535/2
PHYSICS
Paper 2
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PHYSICS

Paper 2

2 Hours 15 Minutes

INSTRUCTIONS TO CANDIDATES:

Attempt any **five** *questions.*

Any additional question(s) answered will ***not*** *be marked*

Mathematical tables and silent non–programmable electronic calculators may be used.

These physical quantities may be useful to you.

Acceleration due to gravity	=	$10ms^{-2}$
Speed of sound in air	=	$320ms^{-1}$
Velocity of electromagnetic waves	=	$3.0 \times 10^{8}ms^{-1}$

Turn Over

1. (a) Define the followings:
   (i) The joule (J) as a unit of work. (1 mark)
   (ii) Power. (1 mark)

   (b) A girl of mass 50kg runs up a flight of stairs of 20 steps in 10s. If each step is 25cm high, determine the power developed by the girl. (3 marks)

   (c) (i) Define efficiency as applied to simple machines. (1 mark)
   (ii) Describe an experiment to investigate the relation between efficiency and load using a block and tackle pulley system. (4 marks)
   (iii) A block and tackle pulley system has 3 pulley wheels in the upper fixed block and 2 pulley wheels in the lower movable block. Determine the load that can be lifted by an effort of 350N if the efficiency of the system is 80%. (4 marks)

   (d) Why is the efficiency of machines always less than 100%? (2 marks)

2. (a) (i) What is a soft magnetic material? Give one example of such a material (2 marks)
   (ii) Explain with the aid of a diagram, how a steel bar can be magnetised by single touch method specifying the polarity of the resultant magnet. (4 marks)
   (iii) Explain where the energy stored in the magnet in (a)(ii) above comes from. (2 marks)

   (b) Explain with the aid of a diagram what happens when two vertical parallel conducting wires are placed near one another carrying current in
   (i) the same direction. (3 marks)
   (ii) opposite direction. (3 marks)

   (c) Sketch the magnetic field around a solenoid in which current, *I*, is flowing. Indicate the polarity. (2 marks)

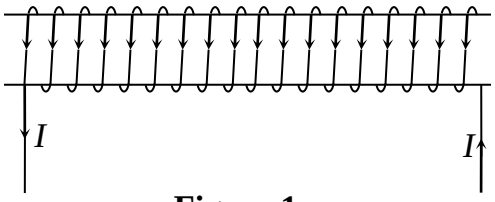

Figure 1

3. (a) (i) Define wavelength of a wave. (1 mark)
   (ii) Differentiate between transverse and longitudinal wave and give one example of each. . (2 marks)

(b) Figure 2 shows a section of a progressive wave after 2.5 seconds from the start.

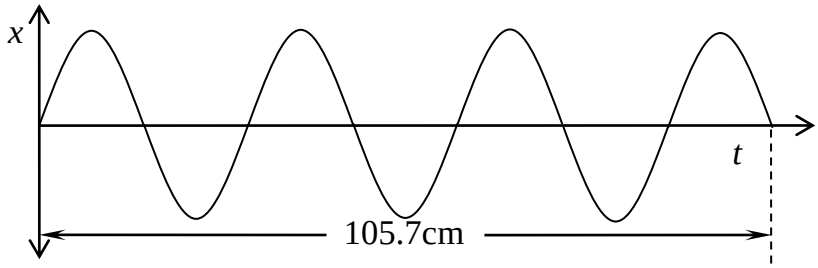

Figure 2

Calculate

(i) The wavelength of the wave. (2 marks)

(ii) The period of the wave. (2 marks)

(c) Describe an experiment to determine the speed of sound in air by echo method. (6 marks)

(d) A student stands between two cliffs and makes a loud sound. If he hears the first echo after 1.5s and the second echo after 2.0s, find the distance between the cliffs. (3 marks)

4. (a) (i) What is light? (1 mark)

(ii) State the laws of reflection. (2 marks)

(b) With the aid of a diagram, differentiate between diffused and regular reflection. (4 marks)

(c) Figure 3 shows light incident at A one side of a semi – circular glass block and is refracted critically at B.

