienced by the slave cylinder?

| | Pressure at slave cylinder / $Ncm^{-2}$ | Force at slave cylinder / N |
|---|---|---|
| A | 3.3 | 40 |
| B | 3.3 | 90 |
| C | 5.0 | 40 |
| D | 5.0 | 90 |

18 The figure shows a mercury barometer. The space above the top of the mercury inside the tube is a vacuum.

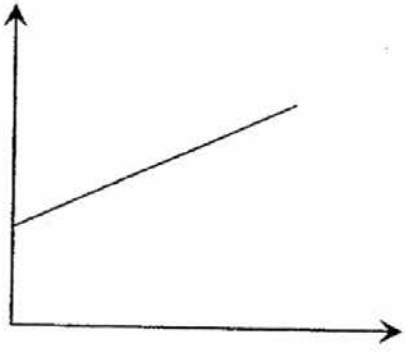



The barometer is brought to a mine shaft 3.5 kilometres below sea level.

Which of the following lengths will increase?

**A** PQ
**B** QR
**C** RS
**D** PS

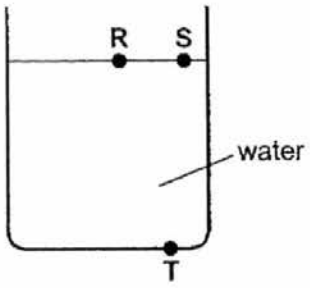
19 The graph indicates properties of a fixed mass of gas.



Which of the following could describe what is plotted on the graph?

| | Vertical axis | Horizontal axis | Condition |
|---|---|---|---|
| **A** | Density | Temperature | Constant pressure |
| **B** | Pressure | Volume | Constant temperature |
| **C** | Volume | Temperature | Constant pressure |
| **D** | Volume | Density | Constant temperature |

**20** A student has a beaker of water, and he wants to set up a convection current.




Which of the following would do this?

**A** Heating at R
**B** Heating at S
**C** Cooling at S
**D** Cooling at T

**21** An experiment was carried out by using four bars, all having the same size, and with each placed one end in water that is at 90 °C. The time taken for the temperature to rise by 2 °C on the other end of the bars are recorded:

| Material | Time for 2 °C rise / s |
|---|---|
| Aluminium | 10 |
| Copper | 5 |
| Fibreglass | 600 |
| Polystyrene | 1000 |

To make a metal tank with the least heat loss, which material should be used for the tank and its insulation?

| | Tank | Insulation |
|---|---|---|
| **A** | Aluminium | Fibreglass |
| **B** | Aluminium | Polystyrene |
| **C** | Copper | Fibreglass |
| **D** | Copper | Polystyrene |

22 The resistance of a resistance thermometer is 8.0 Ω when the temperature is 10°C, and 45 Ω when the temperature is 100°C.

Determine the temperature of a cup of water if the resistance is 30 Ω when the thermometer is inserted into the water.

**A** 43.5°C **B** 53.5°C **C** 59.5°C **D** 63.5°C

23 Which of the following best defines specific heat capacity of a substance?

**A** Specific heat capacity is the amount of thermal energy required to change the temperature of a unit mass of the substance by 1 K or 1 °C.

**B** Specific heat capacity is the amount of thermal energy required to change the temperature of a unit mass of the substance.

**C** Specific heat capacity is the amount of thermal energy required to change the temperature of the substance by 1 K or 1 °C.

**D** Specific heat capacity is the amount of thermal energy required to change the temperature of the substance.

24 A substance which is originally a solid is being heated strongly for some time. At one stage, the energy given to it is used as latent heat of vaporisation.

What change does the energy cause at that stage?

**A** It makes the molecules move faster and so the temperature rises.

**B** It makes the molecules move faster but there is still a strong attraction between them.

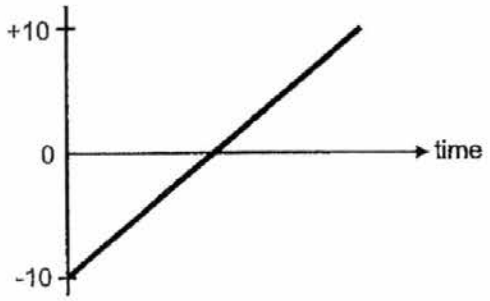
**C** It breaks the bonds holding the molecules together. The solid becomes liquid.

**D** It breaks the bonds holding the molecules together. Molecules escape from the liquid.

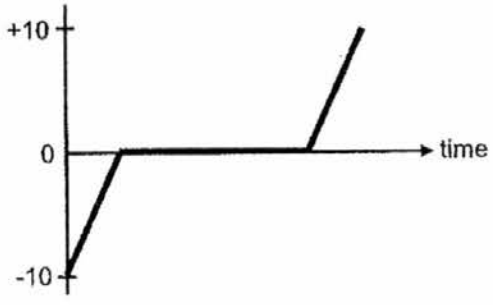
25 Ice at -10 °C is being heated at a constant rate until it is water at +10 °C.

Which graph shows how temperature changes with time?

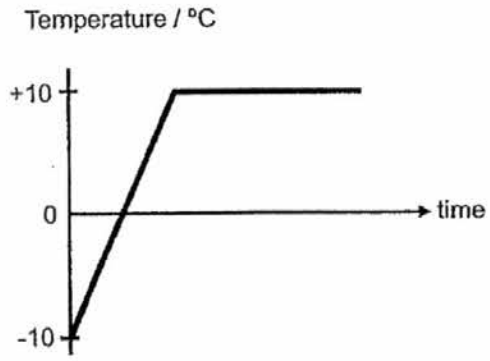
A



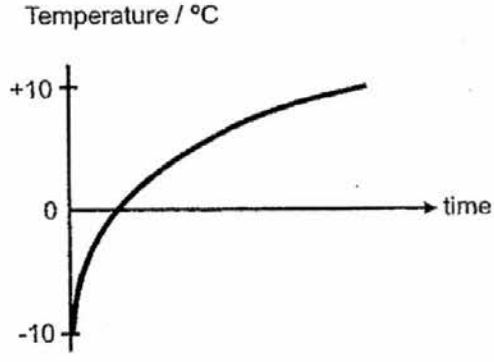

B




C

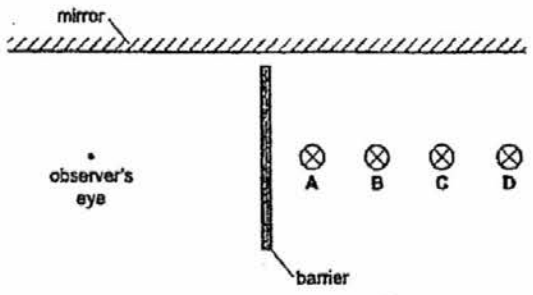



D



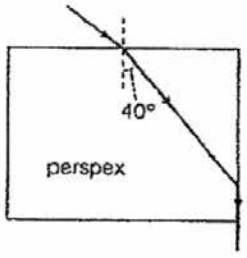

26 The diagram shows a barrier placed at right angles to a plane mirror with four lamps placed at positions A, B, C and D.

