

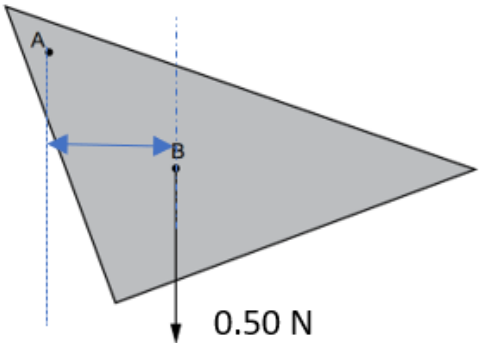


COMMONWEALTH SECONDARY SCHOOL
SECONDARY FOUR EXPRESS PHYSICS 6091
PRELIMINARY EXAMINATIONS 2026

MARK SCHEME

Section A (70 marks)

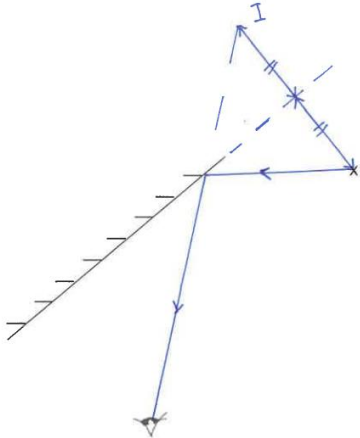
Deduct a maximum of one mark for error in sf.

Q		Answers	Marks / Remarks	Accept	Reject
1	(a)	- For an object in equilibrium, - the sum of the clockwise moments about a pivot / point is equal to the sum of anticlockwise moments - about the same pivot / point.	[2] for all three points. [1] for any two.		
	(b)	(i) The whole / entire weight of the metal sheet appears / seems / is considered to act through Point B .	[1]		If B is not referenced in answer.
	(b)	(ii)  perpendicular distance indicated correctly	[1]		

Q		Answers	Marks / Remarks	Accept	Reject
		Moment = force x perpendicular distance (accept symbol form) Or: 0.50 N x 0.026 m Or: 0.50 N x 0.025 m Or: 0.50 N x 0.024 m Or: 0.50 N x 2.6 cm Or: 0.50 N x 2.5 cm Or: 0.50 N x 2.4 cm	[1] for working if distance is indicated correctly No ecf from first part.		
		0.013 N m Or: 1.3 N cm Or: 0.012 N m Or: 1.2 N cm	[1]		
	(iii)	The final position of B is vertically below pivot A .	[1]		B is below A.
		The weight of the sheet has no moment as its perpendicular distance from pivot A is zero.	[1]		Perpendicular distance is zero without mention of weight
		Total mark for Q 1	[8]		
2	(a)	(i) $\frac{1}{2}mv^2$ Or: $[\frac{1}{2} \times 970 \text{ kg} \times (27 \text{ m/s})^2]$ Or $[\frac{1}{2} \times 970 \text{ kg} \times (15 \text{ m/s})^2]$ Or: $[\frac{1}{2} \times 970 \text{ kg} \times (27 \text{ m/s})^2] - [\frac{1}{2} \times 970 \text{ kg} \times (15 \text{ m/s})^2]$	[1]		$\frac{1}{2} (970 \text{ kg}) (27 \text{ m/s} - 15 \text{ m/s})^2$
		2.4 x 10⁵ J or 240 000 J or 240 kJ	[1]		
	(a)	(ii) Work done = force x distance Or: Force = energy transferred out / distance Or: 2.4 x 10⁵ J / 40 m	[1] error carried forward from (i)		

Q		Answers	Marks / Remarks	Accept	Reject
		6100 N	[1]		J/m
	(b)	(i) geothermal	[1]		
		(ii) can be replenished naturally Or: “will not run out” “infinite” “will not be depleted”	[1]		“reused” “recycled” ‘regrown’ ‘reproduced’ ‘Unlimited’ ‘Cannot be easily diminished’
		Total mark for Q 2	[6]		
3	(a)	Specific heat capacity, c , of a material is the change in amount of its internal energy per unit mass Or: amount of internal energy transferred per unit mass	[1]		1 kg’ in place of ‘per unit mass’
		for each unit change in its temperature.	[1]		
	(b)	$Q = mc\theta$ $= 20 \text{ kg} \times 4200 \text{ J/(kg } ^\circ\text{C)} \times (100 - 20) ^\circ\text{C}$ $= 6\,720\,000 \text{ J}$ $= 6.7 \times 10^6 \text{ J}$ or 6 700 000 J or 6.7 MJ or 6700 kJ	[1]		
	(c)	Specific latent heat of vapourisation is the amount of energy transferred per unit mass of a substance	[1]		
		to change the state of a substance between the liquid and gaseous states at constant temperature.	[1]		
	(d)	$L = ml$ $= 0.50 \times 20 \text{ kg} \times 2.26 \times 10^6 \text{ J/kg}$	[1]		