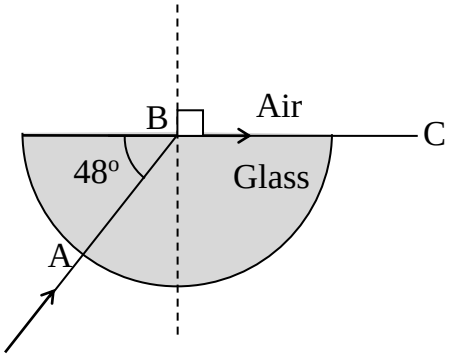

Figure 3

(i) Why does the light ray enter the glass block at point A without deviation? (1 mark)

(ii) Find the refractive index of the glass. (3 marks)

(d) (i) State one possible cause of short – sightedness. Illustrate your answer with a diagram. (3 marks)

(ii) Explain how short – sightedness can be corrected. (2 marks)

5. (a) Distinguish between scalar and vector quantities, giving two examples of each (3 marks)

(b)

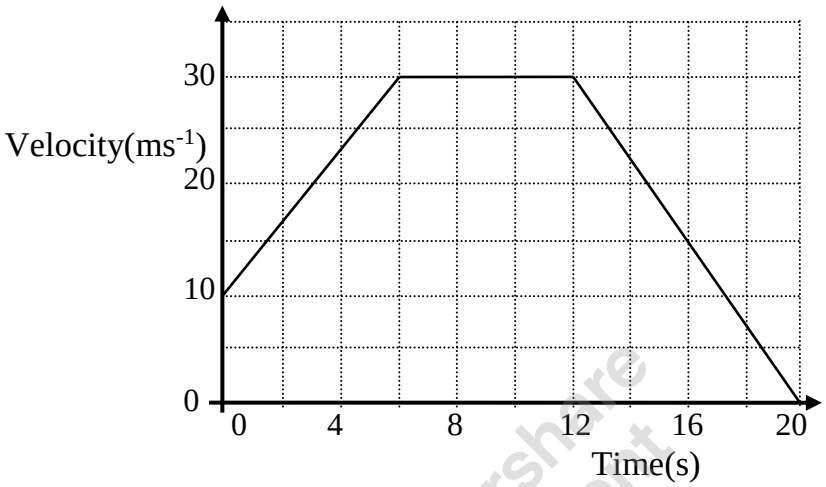

Figure 4

Figure 4 represents a velocity time graph of a body in motion.

(i) Describe the motion of the body (5 marks)

(ii) Calculate the total distance travelled. (4 marks)

(c)

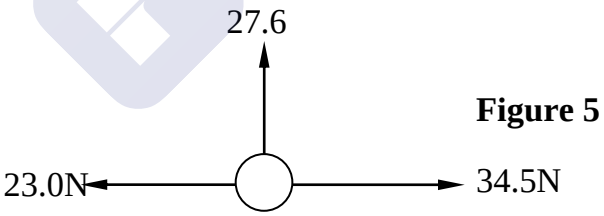

Figure 5

Forces of 23.0N, 27.6N and 34.5N act on a body of mass of 4.0kg, initially at M. Find the magnitude of the acceleration with which the body moves. (4 marks)

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7. (a) (i) State Ohm's law. (1 mark)

(ii) Describe an experiment to verify Ohm's law for a metal wire. (6 marks)

(b) Sketch the current – voltage characteristics for

(i) a filament bulb. (1 mark)

(ii) metal wire. (1 mark)

(c) In the circuit diagram in Figure 6, the battery of e.m.f 12.0V has negligible internal resistance.

