Catholic High School | O-Level Physics
5059 Nov 2017
Suggested Answers

NOT IN SYLLABUS:	
P1:	-
P2:	-

Paper 1 [40 marks]

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

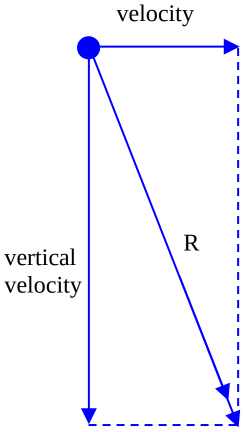
***Q. 15:** **A** The force per collision is greater (due to the gas molecules having greater speed). Since pressure of the gas remains the same, then the rate of collisions must have decreased. If the rate of collisions increased or stayed constant, the pressure would have increased given that the force per collision is greater.
(Both B and C are incorrect.)

***Q. 25:** **D** Statement 1 was incorrect. The speed of light is 3.0×10^8 m/s only in vacuum.
(B is incorrect.)

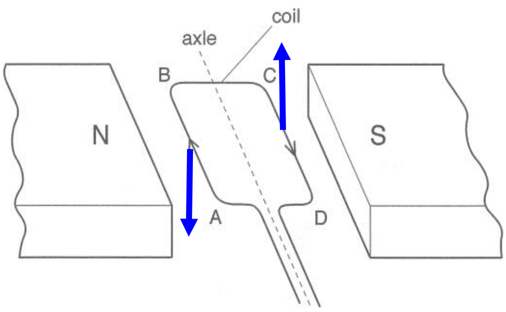
***Q. 35:** **C** *If the question does not indicate otherwise*, assume the resistance of a thermistor will increase with a decrease in temperature (i.e. when it is cold). The LDR would have low resistance when the surroundings are bright.
(D is incorrect.)

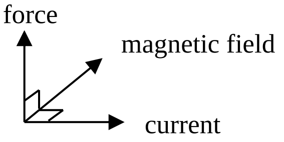
***Q. 40:** **C** A decrease in the resistance of the cables as the cause of the more efficient transmission of electrical energy at high-voltage is a common misunderstanding.
(B is incorrect.)

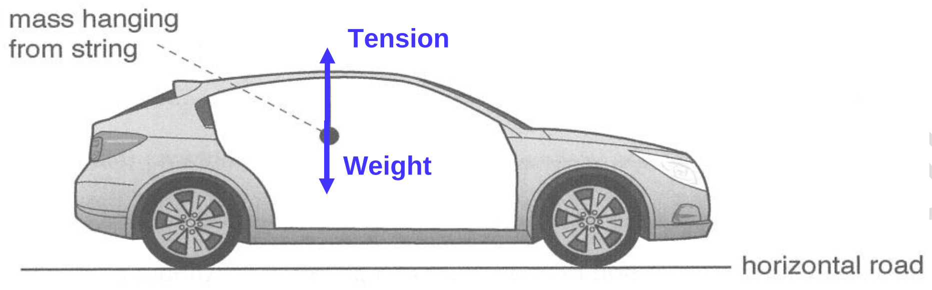
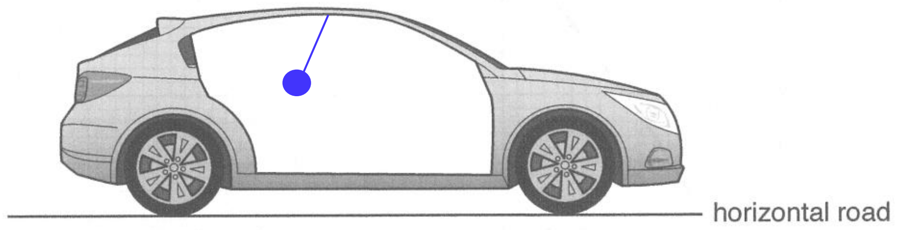
Paper 2 [80 marks]