Q		Answers	Marks / Remarks	Accept	Reject
		$= 22.6 \times 10^6 \text{ J}$ $= 2.3 \times 10^7 \text{ J}$ or 23 000 000 J or 23 MJ or 23 000 kJ			
	(e)	Power = energy transferred / time Or: Time = energy transferred / power Or: $(6.7 \times 10^6 \text{ J} + 2.3 \times 10^7 \text{ J}) / 2.5 \times 10^3 \text{ W}$ Or: $(6.7 \times 10^6 \text{ J} + 2.3 \times 10^7 \text{ J}) / 2.5 \text{ kW}$ Or: answer in (b) / $2.5 \times 10^3 \text{ W}$ Or: answer in (d) / $2.5 \times 10^3 \text{ W}$	[1] error carried forward from (b) and/or (d)		
		12 000 s or 1.2 X 10⁴ s or 12 ks	[1]		
	(f)	The calculation in (e) did not consider the energy that was transferred to the internal store of the air (above the water) / metal tank / pressure cap / tubing / parts of the stripper / surroundings.	[1]		
		Total mark for Q 3	[9]		
4	(a)	(i) $4 \times 5.0 \text{ cm} = 20.0 \text{ cm}$ Or: 0.200 m Or: 20 cm	[1]		
	(a)	(ii) $v = f\lambda$ Or: 10 Hz x 20.0 cm Or: 10 Hz x 0.200 m	[1] error carried forward from (i)		
		200 cm/s or 2.00 m/s or 2.0 m/s	[1]		J/m
		(iii) 1.0 cm or 0.010 m	[1]		

Q		Answers	Marks / Remarks	Accept	Reject
	(b)	A – down or downward D – down or downward G – up or upward	All three correct: [2] Any two correct: [1]		
		Total mark for Q 4	[6]		
5	(a)				
		Image accurately drawn (+/- 1mm) and labeled as I.	[1]		
		A ray accurately drawn with reflected ray extended to image with broken lines.	[1]	two rays instead of one ray	• no image is indicated • missing arrows on rays, • having arrows on dotted lines, • arrows in wrong direction.

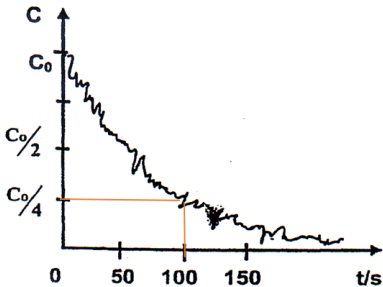
Q		Answers	Marks / Remarks	Accept	Reject
	(b)	(i) Refractive index is the ratio of the speed of light in vacuum to the speed of light in the medium	[1]		'air' instead of 'vacuum'
		(ii) Angle = 35 °	[1]		
		(iii) $n = \sin i / \sin r$ Or: $\sin (65) / \sin (30)$	[1]		$\sin i / \sin r$ appears alone without being equated to n.
		1.8	[1]		
	(c)	(i) Thin converging lens			• missing arrows on ray • arrows in wrong direction
		1 ray through optical centre	[1]		
		1 ray through focal point	[1]		
		Object labelled as O and drawn with an upward arrow .	[1]		
		(ii) Projector	[1]		
		Total mark for Q 5	[10]		

