Catholic High School | O-Level Physics
5059 Nov 2012
Suggested Answers

NOT IN SYLLABUS:	
P1:	-
P2:	-

Paper 1 [40 marks]

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

***Q. 6:** **(B)** The weight of the rocket must not be neglected. In F = ma, F is the resultant force. Thus F is not the thrust alone but F = thrust - weight.
(D is incorrect.)

***Q. 13:** **(D)** There is kinetic energy at the top of the hill.
(A is incorrect.)

***Q. 22:** **(D)** The image cannot be formed at the mirror surface unless the object is at the mirror surface.
(B is incorrect.)

***Q. 23:** **(B)** There is partial reflection at the boundary.
(A and D are incorrect.)

***Q. 24:** **(C)** The ray from O enters the lens normal to the surface PQ because O is the centre of the circle. Bending of the ray cannot occur at surface PQ, so D cannot be correct.
(D is incorrect.)

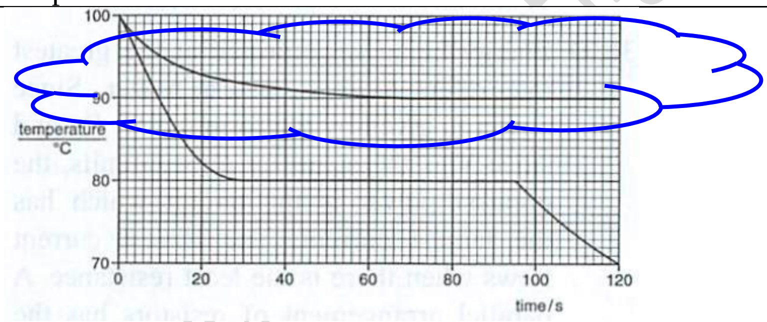
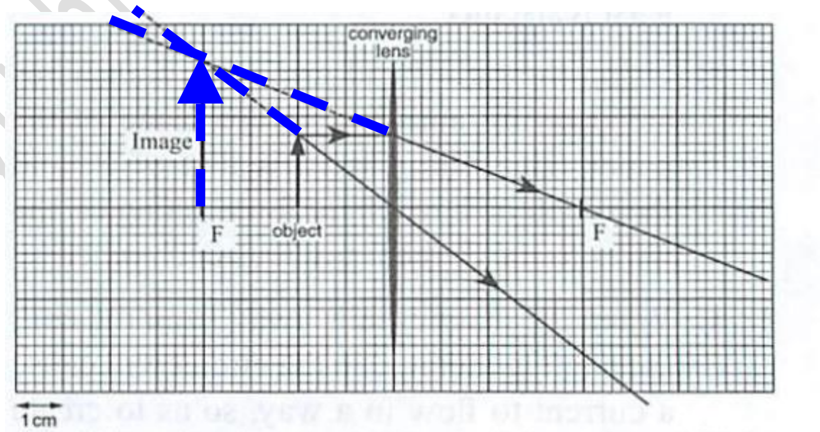
***Q. 34:** **(A)** The flat part of the curve in B suggests that the resistance has become constant, which is inconsistent with as it is stated that 'the resistance of the thermistor decreases as its temperature increases' in the question.
(B is incorrect.)

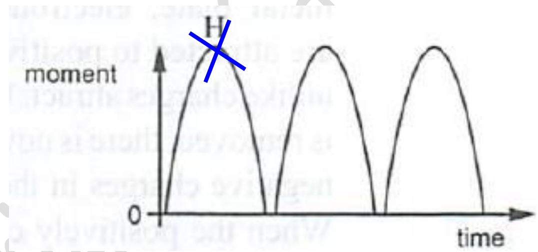
***Q. 40:** **(A)** The question asked for the current in the **primary coil**.
(C is incorrect.)

