

O-LEVEL PHYSICS SEMINAR QUESTIONS

Where necessary assume

- Acceleration due to gravity, $g = 10\text{ms}^{-2}$
- Density of water $= 1000\text{kgm}^{-3}$
- Density of mercury $= 13600\text{kgm}^{-3}$
- Speed of sound in air $= 340\text{ms}^{-1}$

MECHANICS

1. (a) State Newton's laws of motion
- (b) Explain what happens to a person seated in a vehicle when it is suddenly brought to rest.
- (c) The table below shows the velocity of a particle during the course of its motion.

t(s)	0	2	4	7	9	11	12
v(ms^{-1})	0	5	10	10	10	2.5	0

Plot a graph of velocity against time and use it to find.

- i. The acceleration of the body.
 - ii. The retardation of the body.
 - iii. The total distance travelled by the body.
 - iv. Describe the condition of the particle during the period 4s to 9s.
- (d) A ball is projected vertically upwards with an initial velocity of 30 ms^{-1} . Find
- (i) Its maximum height
 - (ii) The time taken to return to its starting point.
- (e) (i) Distinguish between elastic and inelastic collisions. State one example of each
- ii) A body, P, of mass 20kg moving with a velocity of 10ms^{-1} collides with a body, Q, of mass 5kg moving at 20ms^{-1} in the opposite direction to that of P. After collision both bodies stick together and move together. Determine
- (a) The common final velocity of the bodies.
 - (b) The loss in the kinetic energy.

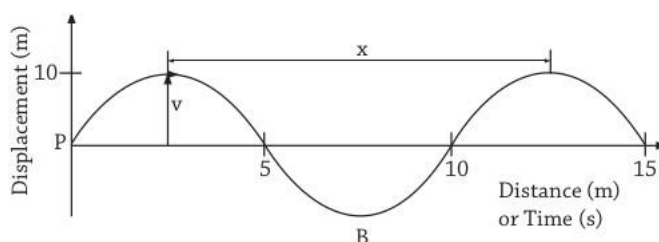
2. (a) (i) State Archimedes' Principle.
- (ii) Describe an experiment to verify Archimedes' Principle.
- (iii) A piece of iron weighs 355 N in air. When completely immersed in water, it weighs 305 N and weighs 315 N when completely immersed in methylated spirit. Calculate the relative density of methylated spirit.
- (iv) State the application of Archimedes' principle.
- (b) (i) State the law of floatation.
- (ii) Describe an experiment to verify the law of floatation.
- (iii) A piece of wood of volume 280 cm^3 floats with only three quarters of its volume submerged. If the density of water is 1000 kgm^{-3} , calculate the mass of wood.
3. (a) Define pressure and state its units.
- (b) Explain why one feels more pain when pricked with a needle than when pricked with a nail. State the assumption made.
- (c) With the aid of a diagram, describe how you would show that the pressure of a liquid is independent of cross-sectional area and shape of a container.
- (d) State the principle of transmission of pressure in fluids.
- (e) In a hydraulic press the smaller piston has a diameter of 14 cm while the larger has a diameter of 280 cm. If a force of 77 N is exerted on the smaller piston, calculate the force exerted by the larger piston.
4. (a) Define the following;
- i. joule as a unit of work
- ii. newton
- iii. watt
- (b) A boy of mass 50 kg runs up a flight of stairs of 20 steps in 10 s. If each step is 25 cm high, determine the power developed by the boy.
- (c) i. Define efficiency as applied to simple machines.
- ii. Describe an experiment to investigate the relation between efficiency and load using a block and tackle pulley system.
- (d) Why is the efficiency of a machine always less than 100%?

LIGHT

5. (a) i. What is light?
- ii. State the laws of reflection of light.
- (b) By use of a ray diagram, show how a concave mirror may be used as a magnifying mirror.
- (c) (i) Distinguish between real and virtual images.
- (ii) Under what condition is a virtual image formed by a concave mirror
- (d) An object of height 3 cm is placed at a distance of 30 cm in front of a converging mirror of focal length 20 cm perpendicular to the principal axis. By use of a scale ray diagram, determine:
- (i) The position of the image.
- (ii) The nature of the image.
- (iii) The size of the image.
- (e) (i) State one possible cause of short sightedness. Illustrate your answer with a diagram
- (ii) Explain how short sightedness can be corrected.

WAVES

6. (a) (i) Define wavelength of a wave
- (ii) Differentiate between transverse and longitudinal wave and give one example of each.
- (b) The figure represents a wave motion of a vibrating particle.