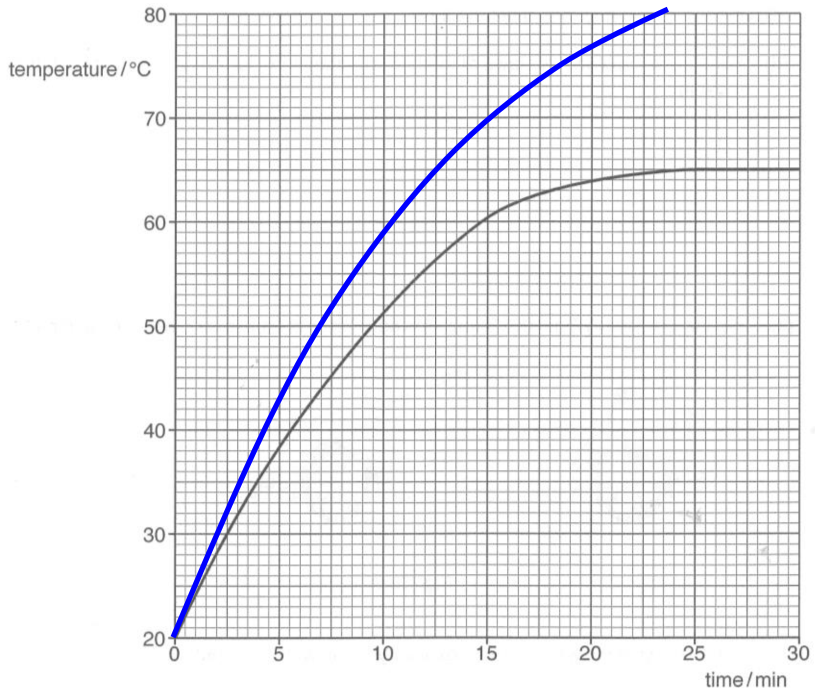
<table>
<tr><td>1</td><td>a</td><td><table><tr><td>prefix</td><td>symbol</td><td>value</td></tr><tr><td>milli</td><td>m</td><td>10^{-3}</td></tr><tr><td>mega</td><td>M</td><td>$\mathbf{10^{6}}$</td></tr><tr><td>kilo</td><td>k</td><td>10^{3}</td></tr><tr><td>nano</td><td>n</td><td>10^{-9}</td></tr></table></td><td>3</td></tr>
<tr><td></td><td>b</td><td>acceleration <u>density</u> <u>speed</u> <u>time</u> <u>volume</u> weight</td><td>1</td></tr>
<tr><td></td><td>c</td><td>

Length of R = 5.4 cm
Magnitude of R = 5.4 × 2.0 = <u>10.8 m/s</u> (3 s.f.)</td><td>1
1
1</td></tr>
<tr><td>2</td><td>ai</td><td>When an object is in equilibrium,
the sum of clockwise moments about any point is equal to sum of anti-clockwise moments about the same point.</td><td>1
1</td></tr>
<tr><td></td><td>aii</td><td>Taking moments about the wheels,
Sum of clockwise moments = Sum of anticlockwise moments
$F_1 \times d_1 = F_2 \times d_2$
12 × (21 + 4.0) = W × 4.0
W = <u>75.0 N</u> (3 s.f.)</td><td>1
1</td></tr>
<tr><td></td><td>b</td><td>With the heavier contents near the base, the centre of gravity of the suitcase is lower.
The line of action of the weight is more likely to fall within the base area when the suitcase is tilted.</td><td>1
1</td></tr>
<tr><td></td><td>c</td><td>The normal reaction (or contact) force acting on the suitcase by the ground.
This force acts upwards (on the wheels of the suitcase), and is equal to the normal reaction (or contact) force acting on the ground by the suitcase.</td><td>1
1</td></tr>
<tr><td>3</td><td>ai</td><td>The gas supply exerts a pressure on the water surface on the left that is greater than atmospheric pressure on the right.]</td><td>1</td></tr>
<tr><td></td><td>aii</td><td>The gas pressure on the left is equal to the total pressure due to 9 cm of water column and atmospheric pressure.</td><td>1</td></tr>
<tr><td></td><td>b</td><td>Pressure difference = $h\rho g$ = [(17 - 8)/100] × 1000 × 10
= <u>900 Pa</u> (3 s.f.)</td><td>1
1</td></tr>
<tr><td></td><td>c</td><td>Use a liquid of higher density (e.g. mercury).</td><td>1</td></tr>
</table>