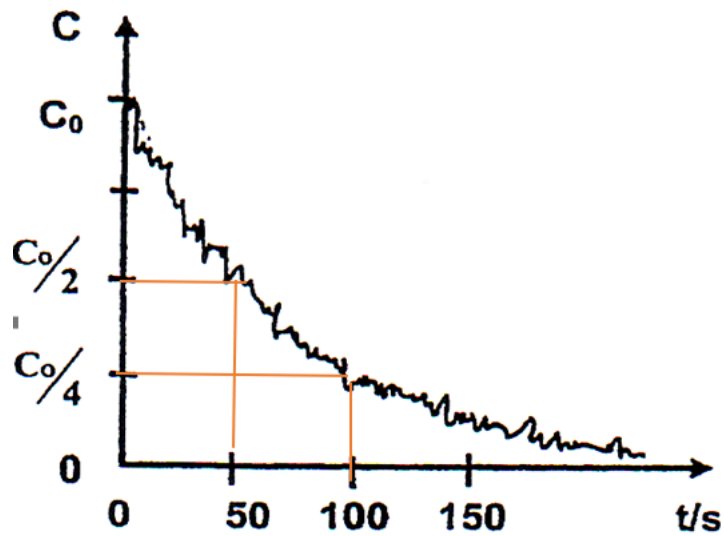
Q		Answers	Marks / Remarks	Accept	Reject
6	(a)	(i) The current flowing through the lamp is not directly proportional to the pd across it. Or: the graph is not a straight line that passes-through origin Or: the graph is a curve . Or: the resistance of the lamp increases as I / V / temperature increases. Or: I and V do not increase proportionally to each other Or: Current does not increase proportionally as its potential difference increases.	[1]	Aww for not stating 'pass through origin'	
		(ii) $R = V / I$ Or: 4.50 V / 0.070 A Or: 4.50 V / 70 mA	[1]		
		64 Ω or 64.3 Ω	[1]		
	(b)	The resistance of the filament lamp decreases .	[1]		
		As temperature decreases, the resistance of the thermistor increases .	[1]		
		The p.d. across thermistor increases . Since the emf is shared between the filament lamp and the thermistor, the p.d. across the filament lamp decreases . Or: Current through the lamp decreases .	[1]		
		Total mark for Q 6	[6]		

Q		Answers	Marks / Remarks	Accept	Reject
7	(a)	Conduction, convection and radiation	[1]		
	(b)	(i) Metal is a good conductor of heat Or: metal increases the rate of transfer of energy through conduction.	[1]		
		(ii) Black is a good (or better) radiator / emitter of infra-red radiation Or: black increases the rate of transfer of energy through radiation.	[1] Ignore 'absorber'	'radiant heat' in place of 'radiation'	'heat' or 'thermal energy' in place of 'radiation'
		(iii) To increase the surface area with air. Or: increases the rate of transfer of energy to air	[1]		
	(c)	Rate of energy transferred to the heat sink from the component = the rate of energy transferred from the heat sink to the surroundings. Or: Amount of energy transferred to the heat sink from the component = amount of energy transferred from the heat sink to	[1]		
		Total mark for Q 7	[5]		

Q		Answers	Marks / Remarks	Accept	Reject
8	(a)	The guitar string is magnetised by induction in the presence of the cylindrical magnet.	[1]		misconception or contradiction. The coil is magnetized by the magnet.
		The magnetic field of the string linking the coil changes as the string vibrates. Or: The magnetic flux in the coil changes as the string vibrates.	[1] Do not award this mark if the first mark is not awarded		Not clear how the changing field comes about. The magnetic field due to the magnet changes.
		By Faraday's law, an e.m.f. is induced in the coil. Since the circuit is a closed circuit, an induced current therefore can flow hence generating an electrical signal between its terminals.	[1] Do not award this mark if the first mark is not awarded		
	(b)	Nylon is a non-magnetic material Or: Nylon cannot be magnetised by induction in the presence of the cylindrical magnet.	[1]		
		The coil does not experience a changing magnetic flux as the string vibrates and thus no e.m.f. will be induced in the coil.	[1]	'field' in place of 'flux'	'no magnetic field'
		Total mark for Q 8	[5]		

