

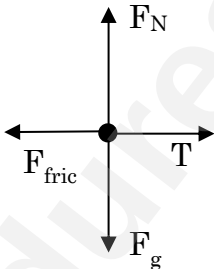
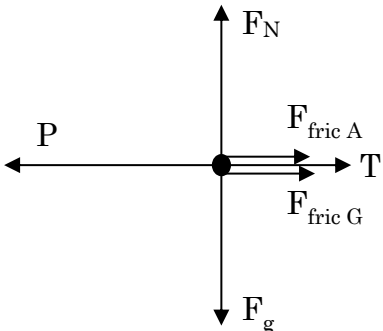


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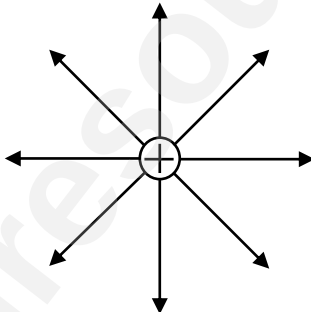
Question 1 MCQ's				
1.1	B✓✓	1.6	C	
1.2	D	1.7	A	
1.3	D	1.8	C	
1.4	A	1.9	C	
1.5	C	1.10	B	
				[10x2=20]
Question 2				
2.1	2.1.1	Take up as '+': $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $-48.77 \checkmark = (v_i \times 5) + (\frac{1}{2} \times -9.8 \times 5^2) \checkmark \checkmark$ $v_i = \frac{122.5 - 48.77}{5} = 14.75 \text{ m.s}^{-1} \checkmark$ No alternative method!		(5)
	2.1.2	Take up as '+': $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $0^2 \checkmark = (14.75^2) + (2 \times -9.8 \Delta x) \checkmark$ $\Delta x = \frac{-(14.75)^2}{-2 \times 9.8} = 11.1 \text{ m} \checkmark$		(4)
	2.1.3	Take up as '+': (Up and down) $v_f^2 = v_i^2 + 2a\Delta x \checkmark$ $v_f^2 = (14.75)^2 + (2 \times -9.8 \times -19.5) \checkmark \checkmark$ $v_f = \sqrt{599.76} = 24.5 \text{ m.s}^{-1} \checkmark$ OR Take down as '+': (Down only – from max ht. above starting point) $v_f^2 = v_i^2 + 2a\Delta x$ $v_f^2 = 0^2 + (2 \times 9.8 \times (11.1 + 19.5))$ $v_f = \sqrt{599.76} = 24.49 \text{ m.s}^{-1}$		(4) [13]

2.2	2.2.1	5 m.s ⁻¹ ✓ Downloaded from eduresourceza.com	(1)
	2.2.2	$v_f = v_i + a\Delta t$ $0 \checkmark = 5 - (9.8\Delta t) \checkmark$ $\Delta t = \frac{-5}{-9.8} = \mathbf{0.51\ s} \checkmark$	(3)
	2.2.3	Time taken for the ball to reach the maximum height✓(above the player, before falling back down.)	(1)
	2.2.4	Up and down: Take up as '+': $v_f = v_i + a\Delta t$ $v_f = 5 \checkmark + (-9.8 \times 1.25) \checkmark = -7.25\ \text{m.s}^{-1} \therefore \mathbf{7.25\ m.s}^{-1} \checkmark$ OR Down only: From t_1 to 1.25 s: Take down as '+': $\Delta t = 1.25 - 0.51 = 0.74\ \text{s}$ $v_f = v_i + a\Delta t = 0 + (9.8 \times 0.74) = 7.25\ \text{m.s}^{-1}$	(3)
	2.2.5	The ball bounced ✓(for the 1 st time), or The ball struck the ground.	(1)
	2.2.6	Area under the v-t graph (=Δx) ✓ = sum of area of two triangles = ($\frac{1}{2} \times 0.51 \times 5$) + ($\frac{1}{2} \times (1.25 - 0.51) \times 7.25$) ✓✓ = -1.41 m i.e. the ball struck the ground 1.41 m below its starting point $\therefore$ ball was released/tossed upwards from a height of 1.41 m✓ (coe from 2.2.2 and 2.2.4)	(4) [13]
2.3	2.3.1	<i>Free fall</i> – an object that falls with gravitational acceleration✓, or falls only under the influence of gravity	(1)
	2.3.2	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $274.3 \checkmark = (0 \times \Delta t) + (\frac{1}{2} \times 9.8 \times \Delta t^2) \checkmark$ $\Delta t = \sqrt{\frac{274.5}{4.9}} = \mathbf{7.48\ s} \checkmark$	(4)
	2.3.3	Time taken for Superman to save student (Δt) = 7.48 – 5 = 2.48 s $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \checkmark$ $274.5 \checkmark = (v_i \times 2.48) + (\frac{1}{2} \times 9.8 \times 2.48^2) \checkmark$	(4)

