Catholic High School | O-Level Physics
6091 Nov 2019
Suggested Answers

NOT IN SYLLABUS:	
P1:	-
P2:	-

Paper 1 [40 marks]

1	**A**	11	**B**	21	**A**	31	**A**
2	**B**	12	**B**	22	**D**	32	**A**
3	**A**	13	**D**	23	**B**	33	**B**
4	**D**	14	**C**	24	**D**	34	**B**
5	**A**	15	**B**	25	**D**	35	**D**
6	**C**	16	**B**	26	**C**	36	**D**
7	**D**	17	**C**	27	**B**	37	**B**
8	**A**	18	**D**	28	**A**	38	**A**
9	**C**	19	**A**	29	**C**	39	**D**
10	**C**	20	**B**	30	**D**	40	**D**

***Q. 5:** **A** C corresponds to the average acceleration between $t = 0$ and $t = 30$ s and not to the instantaneous acceleration at the latter time.
(C is incorrect.)

***Q. 7:** **D** It is necessary to convert the values into units which students remembered.
(B and C are incorrect.)

***Q. 10:** **C** A can be obtained wrongly by dividing the weight of the block by the correct area but leaving it in cm^2.
(A is incorrect.)

***Q. 12:** **B** To obtain D, it would have been necessary to add the pressure due to the mercury thread to that of the atmosphere. The pressure of the trapped air, however, must be less than that of the atmosphere.
(D is incorrect.)

***Q. 18:** **D** It is possible to increase the temperature of a gas with increased or constant volume. Likewise, an increase in temperature may occur with increased or constant pressure. An increase in the temperature, however, must be accompanied by an increase in the internal energy irrespective of what else happens.
(A and B are incorrect.)

***Q. 19:** **A** Those who chose A or C realised that the heat capacity of the smaller block is less than that of the larger block, while the specific heat capacity is a constant for copper. For those who chose C, they were unaware that the internal energy of a larger block of copper is greater than that of a smaller block, given the circumstances described in the question.
Those who chose B may have confused heat capacity and specific heat capacity.

Those who chose D must have believed that all of the quantities depended only on the temperature of the block.
(B, C and D are incorrect.)

***Q. 28:** **A** This question was difficult to approach systematically. It was necessary to consider what would happen in each of the four arrangements. The light in the first option behaves in the expected way and this would have been clear to those with a good understanding of total internal reflection.
(B, C and D are incorrect.)

***Q. 29:** **C** Both the pen and the cloth are charged as the pen is rubbed, and the charging is a result of the transfer of electrons. Those who concentrated on the idea of attraction or repulsion and did not consider the need to deduce, first of all, whether the cloth and the pen had similar or opposite charges.
(B is incorrect.)

***Q. 30:** **D** A did not conserve the total quantity of charge on the sphere. The charge has to be conserved as the sphere is positioned on an insulating mat. This option correctly shows the repulsion of negative charge to the right of the sphere but does not show the positive charge that would remain on the left-hand side.
B shows there is no net charge on the sphere.
(A and B are incorrect.)

***Q. 32:** **A** The graph is horizontal between P and Q and it would be easy to assume that some quantity is zero because the gradient is zero – thus C or D where the resistance is stated to be zero. Careful consideration would have shown that the resistance is not given by the gradient of this graph.
(C and D are incorrect.)

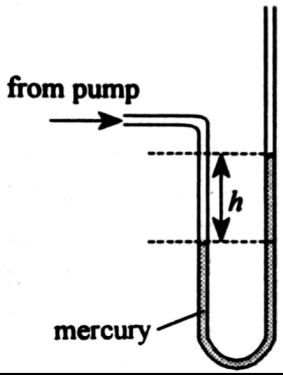
***Q. 33:** **B** C suggests that as the potential difference varies, the resistance of the lamp remains constant; this is not the case for light bulbs.
(C is incorrect.)

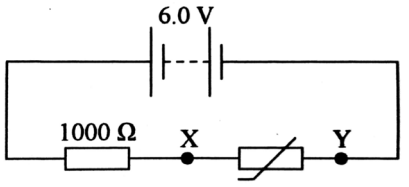
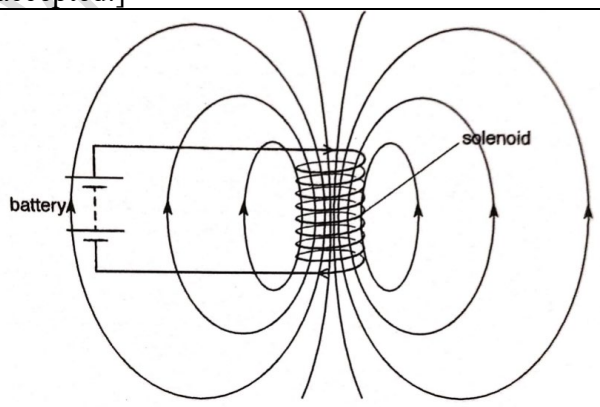
***Q. 34:** **B** This question required one to understand not only what the earth wire does, but how it does so.
(A and D are incorrect.)