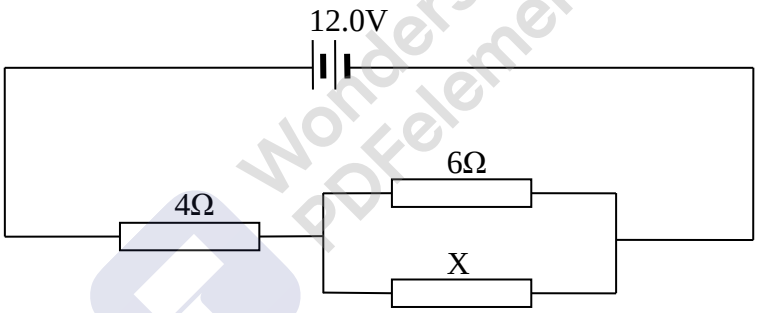

Figure 6

If the p.d across the resistor of 4.0Ω is 8.0V, calculate

(i) The current from the battery. (2 marks)

(ii) The value of the resistor, X. (4 marks)

(iii) The current through resistor X. (1 mark)

8. (a) Define the term **radioactivity**. (1 mark)

(b) (i) A radioactive gas sample has a half-life of 16 hours. What is meant by this statement? (1 mark)

(ii) A radioactive substance decays to an $\frac{1}{8}$ th of its original mass after 24 years. Find its half-life. (3 marks)

(c) (i) State two uses of radioactivity in medicine. (2 marks)

(ii) State two methods of producing electrons from metals. (2 marks)

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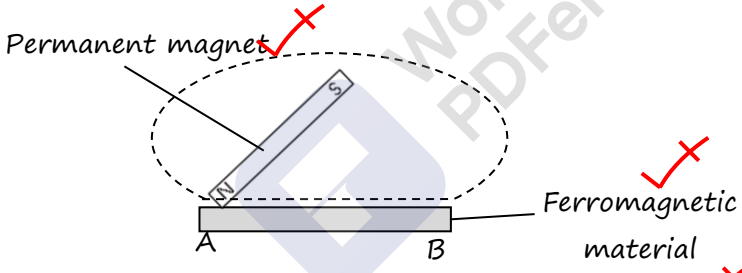
535/2 PHYSICS PAPER 2 GUIDE

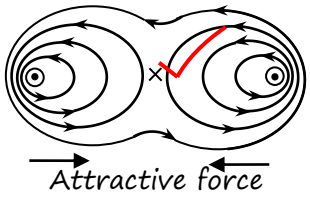
No	SCORING POINTS	REMARKS	M
1(a)(i)	1 joule is the work done when a force of 1N moves its point of application through 1m in the direction of the force. ✓		
(ii)	Power is the rate at which work is done. ✓		
(iii)	Total height of stairs = $\frac{25 \times 20}{100}$ = 5m ✓ ✓		
(b)	Power = $\frac{\text{Work done}}{\text{time taken}} = \frac{Fs}{t} = \frac{50 \times 10 \times 5}{10}$ = 250W ✓	Mark as wrong if define as ratio of MA to VR Can draw diagram of pulleys ...scale pan...	
(c)(i)	Efficiency is the ratio of work output to work input expressed as a percentage. ✓		
(ii)	– The pulley system is set up and a known weight is hung at the lower pulley block. ✓ – A spring balance connected to effort point is pulled at a constant velocity to lift the load and the effort is read and recorded. ✓ – MA and efficiency are calculated. – The experiment is repeated for different values of load. ✓		

	– A graph of efficiency of efficiency against load is plotted showing the relation between efficiency and load.		
(iii)	VR = 5 From $\eta = \frac{MA}{VR} \times 100\%$ $\Rightarrow$ $80 = \frac{MA}{5} \times 100\%$ $MA = 4$ But $MA = \frac{L}{E}$ $4 = \frac{L}{350}$ $L = 1400N$		
(d)	Some of the effort applied is used to overcome resistive forces such as friction and to lift parts of the machine. Useless work is done to overcome these forces.		

No	SCORING POINTS	REMARKS	M
2(a)(i)	Soft magnetic material is one used for making temporary magnets. Example: Soft iron		
(ii)	 – One pole of a permanent magnet is placed in contact with one end of a ferromagnetic material and dragged up to the other end. – The magnet is then lifted up and the process is repeated using the same pole. – This will cause the dipoles in the domains to align themselves making end B **(in this case)** to become a south pole.		
(iii)	A magnetic material consists of dipoles (molecular magnets) in different domains which are oriented in different directions. When the dipoles are aligned to face one direction, then they create a force due to the field that can make it have potential energy to affect ferromagnetic materials.		