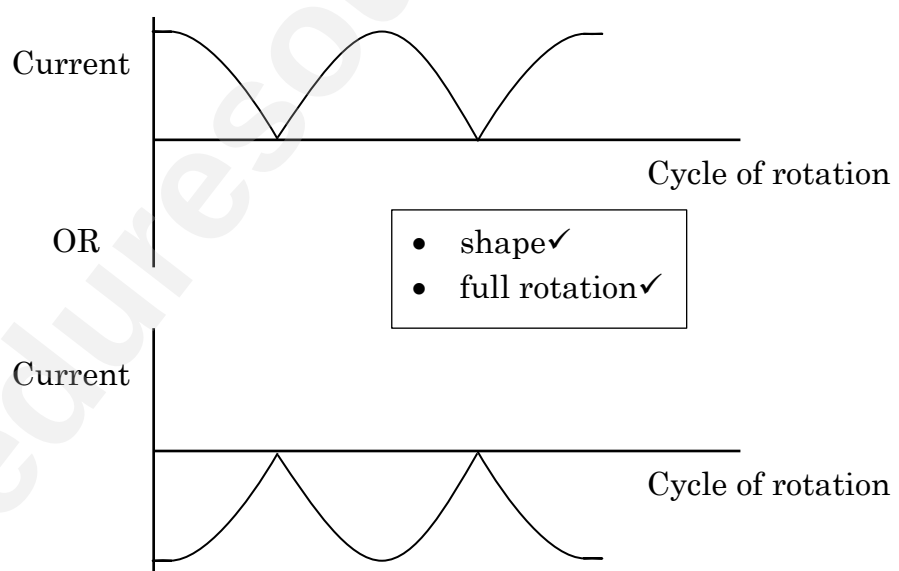
		$v_i = \frac{274.5 - 38.14}{2.48} = 98.45 \text{ m.s}^{-1}$	[9]
2.4	<u>Distance apple 1 falls to the ground:</u> From the graph (solid line) $\Delta t = 2 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ $\Delta y = (0 \times 2) + (\frac{1}{2} \times 9.8 \times 2^2) \checkmark = 19.6 \text{ m} \checkmark$ <u>Initial velocity of apple 2:</u> $\Delta t = 2.25 - 1.0 = 1.25 \text{ s}$ $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ($\checkmark$ for both formulas) $19.6 \checkmark = (v_i \times 1.25) \checkmark + (\frac{1}{2} \times 9.8 \times 1.25^2) \checkmark$ $v_i = \frac{19.6 - 7.66}{1.25} = 9.55 \text{ m.s}^{-1} \checkmark$		[7]
			[42]
Question 3			
3.1	<i>Frictional force</i> – a force that opposes the motion of an object $\checkmark$ and acts parallel to the surface $\checkmark$ with which the object is in contact.		(2)
3.2	Block A  F_N – normal force F_g – force due to gravity / weight T – tension in cord F_{fric} – force of friction	Block B  F_N – normal force F_g – force due to gravity/weight T – tension in cord $F_{\text{fric A}}$ – force due to fric of A $F_{\text{fric G}}$ – force due to friction of ground $\checkmark \checkmark \checkmark$	(5)

