REDSPOT New Solutions . New Minds

About O Level

(PURE) PHYSICS

(YEARLY)

About Thinking Process

When solving problems, we first analyse the questions and then gather relevant information until we are able to determine the answers. But for presentation reason, we need to organise, rearrange and then present ONLY the required workings and solutions.

Thinking process reveals the extra but relevant information which is not required as part of the solutions.

About MCQ with HELPs

Explanations are given so that students know exactly why the answer is the right one.

period	2010 to 2022
contents	June & November, Paper 1 & 2, Worked Solutions
form	Year By Year
compiled for	O Levels
special features	Thinking Process, MCQ with HELPs

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'O' Level (Pure) Physics 5054 (Yearly)

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Revised Syllabus

MCQ Answers

JUNE 2022 PAPER 1

MCQ Section

1. A force of 3.0 N and a force of 4.0 N act on an object.

What is the maximum possible resultant of these two forces?

A 1.0 N **B** 5.0 N

C 7.0 N **D** 12 N

[Topic 3]

2. A length of copper wire is labelled: length 0.50 m and diameter 0.50 mm.

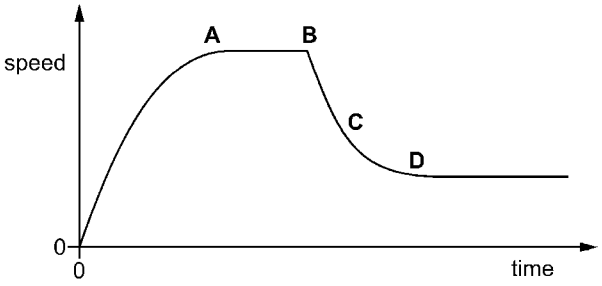
Which instruments are most suitable to measure accurately the length and the diameter of the wire?

	length	diameter
A	metre rule	metre rule
B	metre rule	micrometer
C	calipers	metre rule
D	calipers	micrometer

[Topic 1]

3. The graph shows the speed–time graph for a parachutist who jumps from a plane but does not open his parachute immediately.

At which point does he open his parachute?



[Topic 2]

4. A 60 kg passenger enters a stationary lift. The gravitational field strength g is 10 N/kg.

How much force does the floor of the lift exert on the passenger when the lift accelerates upwards at 2.0 m/s^2?

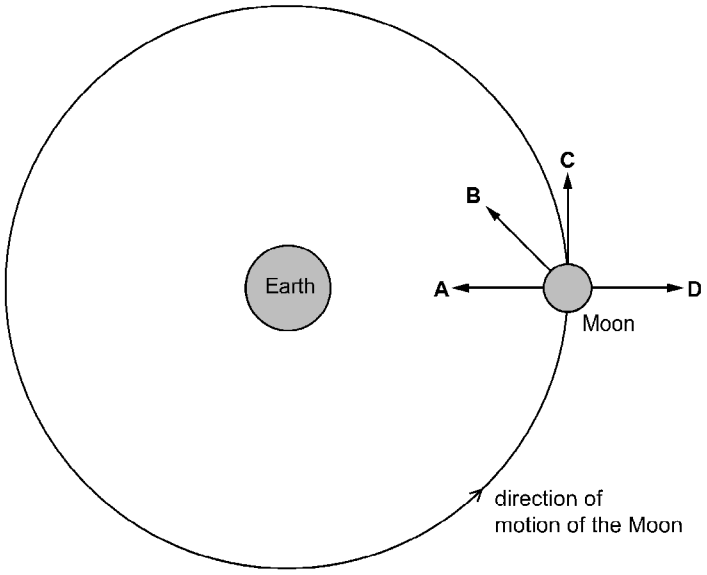
A 120 N **B** 480 N

C 600 N **D** 720 N

[Topic 3]

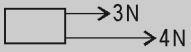
5. The diagram represents the Moon in its orbit around the Earth.

Which arrow represents the direction of the resultant force acting on the Moon at the instant shown?



[Topic 3]

1. C Maximum resultant force will be when both forces will act in the same direction. Hence the 2 forces will be added (3 + 4 = 7)



2. B Calipers cannot measure a length of 0.50 m, since the length is beyond its range.

Diameter is too small to be measured by a meter rule.

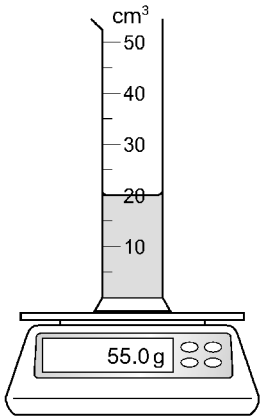
3. B When parachute opens air resistance increases and hence speed decreases.