Which of the lamps can be seen by the observer's eye?



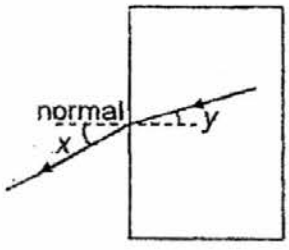
27 A ray of light passes through a block of Perspex.

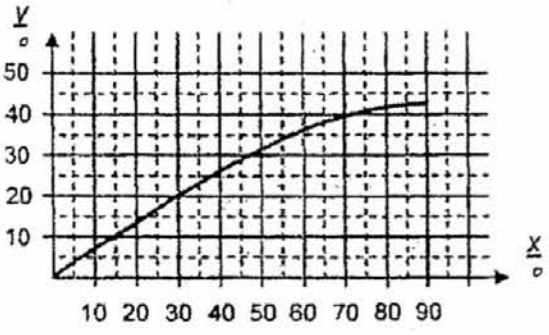
What is the refractive index of the rectangular Perspex block shown in the diagram?




A 1.15
B 1.31
C 1.50
D 1.56

28 A student conducts an experiment to determine the angle of incidence y for light exiting a glass block at various angles of refraction x as shown. A graph of angle y against angle x was plotted.




What is the critical angle of the glass used in the experiment?

A 0°
B 29°
C 43°
D 90°

29 A converging lens is used to focus the light rays from a distant tree. The nature of focused image would be

**A** inverted, real, and diminished.

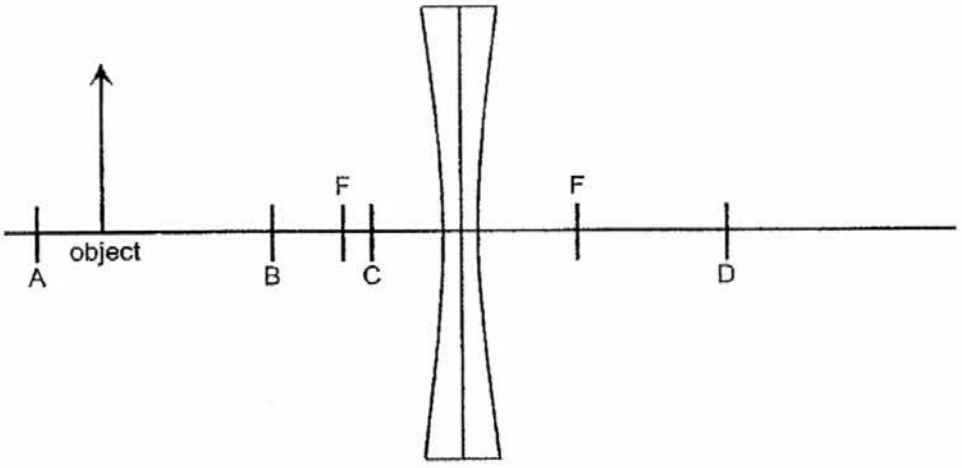
**B** inverted, virtual, and diminished.

**C** upright, real, and diminished.

**D** upright, virtual, and diminished.

30 An object is placed in front of a diverging lens, as shown in the **scaled** diagram. The principal focus F is marked on each side of the lens.

At which position will the image be formed?



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| Section B | | | |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| | | | |
| 5 | 6 | 7 | |
| | | | |
| Section C | | | |
| 8 | 9 | 10 | |
| | | | |

| For Examiner's Use | |
|---|---|
| Section A | / 30 |
| Section B | / 40 |
| Section C | / 30 |
| Total | / 100 |

Sections B and C of this Question Paper consists of 30 printed pages.

**Section B (40 marks)**
Answer all questions in this section.

1 A small spacecraft is about to land on planet Mars.

The spacecraft enters the planet's atmosphere, and when it is reaches a speed of 1600 km/h, it deploys a parachute to slow its fall. The spacecraft eventually reaches a steady speed, and finally hits the surface.

**(a)** In the graph provided in Fig.1.1, complete the speed-time graph for the spacecraft. The parachute opens at time $t_1$, and the spacecraft hits the surface of Mars at time $t_2$.

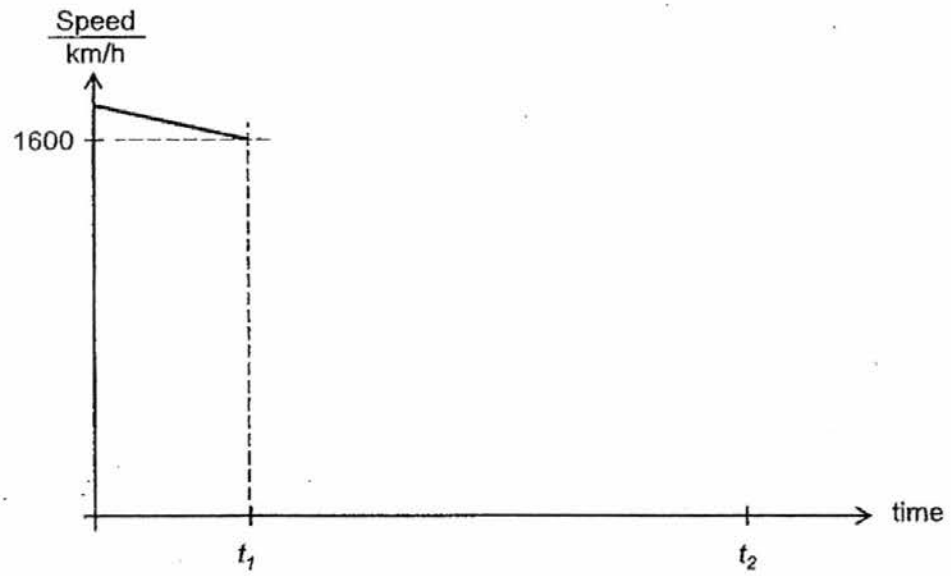
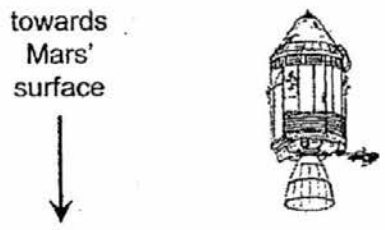



**Fig. 1.1** [2]

**(b)** The mass of the spacecraft is 70 kg. The gravitational field strength of Mars is 3.0 N/kg and the total upwards force on the spacecraft is 500 N.