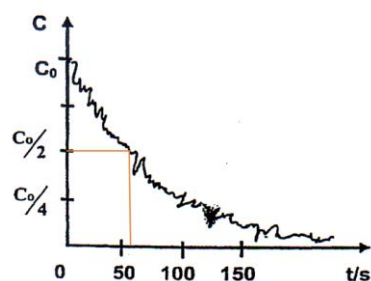
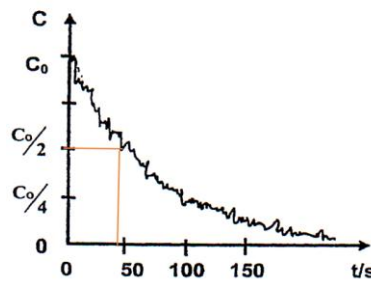
Q		Answers		Marks / Remarks	Accept	Reject
9	(a)	(i)	The count rates exhibit a certain irregularity. Or: the points do not lie on a perfectly smooth curve. Or: the count rates fluctuate	[1]	The graph is not smooth The curve is not even, creating many bumps to show it is random.	
	(a)	(ii)	Radioactive decay takes place regardless of temperature .	[1]	Any statement that shows that radioactive decay is not affected by higher temperature	'heat' instead of 'temperature'
	(b)	(i)	The half-life of a radioactive nuclide is the time taken for <i>half</i> the nuclei of that nuclide in any sample to decay .	[1]		Time taken for the nuclei to decay and reach half of its original mass. Time taken for the number of atoms in a radioactive nuclei to halve. Time taken for half

						of the radioactive sample to undergo decay.
		(ii)	Half-life = 50 s	[1]	Accept 40 to 60 s.	
			Evidence of using at least two half – lives. Eg. lines on Fig. 9.1 or Fig. 9.2 to obtain the time taken for $C_0/4$:  Or: $2 t = 100 \text{ s}$ $t = 50 \text{ s}$ Or: lines on either Fig. 9.1 or Fig. 9.2 to obtain the time taken for $C_0/2$ and $C_0/4$:	[1]		



Or: $(50 \text{ s} + 50 \text{ s})/2 = 50 \text{ s}$

Or: lines on both Fig. 9.1 and Fig. 9.2 to obtain two values of half-lives and averaging it to 50 s:



Total mark for Q 9

[5]

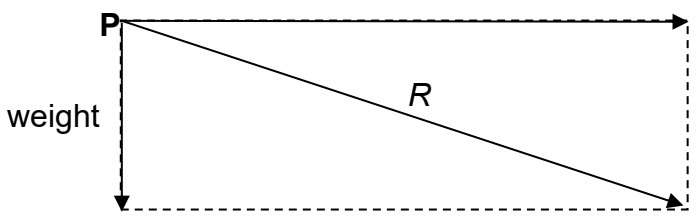
Q		Answers		Marks / Remarks	Accept	Reject
10	(a)	(i)	The compass needle points to West or W .	[1]	Rotates 90° anticlockwise	Downward
		(ii)	The compass needle points to East or E .	[1] error carried forward from (i)	Part (i) correct and Part (ii) 'points in the opposite direction'.	Upward downward
		(iii)	The needle would vibrate from West to East or W to E	[1] error carried forward from (i) and /or (ii)	There would be little or no movement .	'The needle points in opposite direction.' The description does not show that there is a continuous deflection . E.g. "The compass needle deflects one direction and deflects in the opposite direction."

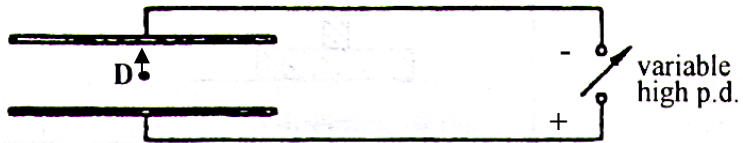
			because of the changing magnetic field of the current in the wire.	[1]	The needle does not move as it is not able to respond to the rapid change in direction of the magnetic field .	changing magnetic flux
	(b)	(i)	direction of current in AB: B to A , or BA , or into paper	[1]	'going in', 'in'	Left
			direction of current in CD: D to C , or DC or out of paper	[1] Allow ecf from AB.	'coming out', 'out'	Right
		(ii)	direction of the force acting on AB : toward the right	[1] Allow error carried forward from (i)		To the right and downwards
			direction of the force acting on CD : toward the left	[1] Allow ecf from AB.		Upward – no ecf from downward
		(iii)	Both forces produced moment / turning effect in the same direction / clockwise about the axle of rotation.	[1]		Resultant force Fleming left hand rule
			clockwise	[1]		
		Total mark for Q 10		[10]		