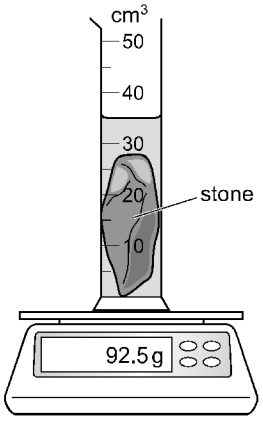
This happens after point **B** on the graph.

6. A measuring cylinder containing water is placed on a balance.

A stone is placed into the water.

The diagram shows the readings on the balance and on the measuring cylinder.





What is the density of the stone?

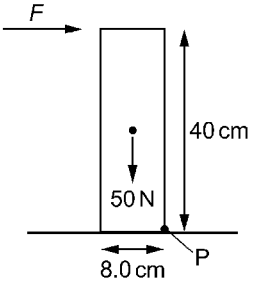
A 1.1 g /cm^3 **B** 1.5 g / cm^3

C 2.5 g /cm^3 **D** 2.6 g / cm^3

[Topic 1]

7. The diagram shows a uniform solid rectangular block of weight 50 N that is pivoted about point P.

The height of the block is 40 cm. The base of the block is 8.0 cm wide.



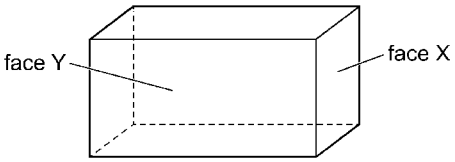
Which horizontal force F just makes the block start to rotate about P?

A 2.5 N **B** 5.0 N

C 10 N **D** 160 N

[Topic 5]

8. The centre of mass of a solid rectangular block is at its centre. A small heavy weight is available.



In which arrangement is the centre of mass the lowest?

A with face X on a table

B with face Y on a table

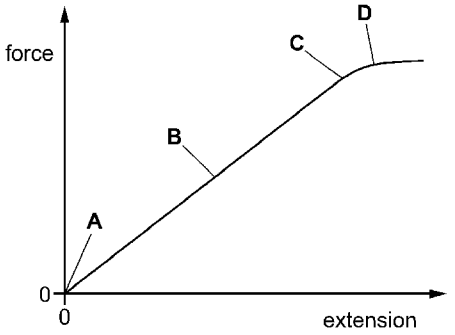
C with face X on a table and the heavy weight attached centrally on top of the block

D with face Y on a table and the heavy weight attached centrally on top of the block

[Topic 5]

9. The graph shows how the extension of a spring depends on the force applied.

Which point is the limit of proportionality?



[Topic 3]

10. An elastic spring has an unstretched length of 30 cm.

A load of 6.0 N is hung from the spring and the length of the spring is now 66 cm.

The 6.0 N load is removed and the spring returns to its original length. A load of 2.0 N is now hung from the spring.

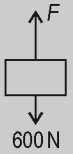
MCQ Answers

4. **D** By Newton's 2nd law,

$F - 600 = ma$

$F - 600 = (60)(2.0)$

$F = 120 + 600 = 720$ N



5. **A** Gravitational force between Earth and Moon provides centripetal force and it always acts towards Earth (i.e., towards the centre of the circle).

6. **C** Volume of stone

$= 35 - 20 = 15\ \text{cm}^3$

Mass of stone

$= 92.5 - 55.0 = 37.5$ g

$\text{density} = \dfrac{\text{mass}}{\text{volume}}$

$= \dfrac{37.5}{15} = 2.5\ \text{g/cm}^3$

7. **B** Anticlockwise moment = Clockwise moment

$(50)(4.0) = (F)(40)$

$F = \dfrac{50 \times 4.0}{40}$

$F = 5.0$ N

8. **B** When the block is lying on face Y, its centre and hence its centre of mass is lowest. Attaching a small weight on top will move the centre of mass higher.

9. **C** End of straight line region is the limit of proportionality.

What is the new length of the spring?

A 22 cm **B** 40 cm
C 42 cm **D** 52 cm

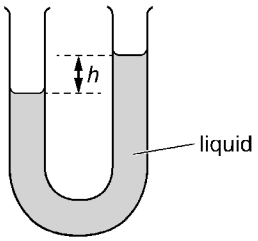
[Topic 3]

11. A barometer is an instrument used to measure atmospheric pressure.

In one type of barometer the height of a liquid in a tube is measured.

In which diagram does the height h represent atmospheric pressure?