**(i)** In Fig. 1.2, draw the two forces representing the spacecraft's weight and atmospheric resistance it experiences. Label the vectors W and F, respectively.




[1]

**Fig. 1.2**

**(ii)** Determine the weight of the spacecraft.

weight = ..... [1]

**(iii)** Determine the resultant force on the spacecraft.

resultant force = ..... [1]

**(iv)** Determine the deceleration of the spacecraft.

deceleration = ..... [2]

**2** Fig. 2.1 shows two men, X and Y, carrying a load using a uniform pole that is 4.0 metres long, and has a mass of 5.0 kg. The ends of the pole rest on each man's shoulder, and the pole is kept in a horizontal position.

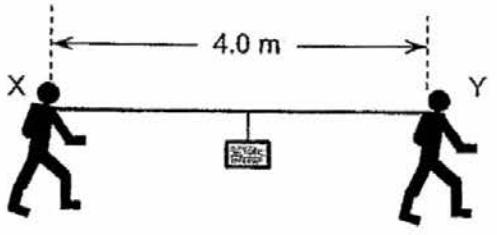



**Fig. 2.1**

The load has a mass of 16 kg, and is suspended by a rope of negligible mass.

**(a)** Explain what is meant by *moment of a force*.

.....

..... [1]

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**(b)** **(i)** Along the journey, Y injures his foot, so X adjusts the position of the load such that the vertical force on his shoulder is twice as great as the vertical force on Y's shoulder.

Fig. 2.2 shows the load being shifted to the new position.

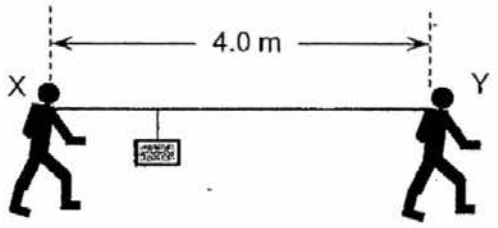


**Fig. 2.2**

Fig. 2.3 is a free-body diagram showing the contact forces of the men on the pole.

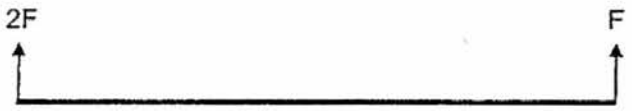


**Fig. 2.3**

In Fig. 2.3, draw the two forces, representing the weight of the pole, and the approximate position of the load. Label them W and L, respectively. [2]

**(ii)** Calculate the value of F.

F = ..... [1]

**(iii)** Let $l$ be the distance from the CG of the pole, to the point where the load is fixed. Taking moments about X, calculate the value of $l$.

$l$ = ..... [2]

3 Fig. 3 shows a diving platform at a height of 10 m above the water surface of a swimming pool. A platform diver of mass 65 kg jumps up into the air before diving vertically towards the water. The height between the highest point he reached and the diving platform is 0.8 m, as shown. Assume air resistance is negligible.

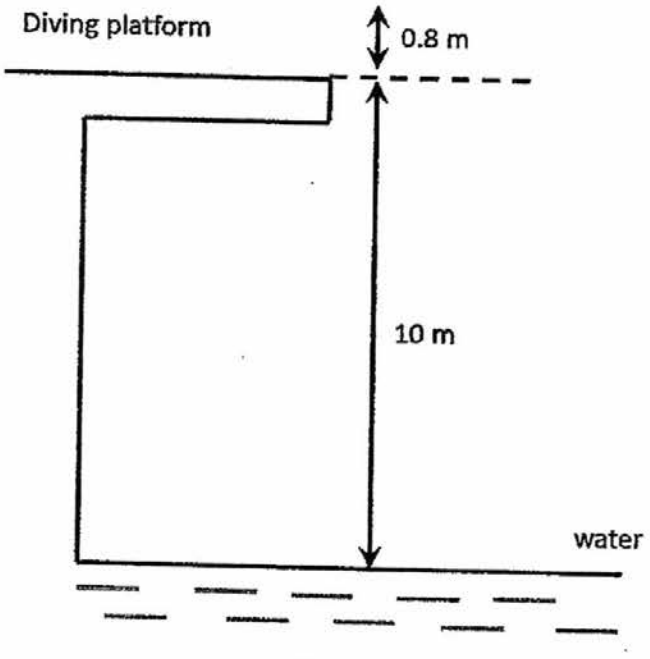


Fig. 3

**(a)** State the energy conversions involved from the point the diver takes off, to the point just before he enters the water. Take the water surface to be the reference level.

.....

.....

..... [2]

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**(b)** Calculate the total energy of the diver when he is at the highest point of his dive.

total energy = ..... [2]

**(c)** If he reaches a depth of 4.0 m in the water, determine the resistive force acting on the diver.

resistive force = ..... [2]

**4** Fig. 4 shows a manometer used to measure the pressure of air inside a flexible plastic container. A pressure difference of 100 Pa causes a one centimetre difference in water levels.