4	a	Work done by a force is the product of the force and the distance moved in the direction of the force.	1
	b	Work done = Gain in GPE = $mg\Delta h$ = 3.9 × 10 × (0.95 × 2) = <u>74.1 J</u> (3 s.f.)	1 1
	c	Power = $\frac{\text{Work Done}}{\text{Time}} = \frac{74.1}{30 \times 60}$ = <u>0.0412 W</u> (3 s.f.) [Note: Time taken for the minute hand to move from pointing vertically downwards to upwards is 30 minutes.]	1 1
5	a	Amplitude = <u>1.50 cm</u> (2 d.p.) [Note: Each wide division is read to a precision of ½ division of 0.25 cm.]	1
	bi	Frequency is the number of complete oscillations per unit time.	1
	bii	Period of the wave = 0.8 s (1 d.p.) [Note: Each wide division is read to a precision of ½ division of 0.1 s.] Frequency, $f = \frac{1}{T} = \frac{1}{0.8}$ = <u>1.25 Hz</u> (3 s.f.)	1
	ci *	Shortest distance between points A and B = ¼λ $v = f\lambda$ = (1.25)(4 × 38) = (1.25)(152) = 190 ≈ 200 cm/s (shown) [Note: When point A is at the crest, point B is at the equilibrium position. Hence shortest distance between points A and B = ¼λ.]	1 1
	cii *	The possible distance between points A and B can be (n+ ¼)λ, where n is an integer. Hence, there are many possible values for λ. [Note: 'Loss of energy to the surroundings air' is not accepted as the amplitude of the graphs is constant.]	1
6	a	• Switch on the live wire • Circuit breaker • Earth wire connected to the metal casing • Double insulation of cables	2 Any two
	bi	Current , $I = \frac{P}{V} = \frac{800}{230}$ = <u>3.48 A</u> (3 s.f.)	1 1
	bii	The 5 A fuse should be used. The 3 A fuse will melt each time the toaster is switched on. The 13 A fuse may not melt when a high current flows (e.g. due to an electrical fault), and can cause overheating of the cables.	1 1
7	ai		1
	aii	By using Fleming's Left Hand Rule. The thumb will point in the direction of the forces on AB (donwards) and CD (upwards), when the first/index finger points in the direction of the magnetic field (left to right) and the middle finger points in the direction of the current (A to B and C to D respectively), and all three directions are perpendicular to each other.	1 1

		[Note: A simple diagram to illustrate this can be drawn by the side.]  	
	b	When AB reaches the lowest point (the coil is in the <u>vertical</u> position), the current in the <u>coil</u> is reversed. This ensures that the force acting on AB near the same magnet is always in the same direction (e.g. the force acting on AB near the north pole is always downwards).	1 1
8	a	Iron is a magnetic material. The left side of the iron ring becomes an induced south pole and is attracted to the north pole of the bar magnet as unlike poles attract.	1 1
	b	Aluminium is a non-magnetic material.	1
	ci	When the magnet moves close to the aluminium ring, the ring experiences a change in magnetic flux linkage with the magnet. By Faraday's Law of Electromagnetic Induction, there will be an induced emf and hence an induced current as the circuit is closed.	1 1
	cii	By Lenz' Law, the induced current in the ring will flow in such a way that its magnetic effect will oppose the change causing it. As the N-pole of the magnet is being brought closer to the ring, the current in the ring will flow to set up a N-pole on the left side of the ring to repel the approaching magnet as like poles repel.	1 1
9	a	Flint glass and cinnamon oil. [Note: They both have a refractive index of 1.601.]	1
	bi	$c = 3.0 \times 10^8$ m/s	1
	bii	Crown glass. [Note: Crown glass has the highest refractive index. The larger the refractive index of a medium, the slower light travels in the medium.]	1
	biii	$n = \frac{c}{v}$ $v = \frac{3.0 \times 10^8}{1.333}$ = <u>2.25×10^8 m/s</u> (3 s.f.)	 1 1
	ci	The *angle of incidence* of the light ray on the piece of glass is greater than the *critical angle* of the silicone oil. Hence, total internal reflection occurs in silicone oil which has a larger *refractive index* than the piece of glass. [Note: Need to use ideas about 'angle of incidence, critical angle and refractive index.]	1 2
	cii	Car headlight glass (refractive index = 1.478). From Fig. 9.2, total internal reflection occurred, which means that the refractive index of the glass must be less than that of silicone oil (1.520). From Fig. 9.3, the light ray bends towards the normal when travelling from glycerol into the glass, which means the refractive index of the glass is greater than that of glycerol (1.466).	1 1
10	ai	Between A and B: The velocity is increasing at a constant rate. (OR: The acceleration is constant.)	1