A



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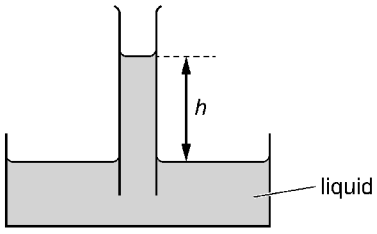
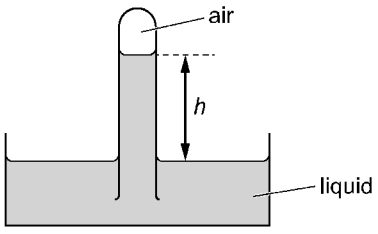
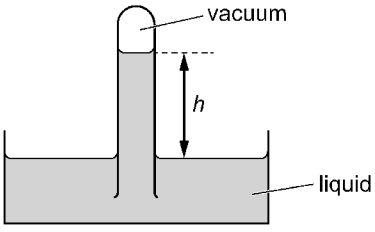


C



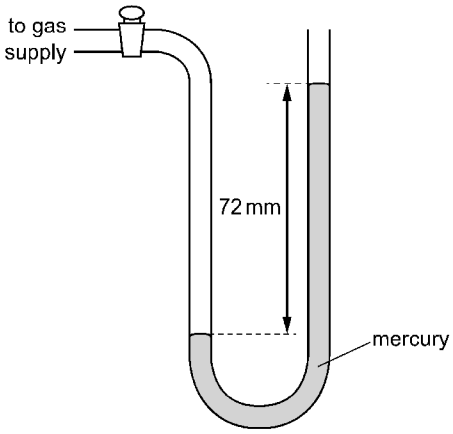
D



[Topic 6]

12. A manometer contains mercury of density 14 000 kg/m^3. The manometer is connected to a gas supply and the difference in the height of the mercury levels is 72 mm. The atmospheric pressure is 100 kPa.

The gravitational field strength g is 10 N/kg.



What is the pressure of the gas supply?

A 90 kPa
B 99 kPa
C 110 kPa
D 200 kPa

[Topic 6]

13. Which device provides a continuous, steady energy output for the longest time?

A a nuclear reactor
B a solar panel
C a 1.5 V cell
D a wind generator

[Topic 4]

14. A load is pulled by a rope attached to a motor. The resultant force exerted by the rope on the load is shown in the diagrams.

In each diagram, the load moves in the direction of the force shown and takes 10 s to travel 1.0 m.

In which diagram does the motor work with the greatest power?

MCQ Answers

10. C When $F = 6$N,

$e = 66 - 30 = 36$ cm

Using, $F = ke$

$k = \frac{F}{e} = \frac{6}{36} = \frac{1}{6}$ N/cm

$\therefore F = \frac{1}{6}e$

When $F = 2.0$ N

$2 = \frac{1}{6}e \Rightarrow e = 12$ cm

So, New length $= 30 + 12$
$= 42$ cm

11. D In a barometer, the tube is closed and there is vacuum inside. If there is air on top inside the tube, then it will exert pressure on the liquid and hence the height h will not represent atmospheric pressure.

12. C

$P_{gas} = P_{atm} + P_{72\,mm}$

$= 100\,k + \rho gh$

$= 100000 + (14000) \times (10)$
$\times (72 \times 10^{-3})$

$= 110080$ Pa

$= 110.080$ kPa

13. A Solar panels and wind generator are variable and hence NOT continuous. 1.5 V cell does not provide energy for the longest time.

14. A

$\text{Power} = \frac{\text{work done}}{\text{time}}$

$= \frac{F \times d}{t}$

Option **A**: $P = \frac{12 \times 1}{10}$
$= 1.2$ W

Option **B**: $P = \frac{8 \times 1}{10}$
$= 0.8$ W

Option **C**: $P = \frac{10 \times 1}{10}$
$= 1$ W

Option **D**: $P = \frac{4 \times 1}{10}$
$= 0.4$ W

NOVEMBER 2022 PAPER 2

THEORY Section

Section A

Answer **all** the questions in this section.

Question 1

A train travels along a straight horizontal track. At time $t = 0$, the train passes through station P at constant speed without stopping.

The driver applies the brakes 70 s before reaching station Q. The train decelerates.

Fig. 1.1 is the speed–time graph for the train from $t = 0$ until it stops at station Q.