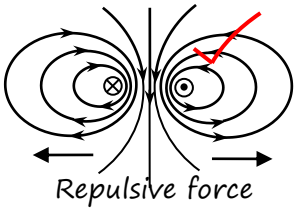
(b)(i) Current carrying conductors have magnetic field around them. When they are carrying current in the same direction, the field interact

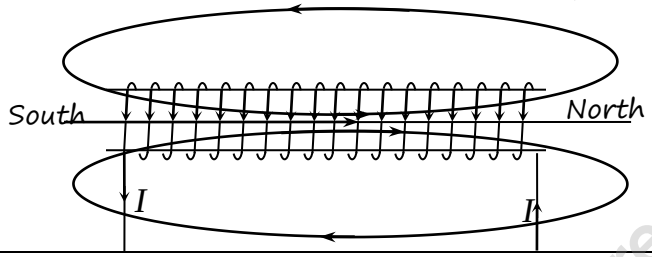
(ii) creating attractive force.



For conductors carrying current in opposite directions, the magnetic fields interact creating repulsive

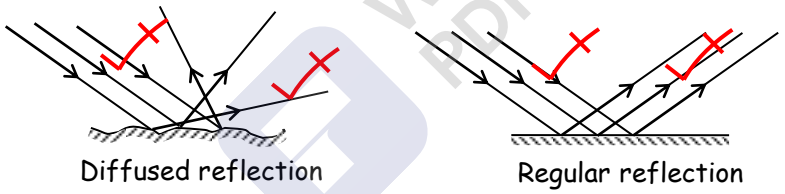
(c) force between them.

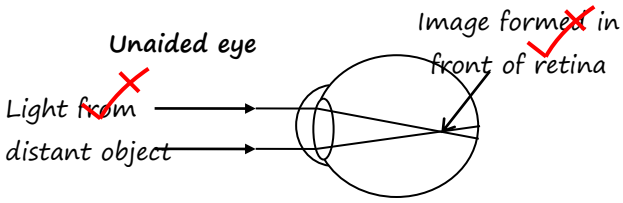




No	SCORING POINTS	REMARKS
3(a)(i)	Wavelength is the distance between two sucessive wave particles in phase.	First two
(ii)	Transverse waves are waves where the vibrations are perpendicular to the direction of propagation while longitudinal waves are waves where vibrations are parallel to the direction of propagation.	
	Longitudinal waves: Sound waves	
(b)(i)	Transverse waves: Electromagnetic waves or any other	
	$3.5\lambda = 105.7$	
	$\lambda = \frac{105.7}{3.5} = 30.2cm$	
	3.5 waves are made in 2.5s	
(c)	1 wave is made in $\frac{2.5}{3.5} = 0.714s$	
	– The distance, s between the experimenters and a tall wall is measured.	
	– One observer claps the pair of wooden clappers to produce sound and listen to the echo.	
	– She/he then claps repeatedly such that the next clap coincides with echo of the previous clap.	
	– A second observer starts a stopwatch to coincide with a clap and will count that clap as zero.	

(d)	– Several claps are counted and the stop watch is stopped when the desired number of counts, n, is achieved. The total time, t is recorded. – The velocity is obtained from the expression $v = \frac{2sn}{t}$	
(ii)	Let the distance to 1st wall be S_1, and to second wall be S_2. $2S_1 = ut$ $2S_1 = \frac{ut}{2} = \frac{320 \times 1.5}{2} = 240$ $2S_2 = ut$ $S_2 = \frac{ut}{2} = \frac{320 \times 2}{2} = 320$ $S = S_1 + S_2$ $S = 240 + 320 = 560m$	Total time $= 1.5 + 2 = 3.5s$ $2S = ut$ $2S = \frac{ut}{2}$ $= \frac{320 \times 3.5}{2}$ $= 560$