Q		Answers	Marks / Remarks	Accept	Reject
11	(a)	(i) A to B: stationary	1 mark for any three correct answers. Total: [2] marks.		
		B to C: increasing speed at its greatest rate			
		C to D: increasing speed			
		D to E: braking			
		E to F: colliding with another car and stopping			
9		(ii) The driver stepped on the brake. There are forces acting to oppose the rotation of the wheels. Or there is an opposing / resistive / resistance force acting on the car when the brake is applied.	[1]		<i>Increase the frictional force between the tyres of the car and the ground. Reject as frictional force between the tyre and ground depends on normal contact force and nature of surface of tyres and ground.</i> <i>Frictional force acting on the wheels opposing the motion of the wheels. Reject, as it is not clear whether this is frictional between the road and tyres or due to the friction between the tyres and brake disc.</i>

Q		Answers	Marks / Remarks	Accept	Reject
		The resultant force of the car is backward or negative .	[1]		
	(b)	G to H: moving in opposite direction / backwards and J to K: moving in the original direction / forwards	[1]		Negative direction Positive direction
		G to H: From 38 s to 43 s / first 5 seconds speed increases at a non-uniform / decreasing rate Or: velocity decreases from 0 m/s to -10 m/s with a non-constant / non-uniform / decreasing rate Or: acceleration is negative and non-uniform / decreasing	[1]	Decreasing acceleration	Decreasing deceleration <i>Velocity increases at a decreasing rate</i> Contradiction: Speed up with decreasing deceleration.
		G to H: from 43 s to 53 s / last 10 s speed decreases at a non-uniform / increasing rate for the last 10 s Or: velocity increases from -10 m/s to 0 m/s with non-constant / non-uniform / increasing rate Or: acceleration is positive and non-uniform / increasing	[1]		Velocity decreases at an increasing rate. The car decelerates in the negative direction
		J to K: speed / velocity increases at a constant rate or constant / uniform positive acceleration	[1]	'move forward with constant acceleration' in	constantly accelerating

Q		Answers	Marks / Remarks	Accept	Reject
				place of 'constant positive acceleration'	
	(c)	Use of gradient $(y_2 - y_1) / (x_2 - x_1)$ Or: $a = (v - u) / t$ Or: $(20.0 \text{ m/s} - 15.0 \text{ m/s}) / (25.0 \text{ s} - 17.0 \text{ s})$ Or: $5.0 \text{ m/s} / 8.0 \text{ s}$	[1]		
		0.625 m/s² or 0.63 m/s²	[1]	2 or 3 sf	
		Total mark for Q 11	[10]		

Q		Answers	Marks / Remarks	Accept	Reject
12	(a)	<i>R</i> correctly constructed with labelling and arrow. 	[1]	single arrow for <i>R</i> .	Tip to tail method
		<i>R</i> in the acceptable range from 0.156 to 0.160 N and size of T= size of <i>R</i>.	[1]	Accept 2 or 3 sf.	Did not label <i>R</i> but draw a double arrow
		θ in the acceptable range from 70° to 73°	[1]		

	Q		Answers	Marks / Remarks	Accept	Reject
	(b)	(i)	A region in which an electric charge experiences a force .	[1]	Area instead of region Charge object /particles instead of electric charge.	
		(ii)	Correct shape: Vertical straight lines are drawn from one plate to another	Total: [2] All three correct [2] Any two correct [1]		
			with equal spacing between the lines (check visually)			
			Correct direction: The arrows point from bottom plate to top plate			
		(iii)	Positive or +	[1]		
		(iv)	An upward arrow passing through the drop as shown. 	[1] Allow e.c.f. from part (iii).		
		(v)	The oil drop will fall or move downward .	[1] - to be awarded provided the explanation does not contradict.		

		Either: The electric field is now weaker or: The upward force due to the electric field is now weaker / smaller than the weight of the object (downwards) or: The upward force due to the electric field is now weaker / smaller than the downward force due to the weight of the object Or: there is a resultant force downwards.	[1] No ecf from (iii) or (iv).	A smaller force due to the electric field strength	
		Total mark for Q 12	[10]	[10]	