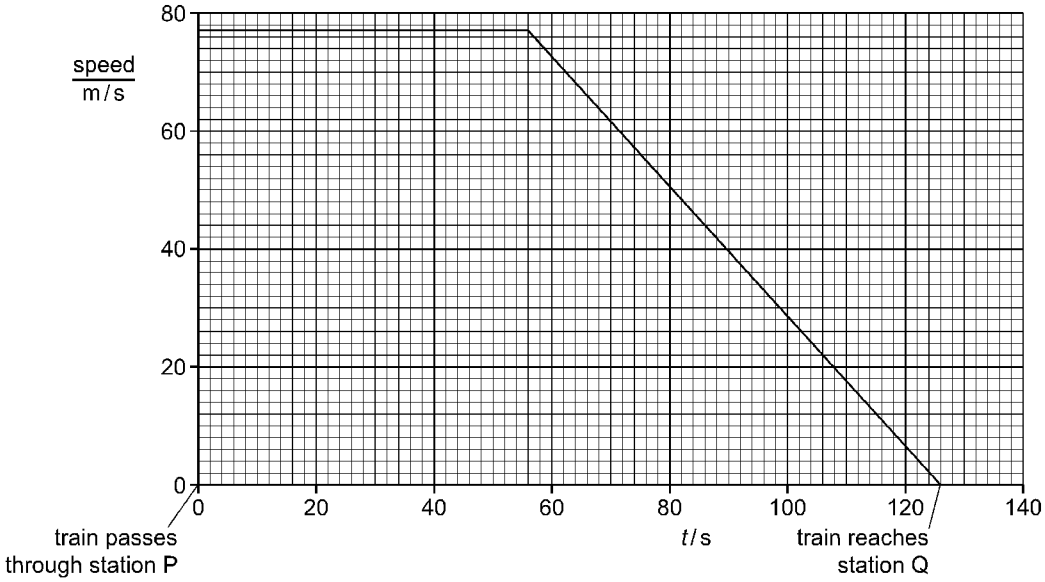


Fig. 1.1

(a) Using Fig. 1.1, determine the distance between station P and station Q. [3]

(b) The mass of the train is 3.8×10^5 kg.

(i) Determine the deceleration of the train in the 70 s before it stops at station Q. [2]

(ii) Calculate the resultant force on the train as it decelerates. [2]

[Topic 2]

Solution

(a) Distance = Area under graph

= Area of trapezium

$= \frac{1}{2} \times 77 \times (56 + 126)$

$= 7007$ m

$= 7.0 \times 10^3$ m

(b) (i) Deceleration, $a = \dfrac{\Delta v}{\Delta t}$

$$= \frac{77}{126-56} = 1.1\ \text{m/s}^2$$

(ii) Resultant force, $F = ma$

$$= (3.8\times10^5)\times(1.1) = 4.2\times10^5\ \text{N}$$

Question 2

The foundations that support a building are long concrete cylinders that are pointed at one end. A pile-driver is a machine that forces the pointed concrete cylinders into the ground.

Fig. 2.1 shows a pile-driver.

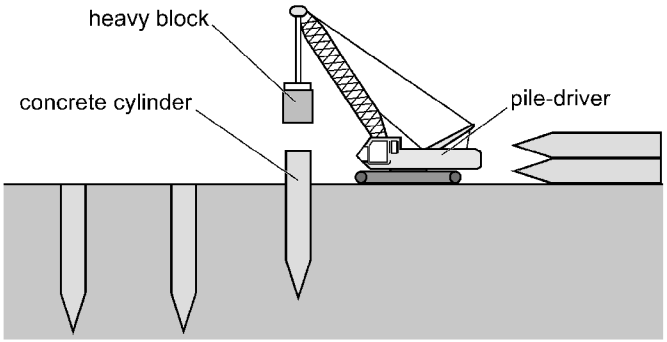


Fig. 2.1

A heavy block of mass 2.9×10^4 kg is lifted into the air then dropped onto the top of a concrete cylinder. This forces the cylinder into the ground.

(a) Fig. 2.2 shows the heavy block.

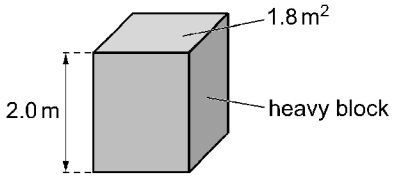


Fig. 2.2

The block is 2.0 m tall and has a cross-sectional area of 1.8 m^2.

Calculate the density of the material used to make the block. [2]

(b) The pile-driver lifts the block from the top of a concrete cylinder, through a height of 0.80 m.

The gravitational field strength g is 10 N/kg.

(i) Calculate the gravitational potential energy gained by the block. [2]

(ii) The block is then dropped from rest onto the top of the concrete cylinder.