***Q. 36:** **D** Those who chose anticlockwise field lines is when one consider the electron flow rather than the conventional current.
(B and C are incorrect.)

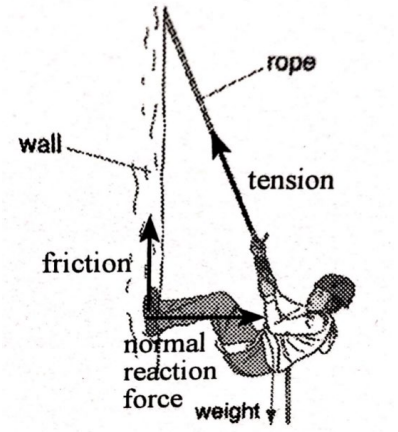
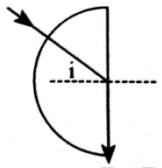
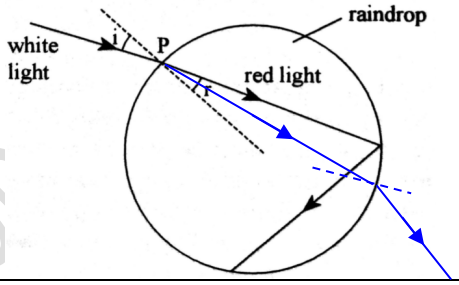
***Q. 38:** **A** Those who thought about the increased frequency did not consider that the rate of cutting flux is also doubled and so the amplitude of the alternating current (a.c.) is also doubled.
(B is incorrect.)

Paper 2 [80 marks]

1	a	1.2 s [Range of answers accepted: any time between 1.2 to 1.8 s.] [Note: The question specifically asked for a time and not for a range.]	1
	b	Velocity always positive: always moving in the forward direction. Acceleration is sometimes negative: velocity is sometimes decreasing.	1 1
	c	Distance travelled is area under the velocity-time graph.	1
	d	Average speed = $\frac{\text{Total distance}}{\text{Total time}} = \frac{100}{9.8}$ = 10.2 m/s (3 s.f.)	1 1
2	a	Point on an object through which its whole weight appears to act (for any orientation of the object).	1
	b	$W = mg = (\frac{250}{1000})(10) = 2.5$ N $M = Fd = (2.5)(0.30)$ = 0.75 Nm (2 s.f.)	1 1 1
	c	Line of action of weight passes through the pivot A, hence the weight does not set up moments about the pivot as the perpendicular distance is zero.	1
3	a	Kinetic energy: Energy possessed by an object due to its motion. Gravitational potential energy: Energy possessed by an object because of its height from the ground.	1 1
	bi	K.E. = $\frac{1}{2}mv^2 = \frac{1}{2}(1.5)(20)^2$ = 300 J (2 s.f.)	1 1
	bii 1	Gain in G.P.E. = K.E. at A - K.E. at B = 300 - 180 = 120 J (0 d.p.)	1
	bii 2	G.P.E. = mgh $h = \frac{120}{mg} = \frac{120}{(1.5)(10)}$ = 8.0 m (2 s.f.)	1 1
4	a	No. of particles per unit volume increases. Frequency of collisions with the walls of the pump increases, force per unit area increases hence pressure increases.	1 1
	b	Molecules of water are closely packed together with negligible amount of empty spaces between them. Molecules of water thus cannot be any closer as they can only slide over one another if a force is applied.	1 1
	ci		1
	cii	Pressure difference, $\Delta P = h\rho g$ $h = \frac{\Delta P}{\rho g} = \frac{1.8 \times 10^5 - 1.0 \times 10^5}{(14000)(10)} = \frac{0.8 \times 10^5}{(14000)(10)}$ = 0.57 m (2 s.f.)	1 1

5	a	$v = \frac{2s}{t} \Rightarrow s = \frac{vt}{2}$ $200 = \frac{v(3.6)}{2} - \frac{v(2.3)}{2}$ $400 = 1.3v$ $v = 307.7 = \underline{310}$ m/s (2 s.f.)	 1 1 1
	bi	Loudness decreases.	1
	bii	Pitch increases. [Note: Since $v = f\lambda$ and v is constant as the medium is unchanged, as λ decreases, f increases.]	1
6	a	current; potential difference	1
	bi		1
	bii 1	$\frac{R_1}{R_2} = \frac{V_1}{V_2} \Rightarrow \frac{R}{1000} = \frac{1.4}{(6 - 1.4)}$ R of thermistor = $\underline{300\ \Omega}$ (2 s.f.)	2 1
	bii 2	P.d. across XY (termistor) decreases. Based on the potential divider concept, e.m.f. is shared between the resistor and thermistor.	1 1
7	a	Wind / Hydroelectric / Geothermal [Note: 'Nuclear' is not renewable energy source.]	1
	bi 1	Energy output (to equal initial cost) = 6000 ÷ 0.26 = 23077 kWh No. of years = 23077 ÷ 1500 = $\underline{15\ \text{years}}$ (2 s.f.)	1 1
	bi 2	Energy output from the solar cells / cost for each kWh of energy remains the same over the 15 years. [Note: 'Cells are 100 percent efficient' is not accepted as the question already stated the energy output from the cells.]	1
	bii 1	15% : 1500 kWh 100% : $\frac{1500}{15} \times 100$ Energy incident = $\underline{10\ 000\ \text{kWh}}$ (2 s.f.)	1
	bii 2	Converted into thermal energy (heat) / was reflected. [Note: 'Energy is converted into other forms' is too vague and is not accepted.]	1
8	a	 [Note: Draw the magnetic field lines - on the inside of the coil, - on both sides of the coil.]	3