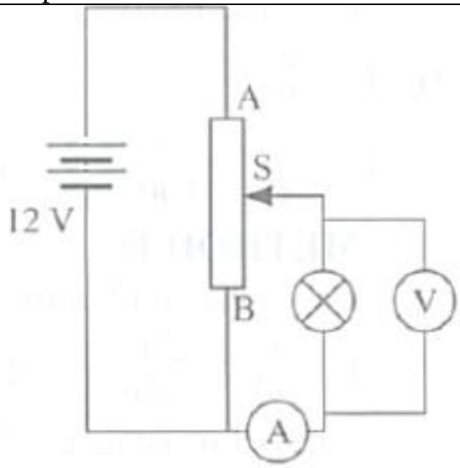
Paper 2 [80 marks]

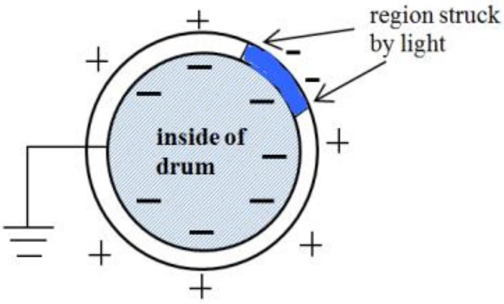
1	a	$a = \frac{v - u}{t} = \frac{25-20}{10-6}$ $= \frac{5}{4} = \underline{1.25 \text{ m s}^{-2}}$ (3 s.f.)	2 1
	b	The shaded area under the speed-time graph represents the distance travelled by the car, when it had a constant deceleration between 10 – 16 s.	1 1
	ci	The average speed of the car is the total distance travelled divided by the total time taken. [<u>Note</u>: Not 'total distance per unit time.'!]	1
*	cii	The speed of the car between 6 – 16 s is always higher than 20 m s^{-1}.	1

		Between 0 – 20 s, the speed of the car is 20 m s^{-1} for half the journey. [Or: The time between 6 – 16 s is half the time taken during the journey. However the distance travelled is more than half.] [Or (longer method): Average speed between 6 – 16 s $= \frac{\text{Total distance}}{\text{Total time}} = \frac{\frac{1}{2}(4)(20+25)+\frac{1}{2}(6)(25+20)}{10}$ $= \frac{225}{10} = 22.5 = 23$ m s^{-1} (2 s.f.) Average speed between 0 – 20 s $= \frac{\text{Total distance}}{\text{Total time}} = \frac{225+(10)(20)}{20} = \frac{425}{20}$ $= 21.25 = 21$ m s^{-1} (2 s.f.) < 23 m s^{-1}] [Note: Need to show comparison between 6 – 16 s and 0 – 20 s.]	
2	a	Chemical potential energy of swimmer to kinetic energy of swimmer.	1
	b	K.E. = ½mv^2 = ½(60)$(0.80)^2$ = <u>19.2 J</u> (3 s.f.)	1 1
*	ci	The swimmer does work on the water by exerting a force backwards on the water, pushing the water backwards. [Note: Need to demonstrate 'work done', by showing the idea of 'a force applied' and 'a distance moved' → work done by swimmer or on the water.]	1
	cii	The work done by the swimmer on the water eventually becomes the thermal energy of the water. [Note: Not 'kinetic energy of water'.]	1
3	a	EM waves are able to travel through a vacuum. [OR: EM waves travel at the speed of 3.0 × 10^8 m s^{-1} in a vacuum.]	1
	bi	Visible light and infra-red radiation.	1
	bii	1. As there is less current, there is less infra-red radiation emitted (ie filament is less hot). 2. The radiation emitted has a lower frequency/ higher wavelength. [Or: Only the visible red part of the EM spectrum is emitted.]	1 1
	ci	Metal is a good conductor of heat and hence heat is conducted from the metal filament to the metal support through transfer of kinetic energy during collisions between filament molecules and support molecules.	1
	cii	When the **nitrogen** gas is heated by the metal filament, it ***<u>expands</u>***, becomes less dense and rises. The cooler, denser nitrogen gas sinks to replace the warmer gas, forming convection currents.	1 1
4	a	$\rho = \frac{m}{V}$ Mass of (cold or hot) air = ρV = (0.0012)(30) = 0.036 g Density of cold air = $\frac{m}{V} = \frac{0.036}{20}$ = <u>0.00180 g cm^{-3}</u> (3 s.f.)	1 1
	bi	The molecules in the cylinder are in constant, random motion and ***collide*** with the walls of the cylinder, thus exerting a force per unit area.	1
	bii	The molecules of the cold air are moving slower at a lower temperature and	1