3.3	Forces are balanced. The sum of the forces is zero ✓	(1)
3.4	$F_f^{\max} = \mu_s F_N \checkmark = 0.25 \times (1.81 \times 9.8) \checkmark = 4.43 \text{ N} \checkmark$	(3)
3.5	4.43 N ✓✓	(2)
3.6	$F_f^{\max} = \mu_s F_N = 0.25 \times ((1.81 + 3.63) \times 9.8) \checkmark \checkmark = 13.33 \text{ N} \checkmark$	(3)
3.7	$P = F_{\text{fric A}} + F_{\text{fric G}} + T = 4.43 + 13.33 + 4.43 \checkmark \checkmark = 22.19 \text{ N} \checkmark$	(3)
		[19]
Question 4		
4.1	Newton's second law – if a net or resultant force acts on an object, the object will accelerate in the direction of the force ✓. The magnitude of the acceleration is directly proportional to the net force and inversely proportional to its mass ✓.	(2)
4.2	Applying a suitable equation of motion to block m: $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$ $1.22 \checkmark = (0 \times 2) + (\frac{1}{2} \times a \times 2^2) \checkmark$ $\therefore a = \frac{1.22 \times 2}{4} = 0.61 \text{ m} \cdot \text{s}^{-2} \checkmark$ (Only one method available! – 3 unknowns: T, m and a)	(4)
4.3	Whole system: $F_{\text{net}} = m_T a \checkmark$ $m \times g \checkmark = (13.6 + m) \times 0.61 \checkmark \checkmark ; \quad 9.8 \text{ m} = 8.3 + 0.61 \text{ m} ; \quad \therefore m = \frac{8.3}{9.19} = 0.90 \text{ kg} \checkmark$ (coe from 4.2) OR 13.6 kg block: $F_{\text{net}} = m_T a ; \quad T = 13.6 \times 0.61 = 8.3 \text{ N}$ Block m: $F_{\text{net}} = m_T a ; \quad mg - T = ma ; \quad 9.8m - 8.3 = 0.61 \text{ m} ; \quad \therefore m = \frac{8.3}{9.19} = 0.90 \text{ kg} \checkmark$	(5)
4.4	13.6 kg block: $F_{\text{net}} = m_T a ; \quad T = 13.6 \times 0.61 \checkmark = 8.3 \text{ N} \checkmark$	(2)
		[13]

Question 5		Downloaded from eduresourceza.com	
5.1	$E_p = mgh \checkmark = 0.5 \times 9.8 \times 1.22 \checkmark = 5.98 \text{ J} \checkmark$	(3)	
5.2	$E_k = \frac{1}{2}mv^2 \checkmark = 0.5 \times 0.5 \times 3.66^2 \checkmark = 3.35 \text{ J} \checkmark$	(3)	
5.3	Work done against friction ($W_{\text{fric}} = 5.98 - 3.35 \checkmark = 2.63 \text{ J} \checkmark$)	(2)	
5.4	<u>Work done by frictional force = loss in kinetic energy</u> $W_{\text{fric}} = \Delta E_k$ $F_{\text{fric}} \times \Delta x = E_f - E_i$ $F_{\text{fric}} \times 2.75 \checkmark = 0 - 3.35 \checkmark \quad ; \quad F_{\text{fric}} = \frac{3.35}{2.75} = 1.22 \text{ N} \checkmark \quad (\text{coe from 5.2})$ <u>Now:</u> $F_f^{\text{max}} = \mu_s F_N \quad ; \quad \mu_s = \frac{F_f^{\text{max}}}{F_N} = \frac{1.22}{(0.5 \times 9.8)} \checkmark = 0.25 \checkmark \quad (\text{Both formulas } \checkmark)$	(6)	
		[14]	
Question 6			
6.1	<i>Law of conservation of linear momentum</i> – the total linear momentum of an isolated (closed) system $\checkmark$ remains constant $\checkmark$.	(2)	
6.2	$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \checkmark \quad ; \quad m_1 - \text{bullet}; m_2 - \text{block}$ $(2 \times 10^{-3} \times 500) + (1 \times 0) \checkmark = (2 \times 10^{-3} \times 100) + (1 \times v_{2f}) \checkmark$ $1 + 0 = 0.2 + v_{2f}$ $\therefore v_{2f} = 1 - 0.2 = 0.8 \text{ m.s}^{-1} \checkmark \text{ in the direction of the bullet} \checkmark$	(5)	
6.3	<u>Total kinetic energy before collision:</u> $E_k = \frac{1}{2}m_1 v^2 = \frac{1}{2} \times 2 \times 10^{-3} \times 500^2 \checkmark = 250 \text{ J} \checkmark$ <u>Total kinetic energy after collision:</u> $E_k = \frac{1}{2}m_1 v^2 + \frac{1}{2}m_2 v^2 = \left(\frac{1}{2} \times 2 \times 10^{-3} \times 100^2\right) + \left(\frac{1}{2} \times 1 \times 0.8^2\right) \checkmark = 10.32 \text{ J} \checkmark$ Inelastic collision $\checkmark$ (kinetic energy NOT conserved) (coe from 6.2)	(5)	