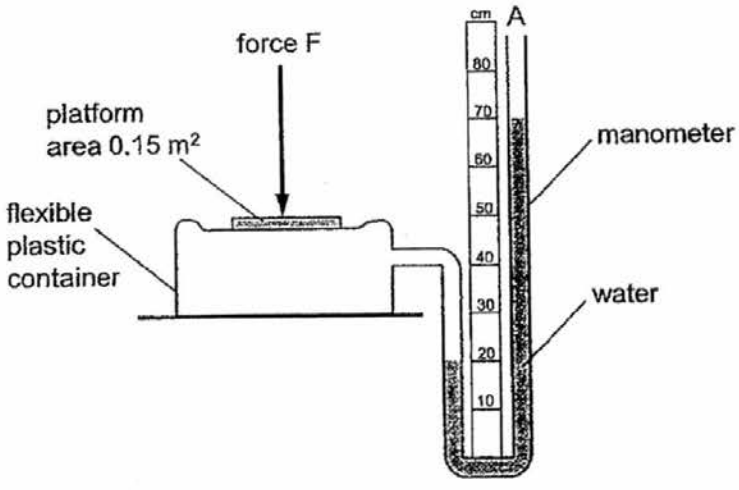


**Fig. 4**

**(a)** **(i)** Using Fig. 4, determine the pressure difference in Pa shown by the manometer.

pressure difference = ..... [1]

**(ii)** The pressure difference measured by the manometer is caused by the force F. This force is the weight of a boy standing on the platform. The area of the platform is 0.15 $m^2$.

Calculate the weight of the boy.

weight = ..... [2]

**(iii)** State what changes, if any, occur to the difference in fluid level if a liquid denser than water is used in the manometer.

.....[1]

**(b)** The water in the manometer is now replaced with oil, and attached to the same plastic container. Taking the density of the oil as 833 $kg/m^3$, calculate the new height difference in the oil levels.

height difference = ..... [2]

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5 Fig. 5 shows the side view of a black colour metal heat sink firmly attached to the top of a computer chip. The heat sink keeps the computer chip cool. The computer chip is mounted on a printed circuit board.

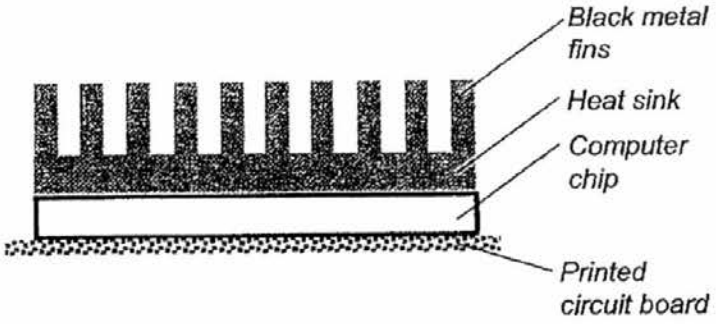


**Fig. 5**

(a) Describe one way in which thermal transfer process via conduction is different from radiation.

.....

.....[1]

(b) State how the design and material of the heat sink enable greater thermal transfer via

**(i)** conduction .....

.....[1]

**(ii)** convection .....

.....[1]

**(iii)** radiation .....

.....[1]

6 A 200 W immersion heater is used to heat 180 g of liquid benzene in an insulated container. The temperature of the benzene increases from room temperature of 22°C to 80°C in 1.5 minutes. The heater is removed and the benzene cools to room temperature in 10 minutes.

(a) Fig. 6 shows the cooling curve of the benzene.

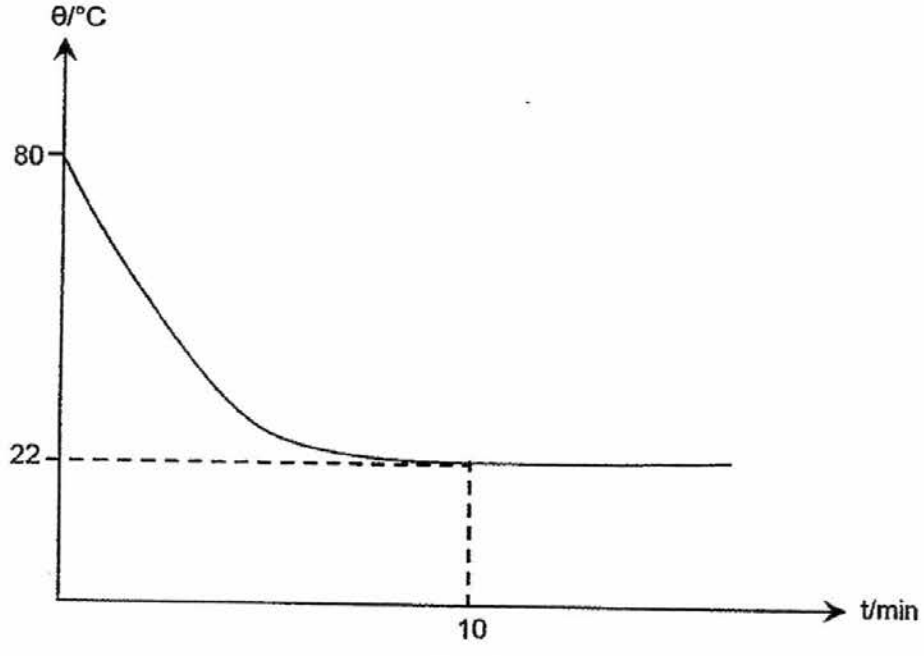


**Fig. 6**

**(i)** With reference to Fig. 6, explain why the temperature changes with time as shown.

.....

.....[1]

**(ii)** Explain what is meant by thermal equilibrium, and suggest how the curve shows that thermal equilibrium is reached.

.....

.....

.....[2]

**(iii)** Describe the change in molecular behavior as liquid benzene cools.

.....

.....[1]

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(b) Calculate the heat capacity of the benzene.

heat capacity = ..... [2]

7 Fig. 7 shows a cross-sectional view of a simple digital camera, used to photograph an object.

The lens forms a focused image of the object on the CCD (charge-coupled device).

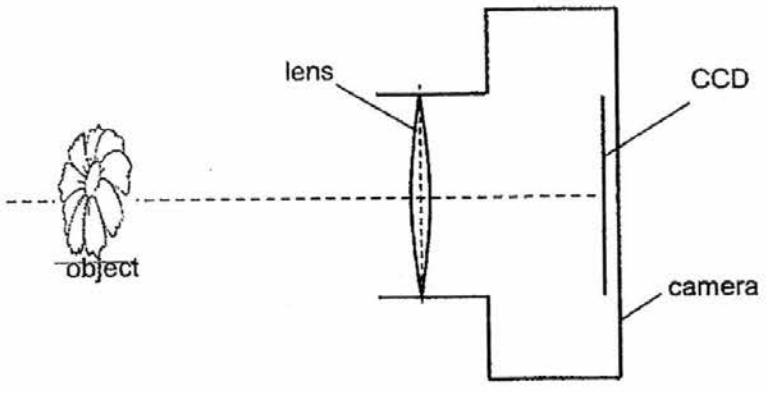


**Fig. 7**

(a) Explain what is meant by the term *focal length*.