No	SCORING POINTS	REMARKS
4(a)(i)	Light is a form of energy that enables us to see.	
(ii)	Angle of incidence is equal to angle of reflection. The incident ray, the normal and the reflected ray, at the point of incident all lie in the same plain.	
(b)(i)	 Diffused reflection Regular reflection Diffused reflection occurs on a rough surface while regular reflection occurs on a smooth surface. In diffused reflection, a parallel beam of light rays is reflected as scattered rays in all directions while in regular reflection, a parallel beam of light rays is reflected as a parallel beam.	
(c)(i)	The light passes without deviation because it strikes the curved surface **normally**.	
(ii)	Critical angle, $c = 90 - 48 = 42°$ Using $n = \frac{1}{\sin c}$ $n = \frac{1}{\sin 42} = 1.49$ or 1.5	

(d)(i)	– The focal length of the eye lens is too short when the ciliary muscles are relaxed. – The eye ball is too long.  	First one	
(ii)	Shortsightedness is corrected by placing a diverging lense in front of the eye. The lens will diverge the ray from a distance object first which is then converged by the eye lens onto the retina.		
No	SCORING POINTS	REMARKS	M

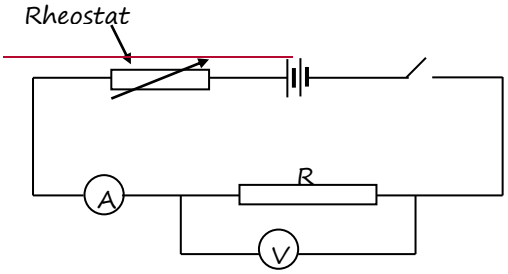
5(a)	A scalar quatity is a quantity having magnitude only while vector quantities are quantities with magnitude and direction. Eamples of scalars: Distance, speed, time, ... Examples of vectors: Displacement, velocity, acceleration, momentum	 First two First two
(b)(i)	– The body started with an initial velocity of 10ms^{-1}. – It accelerated uniformly at 3.33ms^{-2} for 6 seconds to a velocity of 20ms^{-1}. – It then moved with a uniform velocity for 6 seconds. – It then decelerated uniformly at 3.75ms^{-2} for 8 seconds to rest	
(ii)	Total distance is the are under the graph. Dividing shape into two trapezia $S = \frac{(a+b)}{2}h = \frac{(10+30)}{2} \times 6 + \frac{(6+14)}{2} \times 30$ $S = 120 + 300 = \mathbf{420m}$	
(c)	Resultant horizontal force $= 34.5 - 23.0 = 11.5N$ Resultant force $= \sqrt{11.5^2 + 27.6^2} = \mathbf{29.9}$ Using $F = ma$ $29.9 = 4 \times a$ $a = \frac{29.9}{4} = \mathbf{7.475ms^{-2}}$	
6(a)(i)	A saturated vapour is one which is in a dynamic equilibrium with its own liquid or solid while undaturated vapour is one which is in not a dynamic equilibrium with its own liquid or solid while undaturated.	
(ii)	– At high altitude, atmospheric pressure is low. – Liquids (water) will boil at a temperature below their normal boiling points. – Cooking beans in an open sourcpan at such altitude would therefor take too long.	
No	**SCORING POINTS**	**REMARKS**
	– A pressure cooker on the other hand will build pressure inside	

	to a value higher than normal atmospheric pressure. – This making the water boil at a temperature higher than its normal boiling point. – This enables the beans to get cooked in a short time.	
(b)(i)	Specific latent heat of vaporisation is the heat required to change the state of 1kg of a liquid to gaseous at its boiling point	... at constant temperature
(ii)	– The mass, m_c of calorimeter and stirrer are measured. – Water is gently warmed in a beaker until its temperature is about 5°C above the temperature of the surroundings. – The calorimeter is filled to about one third its volume with the warm water and the mass measures again. – The mass of the water m_w is determined. – The initial temperature, T_1 of the warm water and calorimeter is taken. – Small pieces of melting ice which has been carefully dried with blotting paper are added, one at a time to the warm water in the calorimeter, while stirring continuously until the temperature of the water has fallen by about 5°C below the temperature of the surrounding. – The final temperature T_2 of the mixture is measured. – The calorimeter and its content are weighed and the mass m_i of the ice added is determined. – If c_w is the specific heat capacity of water and c_c is specific heat capacity of calorimeter, then latent heat is obtained from $l_f = \frac{(m_w c_w + m_c c_c(T_1 - T_2) - m_i c_w T_2}{m_i}$	
(iii)	Heat loss = Heat gain $m_s l + m_s c_w \theta_1 = m_w c_w \theta_2$ $m_s \times 2260000 + m_s \times 4200 \times 80 = 400 \times 4200 \times 20$ $m_s (2260000 + 336000) = 33600000$ $m_s = \frac{33600000}{2596000} = 12.94g$	