Calculate the speed of the block just before it hits the concrete cylinder. [3]

[Topic 4]

Solution

(a) Density, $\rho = \dfrac{\text{mass}(m)}{\text{volume}(h \times A)}$

$$= \frac{2.9 \times 10^4}{2.0 \times 1.8}$$

$$= 8055.56 = 8.1 \times 10^3 \text{ kg/m}^3$$

(b) (i) G.P.E $= mgh$

$$= (2.9 \times 10^4) \times 10 \times 0.80$$

$$= 232000 \text{ J} = 2.3 \times 10^5 \text{ J}$$

(ii) K.E gained = P.E lost

$$\frac{1}{2}mv^2 = mgh$$

$$v^2 = 2gh$$

$$v = \sqrt{2 \times 10 \times 0.80}$$

$$v = 4.0 \text{ m/s}$$

Question 3

Fig. 3.1 shows a man standing underneath an outdoor heater on a cold evening.

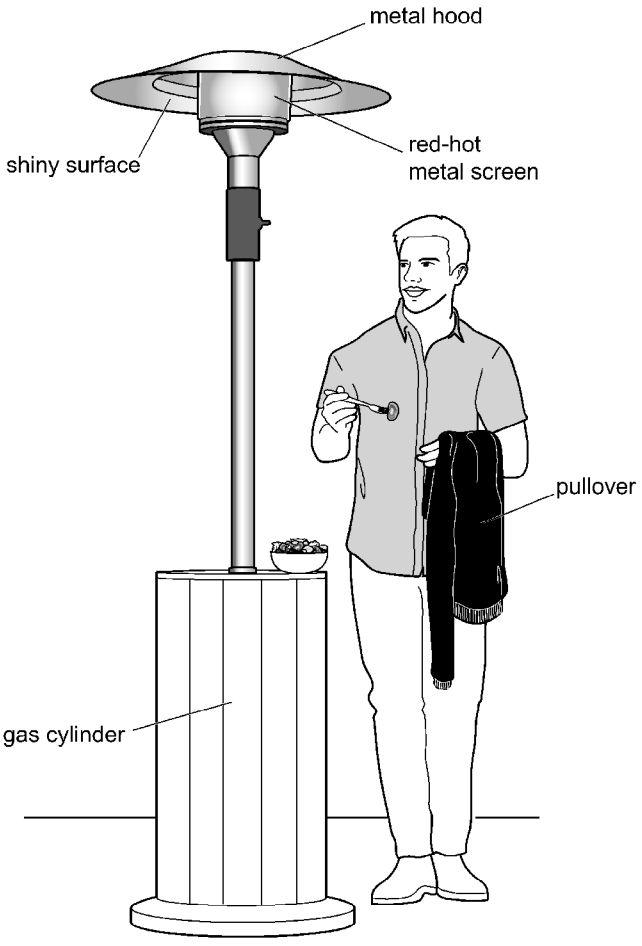


Fig. 3.1

Gas in the cylinder at the base of the heater is the fuel for the heater. When the heater is operating, the gas travels to the top of the heater where it burns.

(a) State the form of energy stored in the gas that is transferred by the heater. [1]

(b) A metal screen surrounding the burning gas is heated by the burning gas until it is red-hot. The hot metal screen warms the man who is standing underneath it.

(i) Describe how thermal energy in the red-hot metal screen is transferred to the man and how it warms him. [3]

(ii) At the top of the heater is a metal hood that has a shiny lower surface.

Explain why this makes the energy transfer from the metal screen more efficient. [2]

(iii) The air temperature decreases and the man puts on a black pullover.

Explain **one** way in which wearing the black pullover helps to keep the man warm. [2]

[Topic 8]

Solution

(a) Chemical potential energy.

(b) **(i)** The thermal energy is emitted, in the form of infra-red radiation, by the red-hot metal screen which travel towards the man.

These infra-red radiations are absorbed by the man which increase his internal energy and he feels warm.

(ii) The shiny metal hood reduces the loss of thermal energy from the top by reflecting back the radiations downwards which increases the intensity of the radiation falling on the man and hence, it makes the energy transfer towards the man more efficient.

(iii) The black surface being a good absorber of infra-red radiation, absorbs more energy and hence, the black pullover helps to transfer more thermal energy to the man and keeps him warm.

COMMENT on **ANSWER**

❝ **(b) (iii)** ***Alternatively:***

— The black pullover traps air which is a good insulator. So it reduces the loss of thermal energy from the man's warm body into the atmosphere and hence, it helps to keep the man warm.❞

Question 4

A sound wave, travelling in air or water, contains compressions and rarefactions.

(a) Describe an experiment to show that a medium is required to transmit sound waves. You may draw a labelled diagram if you wish. [3]

(b) When a sound wave passes through air or water, the molecules of the air or water move.

Describe the motion of the molecules due to the sound wave. [2]

(c) Describe what is meant by 'a rarefaction'. [1]