.....

.....[1]

(b) (i) Draw two rays from the top of the object to show how the lens forms the image on the CCD. [2]

(ii) Locate the focal point of the lens, and label it "F". [1]

(c) The object is moved closer to the camera. State how the lens will need to be adjusted to keep the image in focus.

.....

.....[1]

**Section C (30 marks)**
Answer all questions in this section.

8 Two motorcyclists, A and B, set out on the road. Fig. 8.1 shows the distance travelled over a 20 second interval.

| Time / s | Distance travelled / m | |
|---|---|---|
| | Motorcyclist A | Motorcyclist B |
| 0 | 0 | 0 |
| 5 | 80 | 60 |
| 10 | 170 | 120 |
| 15 | 270 | 240 |
| 20 | 380 | 380 |

**Fig. 8.1**

**(a)** State and explain briefly how the average speed of motorcyclist B compares with that of motorcyclist A over the 20 seconds interval shown in Fig. 8.1.

.....

.....[2]

**(b)** Motorcyclist A was accelerating from t = 0 s till t = 20 s. At 20 s, he started moving at constant speed.

On Fig. 8.2, mark with an 'X', a possible position of the centre of the front wheel of the motorcycle at t = 25 s. With a dotted line, indicate clearly the position of X relative to the scale shown. [1]

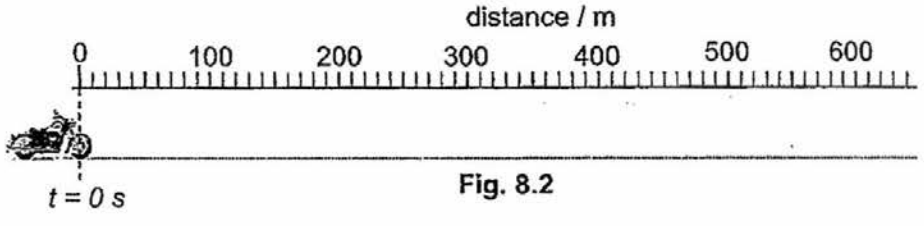


**Fig. 8.2**

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**(c)** At t = 25 s, when motorcyclist A was moving at constant speed of 22 m/s, he saw a child run onto the road in front of him. He applied the brakes after a reaction time of 0.80 s. His motion is shown in Fig. 8.3.

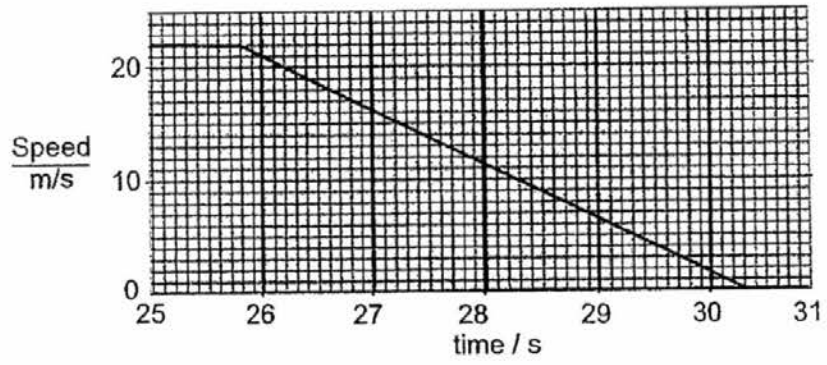


**Fig. 8.3**

**(i)** Calculate the distance he travelled from the moment he saw the child till he stopped his motorcycle.

distance travelled = ..... [2]

**(ii)** Calculate the deceleration of the motorcyclist after he applied his brakes.

deceleration = ..... [2]

**(iii)** In Fig. 8.4, with the help of the values obtained in (c)(i) and (ii), sketch the displacement-time graph of the motorcycle from t = 25 s to t = 30.3 s, indicating clearly the significant timings and corresponding displacement values. [3]

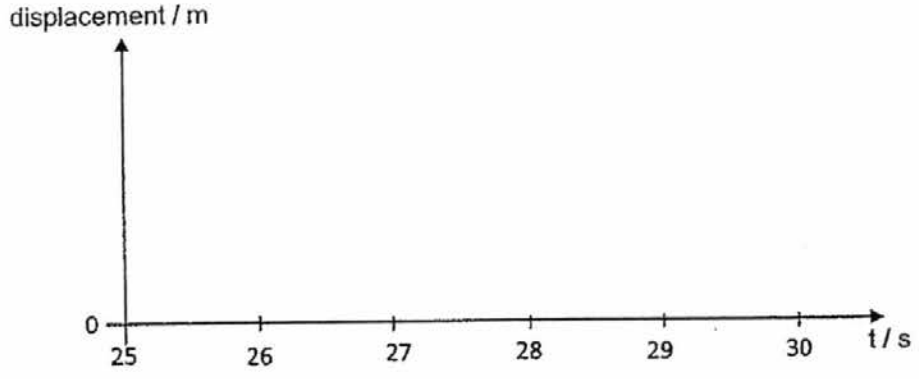


**Fig. 8.4**

9 Fig. 9 shows the apparatus used to observe Brownian motion using pollen grains suspended in a liquid.

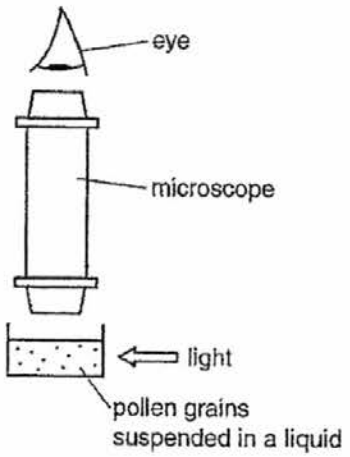


Fig. 9

(a) (i) In the space below, draw the motion of one pollen grain, as seen by the observer under the microscope. [1]

(ii) State two conclusions that may be deduced about the liquid, from the motion of the pollen grains observed with the microscope.

.....

.....

..... [2]

(iii) Suggest how the motion of the pollen grains could be increased.