No	SCORING POINTS	REMARKS	M
7(c)(i)	At constant temperature, the current flowing through a metallic conductor is directly proportional to the potential		

difference across it.

(ii) – The circuit is connected with a voltmeter across the resistor, R as shown in the diagram below

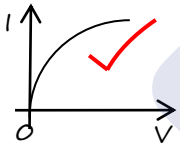


Correct circuit ✓

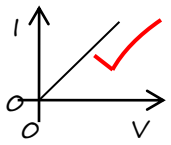
– The switch is closed and the rheostat adjusted to give a suitable reading, I on the ammeter. ✓
– The corresponding voltmeter reading, V is noted. ✓
– The procedure is repeated by adjusting the rheostat to obtain different values of current, I and the corresponding values of p.d, V are recorded. ✓
– When a graph of current, I against potential difference, V is plotted, a straight-line graph through the origin is obtained. ✓
– This shows that current is directly proportional to p.d hence verifying Ohm's law ✓

$I = \frac{}{6} \times 2 = 1.33A$ ✓

(b)



Filament bulb



Metal wire

(c)(i)

From V = IR

(ii) 8 = I x 4 ⇒ I = 2A ✓

P.d across parallel resistors = 12 – 8 = 4V

From V = IR ⇒ 4 = 2 x R ⇒ R = 2Ω ✓

From R = ~~Product~~ Sum ⇒ $\frac{6X}{6+X} = 2$ ✓

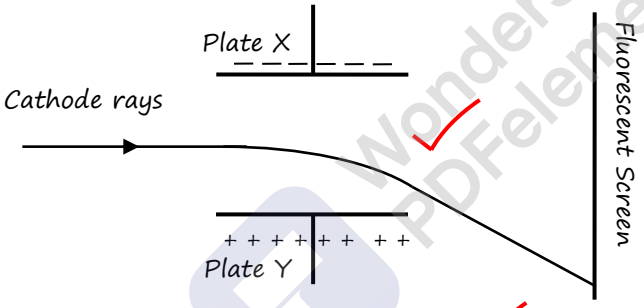
2(6 + X) = 6X

12 + 2X = 6X ⇒ X = 3Ω ✓

From V = IR 4 = I x 3

I = 4/3 = 1.33A ✓

No	SCORING POINTS	REMARKS	M
8(a)	Radioactivity is the spontaneous and continuous disintegration of a heavy unstable nuclei to give out radiations. ✓		

(b)(i)	The statement means that it takes 16 hours for the activity of a sample of the radioactive material to reduce to half their original value.	
(ii)	$1 \rightarrow \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8}$ = 3 half lives $3t_{½}$ = 24 years $t_{½} = \frac{24}{3}$ = 8 years	
(c)(i)	– Treatment of cancer – Sterilisation of medical equipment	Any other correct medical use
(ii)	– Heating the metal (Thermionic emission) – Irradiating the metal surface using electromagnetic radiation (Photoelectric emission)	
(d)	– The beam would be deflected downwards and forms a bright spot on the screen.  – Cathode rays are negatively charged. – They are attracted towards the positive plte, Y and repelled by the negative plate, X. – X – rays carry no charge. – They will therefore move in a straight line. – A bright spot will be formed in the middle of the screen.	Correct path of rays.

END