6.4	$W_{\text{net}} = \Delta E_k \checkmark$; Downloaded from eduresourceza.com $F_{\text{fric}} \times \Delta x = E_f - E_i$ $F_{\text{fric}} \times 0.2 \checkmark = 0 \checkmark - \left(\frac{1}{2} \times 1 \times 0.8^2\right) \checkmark$ $\therefore F_{\text{fric}} = \frac{-0.32}{0.2} = -1.6 \text{ N}$ i.e. 1.6 N ✓ in opposite direction to motion		(5) [17]
Question 7			
7.1	<u>On Earth:</u> $g_e = G \frac{M}{r^2} = 9.8$ <u>On the Moon:</u> $g_m = G \frac{\frac{1}{81}M}{\left(\frac{1}{4}r\right)^2} \checkmark \checkmark = \frac{1}{81} \times \frac{16}{1} \left(G \frac{M}{r^2}\right) = 0.2 \checkmark \times 9.8 = 1.94 \text{ m.s}^{-2}$ i.e. 0.2 = $\frac{1}{5}$ th of g_e ✓		[4]
7.2	7.2.1	<i>Coulomb's Law</i> – the force between two charges is directly proportional to the product of the charges✓ and inversely proportional to the square of the distance between their centres✓.	(2)
	7.2.2	 • Direction of field lines✓ • Lines touch point charge✓ • Lines at 90° to surface of point charge✓	(3)
	7.2.3	<u>Net force on the point charge due to charges at corners B and C:</u> Since these charges lie along a straight line the vector sum ✓ of these two equal but opposite forces of attraction✓ on the point charge is zero.	(2)
	7.2.4	<u>Net force on the point charge due to the charge at corner A:</u> Length of diagonal of square (d) = $\sqrt{0.2^2 + 0.2^2} = 0.28 \text{ m}$ ✓ $F = \frac{kQ_1Q_2}{r^2} = \frac{(9 \times 10^9)(2 \times 10^{-9})(1 \times 10^{-9})}{0.14^2} \checkmark \checkmark = 9.18 \times 10^{-7} \text{ N towards A}$ ✓	(4)
			[11]
			[15]