- (i) Identify what the letters X and V represent
- (ii) Determine the amplitude and velocity of the wave
- (c) (i) Describe an experiment to determine the speed of sound in air by echo method
- (ii) State two possible sources of errors for experiment c(i) above
- (d) A student stands between two cliffs and makes a loud sound. If he hears the first echo after 90 minutes and the second echo after 2s, find the distance between the cliffs.
- (e) Why are open pipes more preferred than closed pipes?

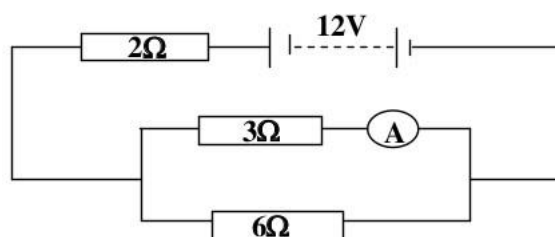
HEAT

7. (a) (i) Distinguish between heat and temperature.
- (ii) What is meant by a thermometric property?
 - (iii) List the qualities that make mercury a better thermometric liquid than water.
- (b) (i) Define a Celsius scale.
- (ii) What is meant by absolute zero temperature?
- (c) (i) Define fundamental interval of a thermometer.
- (ii) When an uncalibrated thermometer is immersed in melting ice, the length of the mercury is 8.0 cm. When the thermometer is immersed in steam from boiling water, the length of the thread becomes 28.0 cm. What is the temperature when the length of the thread is 3.0cm?
 - (iii) Describe an experiment to determine the upper fixed point of a thermometer.
- (d) (i) Differentiate between conduction and convection.
- (ii) Explain how conduction takes place in metals.

ELECTRICITY

8. (a) (i) Define electrical resistance
- (ii) State three physical properties that affect resistance of a metal wire

- (b) Draw sketch graphs of current against p.d for the following
- a metal wire
 - a semiconductor diode
- (c) A battery of e.m.f 12V and negligible internal resistance is connected to resistances of 2Ω , 3Ω and 6Ω as shown below.



Calculate;

- The reading of the ammeter, A
 - Current passing through 6Ω resistor
- (d) Explain why a wire heats up when current is passed through it.

MAGNETISM

9. (a) What is meant by
- Magnetic field
 - magnetic saturation
- (b) (i) Write down the properties of the magnet
- (ii) Use the domain theory to describe demagnetisation
- (c) (i) Distinguish between ferromagnetic and non-ferromagnetic materials. Give examples in each case
- (ii) Describe the following methods of magnetizing a metal
- Stroking method
 - Induction method
 - Electrical method

MODERN PHYSICS

10. (a) (i) What is meant by Radioactivity.
- (ii) Describe a simple experiment to distinguish the three radiations that are emitted by radioactive materials.
- (b) (i) A radioactive gas sample has a half-life of 14 hours. What is meant by this statement
- (ii) The time taken for the activity of a radioactive sample to reduce from 960 counts per second to 60 counts per second is 30 hours. Determine the half-life of the radioactive material.
- (c) What happens to the activity of a radioactive material when its
- (i) temperature is increased
- (ii) mass is increased
- (d) State;
- (i) two industrial and two medical uses of radioactivity
- (ii) two health hazards of radioactivity
- (e) i. What are X-rays
- ii. With the aid of a labelled diagram, describe how X-rays can be produced.
- (f) (i) Distinguish between nuclear fusion and nuclear fission.
- (ii) Give any one example where nuclear fission is applied.

PRACTICAL**Summary of the measuring instruments**

Instrument	Physical quantity	units and accuracy
metre rule	length	cm to 1d.p(least count =0.1(1d.p))
Voltmeter	voltage	V to 2d.p(least count=0.06V) and to 1d.p(least count=0.1V)
Ammeter	current	A to 2d.p(least count=0.02A)
stop watch	time	s to 2d.p(least count=0.01s)
stop clock	time	s to 1d.p (least count =0.5s)
protractor	angles	(⁰) to 0 d.p (least count=1 ⁰)

Treatment of values

This involves the rules governing data manipulation

(a) **Addition and subtraction rule.**

When adding or subtracting two quantities, the value with the least number of decimal places is considered. e.g

$$(i) 4.7(1d.p) + 2.41(2d.p) = 7.1(1d.p) \text{ (we consider the least d.ps)}$$

$$(ii) 4.21(2d.p) - 3.0(1d.p) = 1.2(1d.p)$$

(b) **Multiplication and division rule** when dealing with quotients and products of varying quantities the least number of significant figures of the two quantities is considered.

Significant figures

Are digits in a number that are known with certainty plus the first digit that is uncertain. The Significant Figures of a number have meaning in reference to a measured or specified value. Correctly accounting for Significant Figures is paramount while performing arithmetic so that the resulting answers accurately represent numbers that have computational significance or value.