		collide ***less frequently*** and ***less forcefully*** with the ***walls of the cylinder and piston combined.*** The molecules exert a smaller force but also on ***a smaller area of the walls of the cylinders and piston combined*** (as the total volume has decreased), to create the same pressure. [Or (focusing on the force exerted on the piston only): The molecules of the cold air are moving slower at a lower temperature and hence, the force of collisions will decrease on the fixed area of the piston. But the frequency of collisions increases on the fixed area of the piston, to compensate for the lower force of collisions when the temperature decreases, to create the same pressure.]	1
	c	As the cylinder is cooled and the pressure of the air inside decreases, the larger atmospheric pressure outside pushes the piston to move inwards.	1
5	a	95 s	1
*	b	The liquid is at a higher temperature (70 to 100 °C) compared to the surrounding air (20 °C) throughout the experiment.	1
	c	1. Thermal energy is lost to the laboratory as latent heat of fusion. 2. Intermolecular bonds are being formed. 3. There is a change in state from liquid to solid/ the kinetic energy of the particles remains constant.	2 Any 2
	d	 [<u>Note</u>: Beaker of water is kept at a temperature of 90°C.]	1
6	a	 [<u>NOTE</u>: 1. Image to be formed at 4.0 cm, ± 1 small square. 2. Dotted lines for virtual image.]	3
	b	The image is formed by dotted lines, which are not light rays but which appear to come from the object.	1

	c	1. The image becomes less enlarged. 2. The image moves closer to the lens.	2
7	a	Total resistance = $(\frac{1}{R_1}+\frac{1}{R_2})^{-1}$ = $(\frac{1}{30+30}+\frac{1}{10+30})^{-1}$ = $(\frac{1}{60}+\frac{1}{40})^{-1}$ = <u>24.0 Ω</u> (3 s.f.)	1 1
	b	V = IR ⇒ I = $\frac{V}{R}$ = $\frac{6}{24.0}$ = <u>0.250 A</u> (3 s.f.)	1 1
	ci	The e.m.f. of (or p.d. across) the battery is shared equally between the two resistors in series as they have the same resistance.	1
	cii	Potential difference between C and D = $\frac{R_1}{R_1+R_2}\times 6.0 = \frac{30}{30+10}\times 6.0$ = <u>4.50 V</u> (3 s.f.)	1
*	ciii	Potential difference between A & C = Potential at C - Potential at A = 4.50 - 3.0 = <u>1.50 V</u> [<u>NOTE</u>: p.d. = higher potential - lower potential]	1
8	ai	When the switch is closed, the current in the coil generates a magnetic field which interacts with the magnetic field of the magnet to produce an unbalanced resultant magnetic field. This causes an upward force to be produced on the side of the coil near the North pole, and a downwards force on the side of the coil near the South pole (using Fleming's Left Hand Rule).	1 1
	aii	When the coil passes the vertical position, the direction of the current in the coil reverses due to the split ring commutator. This causes the force on the side of the coil near the North pole to be in the same upwards direction (and for the force on the side of the coil near the South pole to be in the same downwards direction), and the coil rotates clockwise.	1 1
	bi		1
	bii	1. The amplitude (maximum moment) on Fig. 8.2 increases. 2. The period on Fig. 8.2 decreases. [<u>OR</u>: The frequency on Fig. 8.2 increases.]	1 1
9	ai	Similarity: The speeds of water waves in both deep and shallow water increase with wavelengths (up to wavelengths of 400 m). [<u>OR</u>: The speeds of water waves in both deep and shallow water are similar (up to wavelengths of 40 m).]	1
	aii	Difference: The speed of water waves increases constantly with wavelength in deep water, but the speed of water waves stop increasing and become constant from wavelengths of 400 m onwards.	1
	bi	The first wave to reach the ship is the wave with the fastest speed, i.e. 30.6 m s^{-1}. Constant speed, v = $\frac{s}{t}$ Time taken, t = $\frac{s}{v}$ = $\frac{2000\,000}{30.6}$ = 65 400 = <u>65 400 s</u> (3 s.f.)	1 1