	b	Closer together.	1
	ci	A: magnet B: unmagnetised iron C: magnet	1
	cii	A & C: Magnets due to the repulsion. B: Both ends of B are attracted by the same end of A (magnet) and there is no repulsion at all.	1 1
9	ai	Inversely proportional. [Note: 'As the cross sectional area increased, the resistance decreased' is too vague and is not accepted.]	1
	aii	Find the product of cross sectional area and resistance: Row 1: $1.0 \times 10^{-5} \times 1.7 \times 10^{-2} = 1.7 \times 10^{-7}$ Row 2: $2.5 \times 10^{-5} \times 6.8 \times 10^{-3} = 1.7 \times 10^{-7}$ Row 3: $5.0 \times 10^{-5} \times 3.4 \times 10^{-3} = 1.7 \times 10^{-7}$ Row 4: $1.0 \times 10^{-4} \times 1.7 \times 10^{-3} = 1.7 \times 10^{-7}$ Since the product of cross sectional area and resistance is aways the same, they are inversely proportional. [Note: Using one set of data is insufficient and is not accepted.]	1
	bi	$P = I^2R$ & $P = \frac{E}{t}$ $\Rightarrow E = I^2Rt = (30\ 000)^2(R)(12 \times 10^{-3})$ $= 10.8 \times 10^6 \times R = 11 \times 10^6 \times R$	1 1
	bii	From Table 9.1: When cross sectional area = 2.5×10^{-5} m^2, resistance = $6.8 \times 10^{-3}\ \Omega$ From (b)(i): $E = 11 \times 10^6 \times R = 11 \times 10^6 \times 6.8 \times 10^{-3}\ \Omega = 74800$ J Mass of copper, $m = \rho V = (9000)(10 \times 2.5 \times 10^{-5}) = 2.25$ kg $Q = mc\Delta\theta$ hence $\Delta\theta = \frac{Q}{mc} = 74800 / (2.25 \times 390) = 85$ °C (2 s.f.)	1 1 1
	biii	The resistance of iron is more than 5 times that of steel. Given the equation in (b)(i), the amount of thermal energy produced and hence the temperature rise in the iron rod during a lightning strike will be more than 5 times as high as for steel. As the melting point of iron is only slightly higher than that of steel, the temperature rise in the iron rod would likely cause it to melt.	1 1
	c	A fuse prevents the flow of excessive current as it melts when current exceeds the fuse rating. A copper lightning rod directs excess charges safely to the ground.	1
	d	When current flows in the two rods, each will set up a magnetic field. Each rod, being in the influence of the other rod's field, will experience a force. Using Fleming's Left Hand Rule, the direction of the force on each rod is towards the other rod, hence the two rods are attracted to each other.	1 1
10	ai	Infrared radiation	1
	aii	Ultraviolet radiation	1

	b	Total energy absorbed by the water = Efficiency × P × t = 0.45 × 850 × 120 = 45900 J $Q = ml_v$ ➔ $m = \frac{Q}{l_v} = \frac{45900}{(2.3 \times 10^6)} = 0.020$ kg (2 s.f.)	2 1
	c	1. Heating, 2. Ionisation, 3. Damage/Mutation	3
11 E	a	Unbalanced forces will cause an object to accelerate. This means the velocity of the object can change in magnitude and/or direction.	1 1
	b		2
	ci	1. The two forces would have equal magnitude. 2. The two forces would be the same type of force.	1 1
	cii	1. The two force are opposite in direction. 2. The two forces act on two different bodies.	1 1
	d	The other force is the gravitational attraction by the book on the Earth. The magnitude is 10 N and the direction is upwards (towards the book).	1 1
11 Or	a	 1. Vary the angle of incidence i, measured using a protractor. The light ray should be directed to the centre of the straight edge. 2. When the refracted ray exits exactly along the straight edge of the block, the angle i is exactly the critical angle.	1 1 1
	bi & bii 2		1 2
	bii 1	As blue light experiences a higher refractive index than red light, it would slow down more and bend more towards the normal. Hence the angle of refraction at point P for blue light would be smaller than that for red light.	1
	biii	Refractive index, $n = \frac{c}{v}$ ➔ $v = \frac{c}{n} = \frac{3.0 \times 10^8}{1.3} = 2.31 \times 10^8$ m/s $v = f\lambda$ ➔ $\lambda = \frac{v}{f} = \frac{2.31 \times 10^8}{4.3 \times 10^{14}} = 5.4 \times 10^{-7}$m (2 s.f.)	1 2