Question 8		Downloaded from eduresourceza.com	
8.1	8.1.1	<u>Parallel combination(R_p):</u> $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark = \frac{1}{300} + \frac{1}{600} = \frac{(2+1)}{600} \checkmark \quad R_p = 200 \, \Omega \checkmark$ $R_{\text{total}} = 200 + 100 = 300 \, \Omega \checkmark$	(4)
	8.1.2	<u>Current (total) in circuit (I_T):</u> $I_T = \frac{V(\text{emf})}{R_T} = \frac{6}{300} \checkmark = 0.02 \, A \checkmark$ <u>Now:</u> $V_{R_1} = R \times I = 100 \times 0.02 \checkmark = 2 \, V \checkmark \quad \text{OR}$ $R_p : R_1 = 200 \, \Omega : 100 \, \Omega$ $\therefore V_p : V_{R_1} = 2 : 1 \quad \text{i.e. } 4 \, V : 2 \, V \text{ (emf of cell } = 6 \, V)$	(4)
	8.1.3	$I_{R_3} = \frac{V}{R_3} = \frac{4}{600} \checkmark \checkmark = 0.0067 \, A \checkmark$	(3)
	8.1.4	$P = VI \checkmark = 4 \times 0.0067 \checkmark = 0.027 \, W \checkmark \quad \text{OR} \quad P = I^2 R$	(3) [14]
8.2		- Amount of lost volts is small $\checkmark$ - Since the current flowing in the circuit is small $\checkmark$ - Lost volts is directly proportional to current $\checkmark$ ($V_{\text{int}} = I_r$)	[3]
8.3		<u>Resistance of two light bulbs:</u> $P = \frac{V^2}{R} \quad \therefore R = \frac{V^2}{P}$ $R_1 = \frac{V^2}{P_1} = \frac{120^2}{60} \checkmark = 240 \, \Omega \checkmark \quad \text{and} \quad R_2 = \frac{V^2}{P_2} = \frac{120^2}{40} = 360 \, \Omega \checkmark$ <u>Series connection of the bulbs:</u> - The potential difference across each bulb will not be 120 V AND will not be equal since the resistors do not have equal resistance. (Resistors in series are potential dividers.) - Current is the same in a series circuit $R_T = R_1 + R_2 = 240 + 360 = 600 \, \Omega \checkmark$ $R = \frac{V}{I} \quad \therefore I = \frac{V}{R} = \frac{120}{600} \checkmark = 0.2 \, A \checkmark$ $P_1 = I^2 R_1 = 0.2^2 \times 240 = 9.6 \, W \checkmark \quad \text{and} \quad P_2 = I^2 R_2 = 0.2^2 \times 360 = 14.4 \, W \checkmark$	[8]
			[25]

Question 9		Downloaded from eduresourceza.com	
9.1	9.1.1	Electrical✓ energy to kinetic✓ energy (mechanical)	(2)
	9.1.2	Anti-clockwise ✓✓	(2)
	9.1.3	- It reverses the current in the armature ABCD every half rotation✓ - Ensuring the armature rotates in the same direction✓ (e.g. anti-clockwise) - Maintains electrical contact with the brushes whilst allowing the armature ABCD to rotate freely (any 3)	(2)
	9.1.4	- Increase the number of coils of conducting wire that form the armature✓ - Use stronger (electro)magnets✓ - Increase the strength of the current in the coils / armature (any 2)	(2) [8]
9.2	9.2.1	d.c. generator✓	(1)
	9.2.2	Electromagnetic induction✓	(1)
	9.2.3	(Flemming's) Right hand dynamo rule✓ or Lenz's Law	(1)
	9.2.4	DCBA✓✓	(2)
	9.2.5	 Current OR Current Cycle of rotation shape✓ full rotation✓	(2) [7]
9.3	9.3.1	$\frac{N_s}{N_p} = \frac{V_s}{V_p} \checkmark$; $\frac{80}{N_p} = \frac{6}{120} \checkmark$; $N_p = \frac{120 \times 80}{6} = 1600$	(3)

	9.3.2	$V_p I_p = V_s I_s$ ✓, $120 \text{ V}_p \times I_p = 30 \text{ V}_s \times 1.5 \text{ A}$ ✓ $I_p = \frac{6 \times 30}{120} = 1.5 \text{ A}$ ✓	(3)
	9.3.3	$P_s = V_s I_s = 6 \times 30$ ✓ = 180 W ✓	(2)
			[8]
			[23]
Question 10			
10.1	<i>Threshold frequency</i> – the minimum frequency ✓ of incident radiation at which electrons will be released from a particular metal ✓.		(2)
10.2	$W_0 = hf_0$ ✓ = $6.6 \times 10^{-34} \times 9.4 \times 10^{14}$ ✓ = $6.2 \times 10^{-19} \text{ J}$ ✓		(3)
10.3	$\frac{6.2 \times 10^{-19}}{1.6 \times 10^{-19}}$ ✓ = 3.88 eV ✓		(2)
10.4	$E_{\text{photon}} = W_0 + E_{k(\text{max})}$ and $E_{\text{photon}} = \frac{hc}{\lambda}$ $E_{k(\text{max})} = \frac{hc}{\lambda} - W_0$ ✓ = $\frac{(6.6 \times 10^{-34})(3 \times 10^8)}{3 \times 10^{-7}}$ ✓✓ – 6.2×10^{-19} ✓ = $4 \times 10^{-20} \text{ J}$ ✓		(5)
			[12]
	Total : 200 marks		