Rules governing significant figures

1. All non-zero digits in a number are significant e.g 4362(4 S.F), 1241(4 S.F), 1.26(3 S.F), 1.2(2 S.F)
2. All zeroes occurring between non zero digits are significant. They are also known as trapped zeroes. e.g 1.004(4 S.F), 1002(4S.F)
3. law of trailing zeroes: All zeroes to the right of the last non zero digit are
 - (i) Significant if they are not as a result of rounding off. e.g 720(3 S.F)
 - (ii) Not significant if they are obtained as a result of rounding off e.g 6259 to 3S.F is 6260(3S.F).so this zero is not significant
4. Zeroes before a non zero digit are not significant. They are known as leading zeroes. e.g 0.06(1S.F), 0.000000054(2 S.F).

Therefore when multiplying and dividing quantities rules must be followed.

$$(a) 1.24(3sf) \times 1.8(2sf) = 2.2(2sf)$$

$$(b) 1.045(4sf) \times 1.93(3sf) = 2.02(3sf)$$

$$(c) 0.04(1sf) \times 1.2(2sf) = 0.05(1sf)$$

Float values (constant values)

These are values with an infinite number of significant figures and decimal places. when dealing with such values we ignore their significant figures and we consider the significant figures of the varying variables(measured values).e.g when dealing with oscillations $T = \frac{t}{n}$.for this case the S.F of the experimental value of t is considered. i.e $E.V > F.V$ (Experimental value weigh more compared to float values)

Rounding off

For most measurements, finite figures are required. rounding off numbers creates numbers with fewer digits. During rounding off, if the digit to the right is 0,1,2,3,4 the digit being rounded to remains the same. e.g 5.422 to 1d.p is 5.4.

If the digit to the right is 5, 6,7,8,9 the digit being rounded to increases by one e.g 5.46 to 1 d.p is 5.5

Recording trigonometric functions

All trigonometric functions are recorded to 3 decimal places with no units. e.g sin, cos, tan, log, ln e.g $\cos 25 = 0.906$ $\sin 25 = 0.423$ $\tan 25 = 0.466$ $\log 25 = 1.398$

Recording roots of numbers

When dealing with square, cube, fourth roots, e.t.c of a number, they must be recorded to a finite number of decimal places. i.e roots of whole numbers are written to 3 d.ps. e.g

$$\sqrt{4} = 2.000$$

$$\sqrt{25} = 5.000$$

$$\sqrt[4]{56} = 2.736$$

For numbers with decimal places, the significant figures of that number are considered

$$\sqrt{4.0}(2sf) = 2.0$$

$$\sqrt{3.52}(3sf) = 1.88$$

$$\sqrt[3]{25.48}(4sf) = 2.943$$

Symbols, Units and Handwriting

When dealing with practical work candidates must use the best handwriting possible in order for them to score highly. letter construction must be clear to candidates more so when writing numbers such as 2,5,7. Since the majority write, **s** instead of 5 Units that are named after scientists have their symbols written in capital letters and full names written in small letters.e.g

Name	symbol
amperes	A
volts	V
joules	J
newton	N
watts	W

Units that are not names of scientists have their symbols written in small letters

metres	m
centimetres	cm
grammes	g
seconds	s

TRIAL TASKS

During an experiment a S.4 candidate obtained the following results .Copy and complete the table below.

$x(cm)$	$t(s)$			
90.0	19.04			
80.0	21.49			
70.0	24.11			
60.0	27.96			
50.0	33.63			
40.0	42.24			

- (a) Include values of $x(m)$, T , T^2 for $n=20$ oscillations
- (b) Plot a graph of T^2 against x
- (c) Find the slope S of your graph

During an experiment a S.4 candidate obtained the following results .Copy and complete the table below.

$x(cm)$	$\theta(^{\circ})$	$y(cm)$		
0.9	10	6.4		
1.6	20	6.6		
2.4	30	6.8		
3.0	40	7.0		
3.8	50	7.3		
4.5	60	7.6		

- (d) Include values of $\frac{x}{y}$, x^2 , $\sin \theta$.
- (e) Plot a graph of $\sin \theta$ against $\frac{x}{y}$
- (f) Find the slope n of your graph

The table below shows the results that were obtained by students during a practical

$l(m)$	V (V)	$I(A)$
0.200	1.05	0.82
0.300	1.15	0.50
0.400	1.25	0.40
0.500	1.30	0.38
0.600	1.35	0.30
0.700	1.45	0.20

- (g) Include values of $\frac{V}{I}, IV, \frac{1}{I}$
- (h) Plot a graph of $\frac{V}{I}$ against l
- (i) Find the slope S of the graph

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