.....

..... [1]

١٩١

**(b)** In 1924, Howard Somervell and Edward Norton set a new altitude record when attempting to climb Mount Everest. They managed to climb to a vertical height of 8570 m above sea level by breathing naturally.

**(i)** Using ideas about molecules, describe and explain the relationship between pressure and volume of a gas at constant temperature as volume increases.

.....

.....

.....

.....

.....[3]

**(ii)** Explain why it is challenging to breathe in natural air at a height of 8570 m.

.....

.....

.....[2]

**(iii)** The air temperature was measured to be -33 °C. The thermometer used to measure the temperature on the mountain reads 2°C in pure melting ice and 102°C in steam above boiling water at sea level. State the correct temperature of the air on the mountain.

temperature = ..... [1]

**10** Fig.10.1 shows a boy and a girl standing in front of a shop window. The boy stands at point A. He sees the reflection of a girl standing at point B in the shop window.

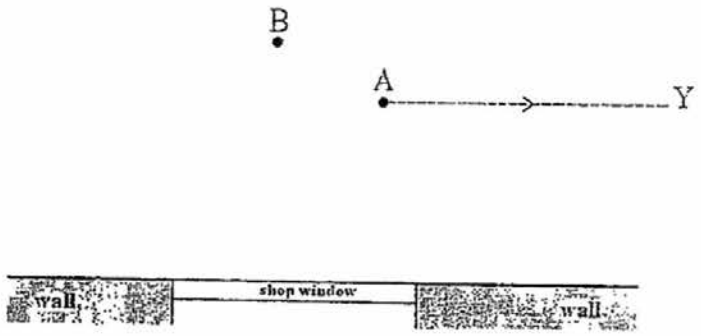


**Fig. 10.1**

**(a)** **(i)** On Fig. 10.1, mark accurately, with a letter **I**$_{M}$, the position of the image of the girl formed by reflection in the shop window. Ignore the thickness of the shop window - reflection happens at the front surface of the shop window. [1]

**(ii)** On Fig. 10.1, draw a ray of light to show how, by reflection, the boy sees the girl. [1]

**(iii)** The boy moves further away from the girl, in the direction shown, towards Y. By means of a ray diagram, indicate the point P in Fig. 10.1, the furthest position where the boy can move, such that the girl and he can still see each other by reflection in the shop window. [2]

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**(b)** Fig. 10.2 shows a spherical droplet of water in air. A ray of yellow light is incident at the water droplet as shown. Water has a refractive index of 1.33 for yellow light.

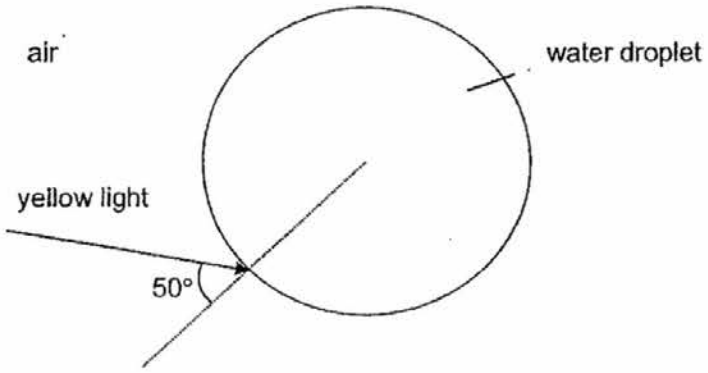


**Fig. 10.2**

**(i)** State the criteria for which total internal reflection can occur.

.....

.....[1]

**(ii)** Calculate the angle of refraction in the water droplet.

angle of refraction:.....[2]

**(iii)** Calculate the critical angle, $c_{water}$.

critical angle:.....[2]

(iv) Fig. 10.3 shows the same yellow ray incident (at the same angle) on a spherical air bubble in water. Show how the ray moves after hitting the air bubble. State all necessary angles. [1]

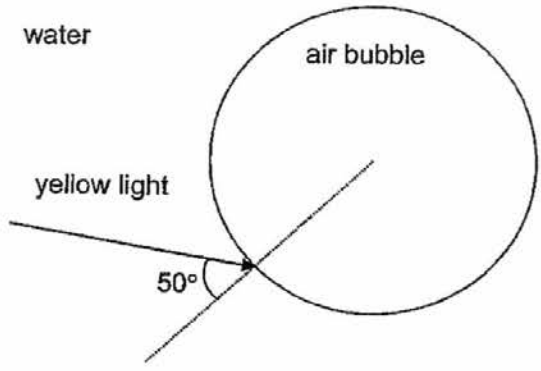


**Fig. 10.3**

**- End of Paper -**

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st. Joseph's

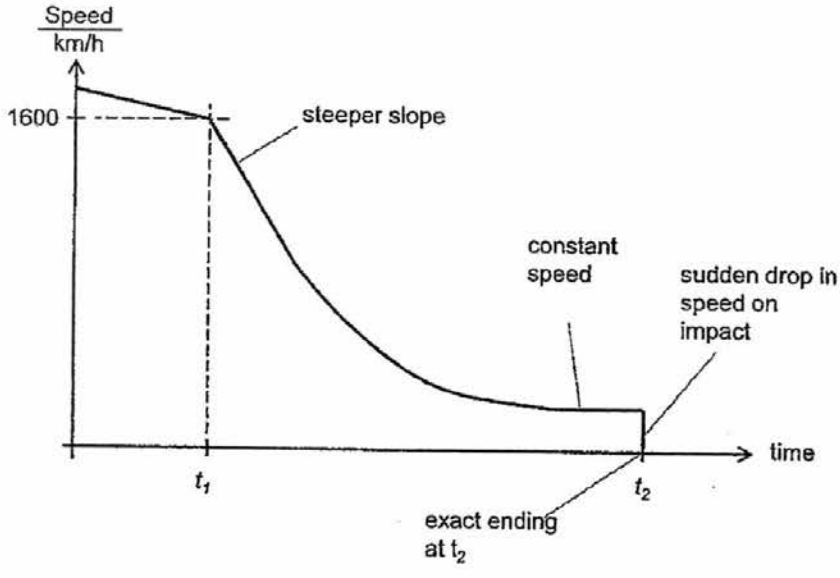
Answer

**Section A**

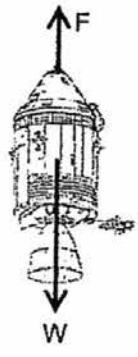
| | | | | | |
|---|---|---|---|---|---|
| 1. | C | 11. | D | 21. | B |
| 2. | A | 12. | A | 22. | D |
| 3. | B | 13. | A | 23. | A |
| 4. | D | 14. | A | 24. | D |
| 5. | C | 15. | D | 25. | B |
| 6. | D | 16. | D | 26. | C |
| 7. | A | 17. | C | 27. | B |
| 8. | D | 18. | B | 28. | C |
| 9. | C | 19. | C | 29. | A |
| 10. | B | 20. | C | 30. | C |

**Section B**

1a.




b(i).