	bii	$v = f\lambda \Rightarrow f = \frac{v}{\lambda} = \frac{30.6}{600}$ $= \underline{0.0510\text{ Hz}}$ (3 s.f.)	1 1
*	biii	Time taken for wave to arrive (4 hrs after first wave) $= (6.54 \times 10^4) + (4)(60)(60) = 79\,800$ s Speed of wave, $v = \frac{s}{t} = \frac{2000\,000}{79\,800} = 25.1\text{ m s}^{-1}$ (3 s.f.) From Fig 9.1, wavelength of wave is approximately <u>400 m</u> (nearest 100 m), with a speed of 25.0 m s^{-1}.	 1 1
	biv	1. The ship will oscillate up and down. 2. The ship will oscillate up and down, at a higher frequency/ with a lower period.	1 1
10	ai		3
	aii	1. He increases the potential difference across the lamp by moving S from point B to A. 2. As the current in the lamp increases, the temperature of the lamp increases. Thus the resistance of the lamp increases. [<u>Note</u>: 'The lamp is non-ohmic' is insufficient and does not gain any mark.]	1 1 1
	bi	$I = \frac{Q}{t} \Rightarrow Q = It = (0.20)(4.0 \times 60)$ $= \underline{48.0\text{ C}}$ (3 s.f.)	1 1
	bii	$V = \frac{W}{Q} = \frac{390}{48}$ $= \underline{8.13\text{ V}}$ (3 s.f.)	1 1
11 E	a	Wire A is connected to the switch and is the live wire. When the lamp is switched off, the lamp is not 'live' and it is safe to touch/ safe to change the bulb. [<u>Or</u>: The lamp is not at high potential.]	1 1
	bi	The fuse will melt and break the circuit when the current is too high for the lamp to operate safely. This will prevent the overheating of the lamp/ wires.	2 1
	bii	When wire A touches the metal case, the current will flow to earth and melt the fuse, creating an open circuit so that no current will flow subsequently.	1
	ci	$P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{p} = \frac{230^2}{100}$ $= \underline{529\ \Omega}$ (3 s.f.)	1 1

	cii	$R = \frac{V^2}{p} = \frac{230^2}{60} = 882\ \Omega$ (2 or 3 s.f.) Ratio of resistance of first lamp to second lamp $= \frac{230^2}{100} : \frac{230^2}{60} = \frac{1}{100} : \frac{1}{60}$ = 60 : 100 = <u>3 : 5</u> or <u>0.60</u>	1
	d	1. The lamp has a *case* which is made of plastic (non-metal). 2. No current can flow in the plastic *case*. 3. The plastic *case* cannot be live.	1 Any 1
11 O	ai	1. The positively charged rod is brought near the metal plate. 2. The lead connected to earth is brought into contact with the metal plate. 3. The lead connected to earth is then disconnected from the metal plate. 4. The positively charged rod is then removed.	1 1 1 1
	aii	When the positively charged rod is brought near the metal plate, the electrons on the metal plate are attracted to the side near the rod, leaving positive charges on the other side of the metal plate. When the lead connection connected to earth is brought into contact with the metal plate, electrons from the earth flow up to neutralize the positive charges on the other side of the metal plate. When the lead connected to earth is then disconnected from the metal plate, the excess electrons are redistributed throughout the metal plate.	1 1 1
	bi	When light strikes the regions on the drum, the positive charges in these regions are neutralised. [<u>Or</u>: The charges in these regions become negative by induction (due to the nearby positive charges), as electrons flow up from earth.] → 	1
	bii	The positively charged toner particles are repelled by the positively charged regions of the drum.	1
	bii	1. • If conducting region is neutral from (bi) → The positively charged toner particles induces a separation of charges on the conducting regions, and are then attracted to the negatively charged side of the conducting region. <u>Or</u>: • If conducting region is negative, from (bi) → The conducting regions are negatively charged by induction and thus attract the positively charged toner particles.	1