	aii	Between B and C: The velocity is increasing at a decreasing rate. (OR: The acceleration is decreasing.)	1
	aiii	Between E and F: The *speed* is increasing at a constant rate (OR: the *velocity* is decreasing at a constant rate OR: the *acceleration* is constant) AND it is moving in the backwards direction. (OR: The acceleration is constant AND it is moving backwards.)	1
	bi		2
	bii	From Fig. 10.1, at t = 30.0 s, the mass (and the car) is moving at constant speed of 8 m s^{-1} (or zero acceleration). Using Newton's First Law of Motion (or: Newton's Second Law of Motion), there is no horizontal resultant force acting on the car and the mass. [Note: Apply Newton's laws to the mass and not just to the car alone.]	1 1
	biii		1
	biv *	From Fig. 10.1, at t = 5.0 s, the mass (and the car) is accelerating. Using Newton's Second Law of Motion, there is a resultant force acting on the mass. Due to inertia, the mass will be reluctant to move forward and thus will swing backwards. [Note: • Apply Newton's laws to the mass and not just to the car alone.] • The resultant of the tension and the weight would be in the forward direction.]	1 1
11 E	a	Molecules in a liquid are in constant, random motion. They are not fixed in position and hence can slide and move amongst each other.	1 1
	bi	Initial rate of rise in temperature = $\frac{30-20}{2.5}$ = <u>4.00 °C/min</u> (3 s.f.)	1
	bii	In 1 minute, the temperature rise is 4.0°C: Q supplied per minute = $mc\Delta\theta$ = (50)(4.2)(4.00) = <u>840 g</u> (3 s.f.)	 1 1
	biii *	As the temperature of the water increased, the rate of heat loss to the surrounding air increased (as the temperature difference between the water and the surrounding air increased). After 25 minutes, the temperature of the water stops rising as the rate of heat loss to the surrounding air is equal to the rate of heat being supplied.	1 1

		[Note: • It is wrong to state that the water is boiling as the temperature was at 65°C which is less than water's boiling point of 100°C. • Note the hint in the earlier part of the question: '… without a lid.']	
	biv 1		2
	biv 2	With a lid on the cup, the rate of heat loss by convection and evaporation will be reduced. The rate of heating of the water would thus be greater (steeper graph), and the water will be able to heat up past 65°C.	1
11 O	a	Ohm's Law states that the current flowing through a metallic conductor is directly proportional to the potential difference across its ends, if physical conditions (e.g. temperature) remain constant.	2
	bi	$I = \frac{V}{R} = \frac{230}{240}$ = <u>0.958 A</u> (3 s.f.)	1 1
	bii	With H_2 switched on, the total resistance = ¼ × 240 = 60 Ω $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{60} = \frac{1}{240} + \frac{1}{R_2}$ $\frac{1}{R_2} = \frac{1}{60} - \frac{1}{240} = \frac{1}{80}$ R_2 = <u>80.0 Ω</u> (3 s.f.)	1 1 1
	ci 1.	As the two resistors are in series, the current passing through them is the same. Using $P = I^2R$, the larger resistor R_1 would have the larger power output.	1
	ci 2.	As the two resistors are in parallel, the potential difference across them is the same. Using $P = \frac{V^2}{R}$, the larger resistor R_1 would have the smaller power output.	1
	cii	effect on I_A | effect on I_B **decreases** | **remains the same**	1