1b(ii). weight = 70 kg x 3.0 N/kg = **210 N**

1b(iii). resultant force = 210 – 500 N = **-290 N**

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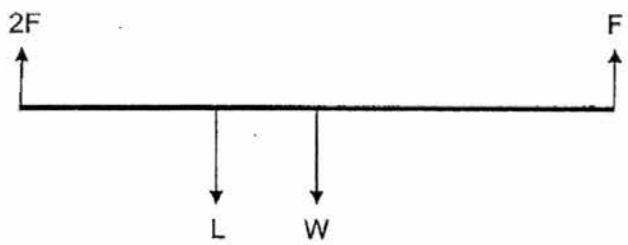
1b(iv). deceleration = 290 N / 70 kg
= **4.14 m/s$^2$**

2a. The moment of a force is the product of the force and the **perpendicular** distance from the **line of action** (of the force) to the **pivot**.

2bi.




2bii. 2F + F = 50N + 160N
3F = 210 N
F = **70 N**

2biii. Let *l* be the unknown distance from CG to rope.
Taking moments about X,
Sum of clockwise moments = sum of anti-clockwise moments
[160N x (2 - *l*)m] + [50N x 2.0m] = [70N x 4.0m]
320Nm – 160*l*Nm + 100Nm = 280Nm
140Nm = 160*l*Nm
*l* = **0.875 m**

3a. As the diver jumps, his KE is converted to GPE. At the highest point, all his KE is converted to GPE. When he starts falling, GPE is converted back to KE. At the surface of the water, his total GPE at the highest point is converted to KE.

3b. Energy = mgh
= 65kg x 10N/kg x 10.8m
= **7020 J**

3c. KE of diver just before he hits surface of water = 65kg x 10N/kg x 10.8m = 7020 J
GPE of diver at water surface = 65kg x 10N/kg x 4.0 m = 2600 J
Work done against water resistance = -F x 4.0 m
-F x 4.0m = Loss in GPE + loss in KE = -2600J – 7020J = -9620 J
F x 4.0m = 9620 J
Resistive force, F = 2405 N = **2400 N**

4ai. Pressure difference = 50cm x 100 Pa/cm = **5000 Pa**

4aii. Pressure = F / area
5000 Pa = weight / 0.15 m$^2$
Weight = **750 N**

4aiii. The difference in fluid level will be **less/lower**.

4b. Pressure difference = 5000 Pa = $\rho \times g \times h$

5000 Pa = 833 kg/m$^3$ x 10 N/kg x h

h = **0.60 m** or **60 cm**

5a. Conduction takes place **through a medium** while radiation can take place **without a medium**.

5bi Thermal energy is conducted quickly **through the metal** from the computer chip **to the air particles** next to the heat sink fins.

5bii The metal fins have more **surface area of contact** with the air, hence increasing the rate of thermal transfer.

5biii Black surface is a **good emitter** of radiation.

6ai As temperature difference between benzene and surroundings decreases/temperature of benzene decreases, the rate of cooling would also decrease hence curve slopes more gently.

6aii When thermal equilibrium is achieved, the net transfer of thermal energy is zero. This is shown by the steady temperature reached.

6aiii As the temperature of the benzene decreases, the internal KE of benzene molecules decreases and their speeds would also decrease.

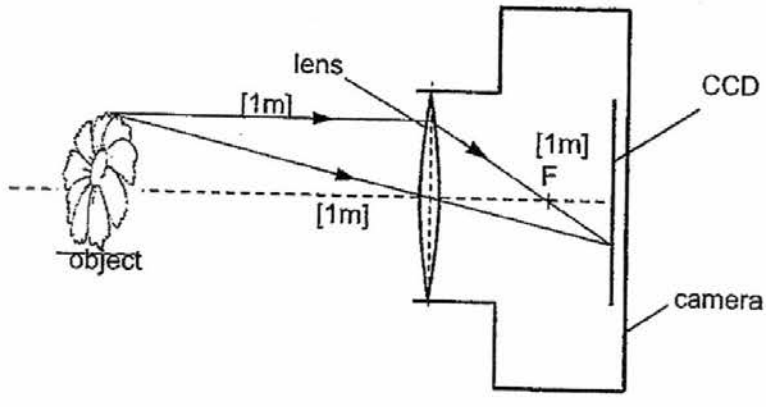
6b. $Pt = C \times \Delta\theta$

$200W \times (1.5 \times 60)s = C \times (80 - 22)°C$

C = **310 J/kg**

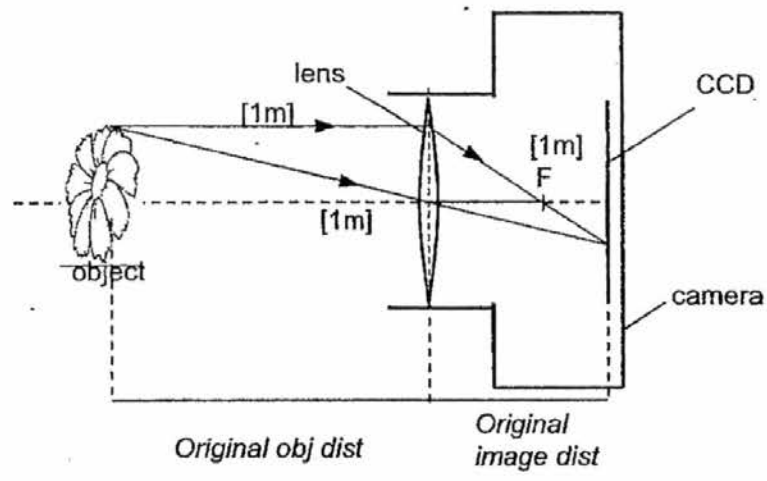
7a. The focal length is the distance between the **optical centre** of the lens to the **focal point**.

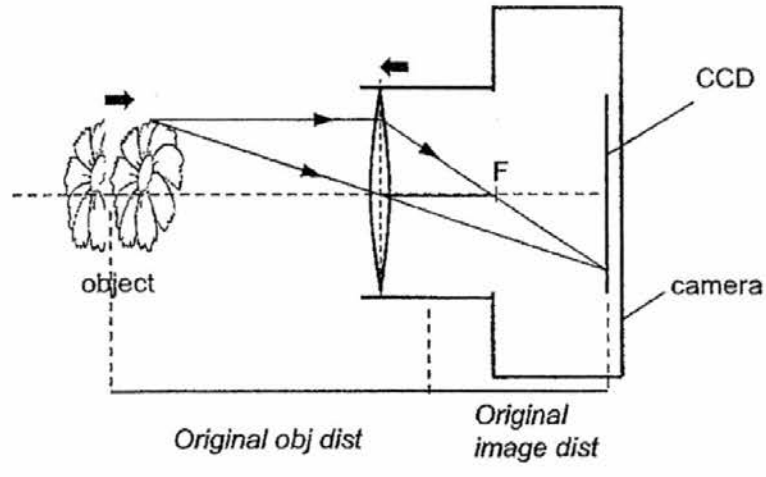
7bi & ii.




.95

7c. The lens will have to move **towards the object** (further **away from the CCD**).




8a. They have the same average speed.
They travelled the same distance in the 20 seconds.

8b.

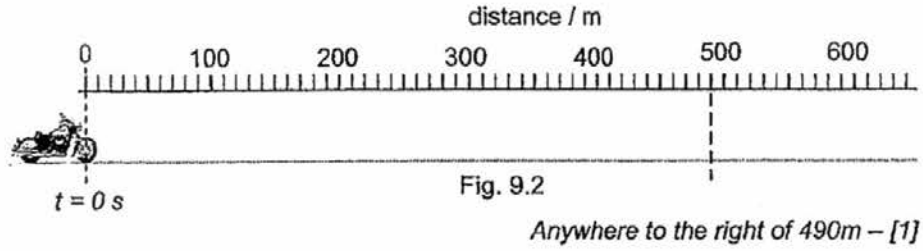


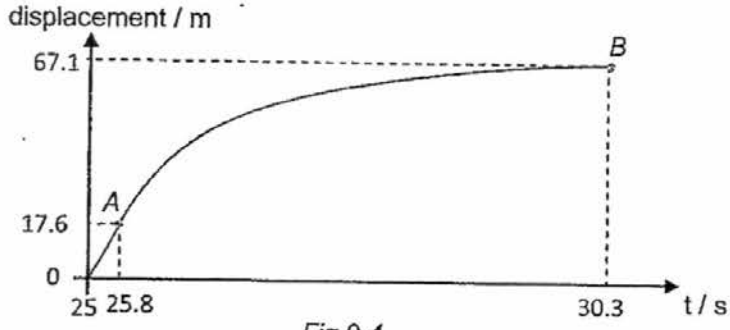

Fig. 9.2

*Anywhere to the right of 490m – [1]*

8ci Distance travelled = ½ x (0.8 + 5.3)s x 22m/s
= **67.1 m**

8cii Deceleration = (22 – 0)m/s / 4.5s
= **4.89 m/s²**

8ciii

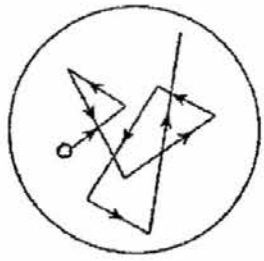



*Correct time & displacement values at A & B – [1]*

*OA is a straight line – [1]*

*Fig 9.4*

9ai.



9aii. Liquid is made up of particles/molecules
Molecules are in constant random motion

9aiii. Increase the temperature of the liquid.

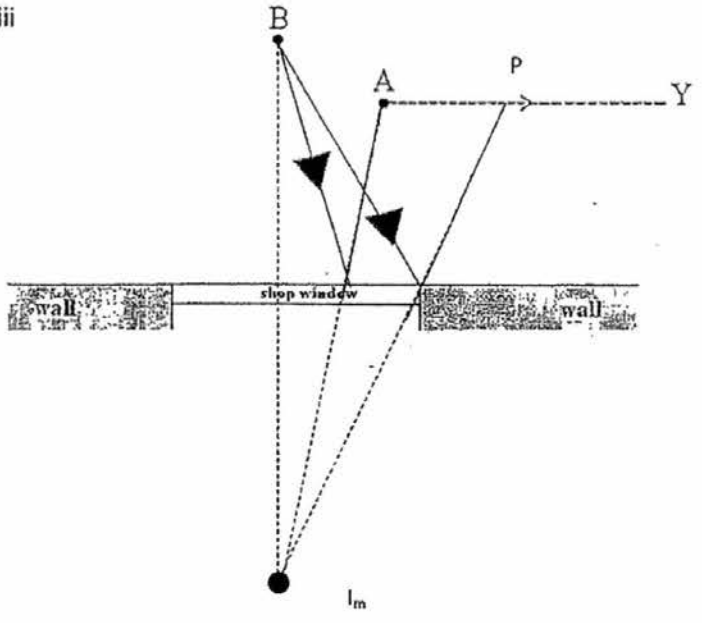
9bi. The pressure of a gas is inversely related to its volume. When volume increases, the number of particles per unit volume decreases, frequency of collisions decrease, force per unit area, which is pressure, therefore decreases.

9bii. The air pressure at this height is about 1/3 (much lower) of that at sea level. This means that the number of air molecules (oxygen molecules) per unit volume is also 1/3 (fewer than) that at sea level. The lack of oxygen would cause the climber to inhale more frequently which would tire him out more easily.

9biii. Correct temperature = 0°C – 35°C = **<u>–35°C</u>**

.96

10ai,ii,iii




10bi Total internal reflection happens in the **optically denser medium** and the angle of incidence in the denser medium is **greater than the critical angle**.

10bii $n = \sin i / \sin r$

$1.33 = \sin 50 / \sin r$

$r =$ **35.2 °**

10biii $c = \sin^{-1} (1/1.33)$

$=$ **48.8 °**

10biv