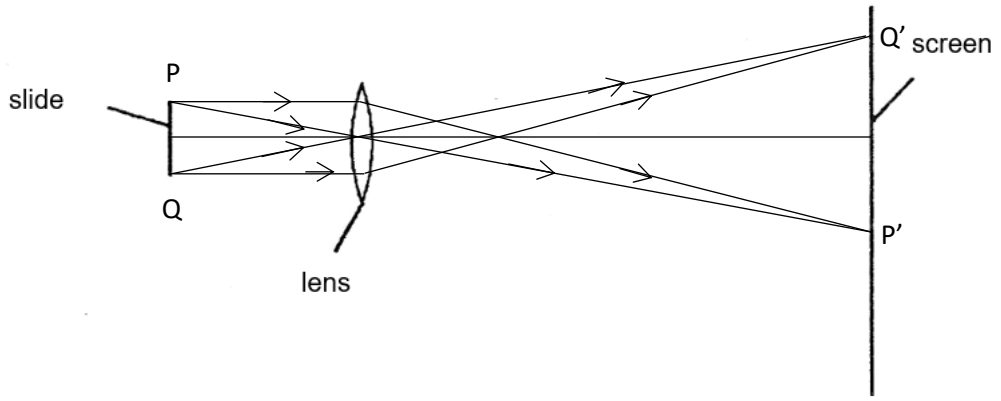
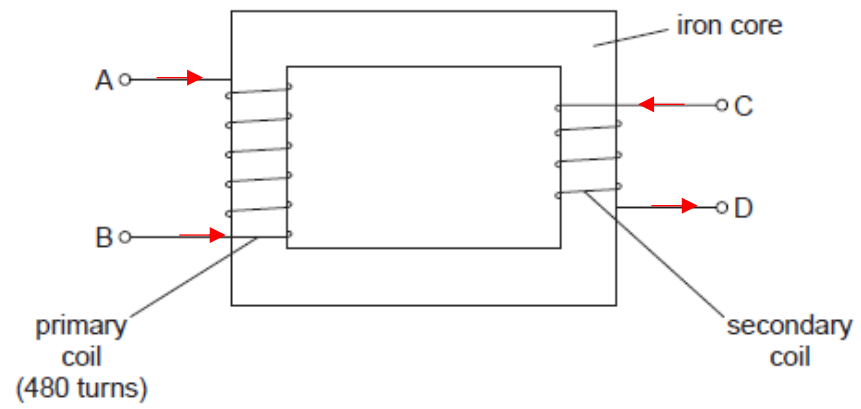
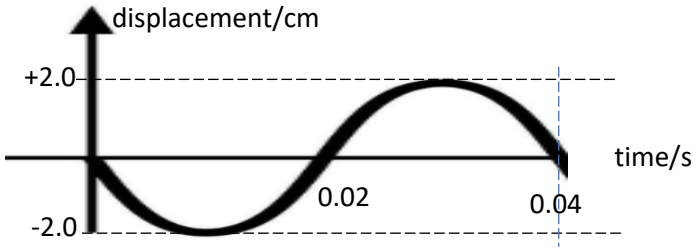
2025 PRELIMINARY EXAMINATION
SUGGESTED ANSWER SCHEME

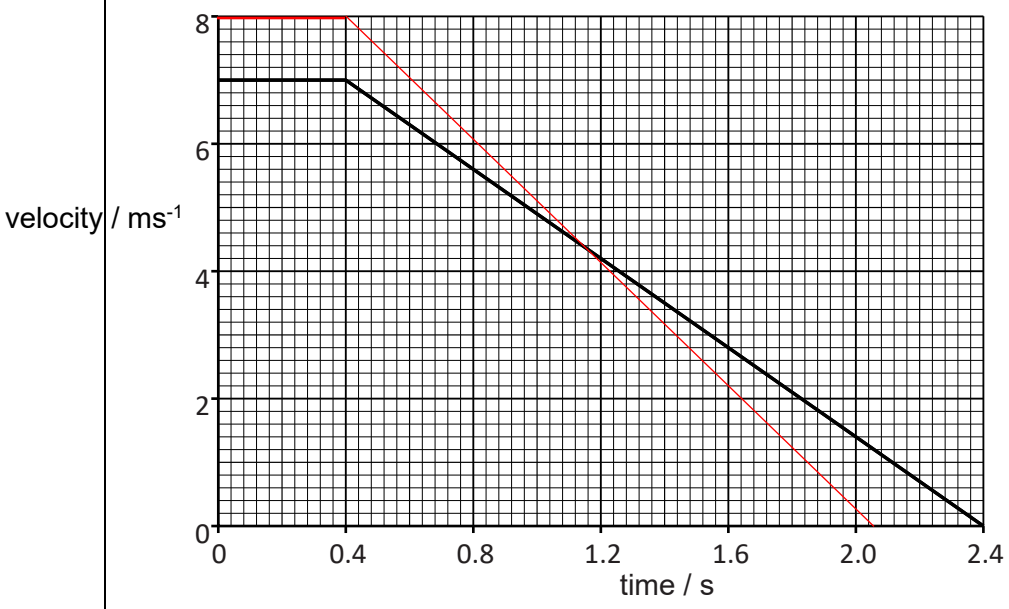
PAPER 2 SECTION A (50 marks)

Qn	Part	Answer	Remark
1	(a)(i)	1. Loss of GPE = 92 kg x 10 N/kg x 1500 m = 1380000 J = 1.4 x 10^6 J (2 s.f.)	
		2. Kinetic energy = ½ (92kg)(52 m/s)^2 = 124384 J = 1.2 x 10^5 J	
	(ii)	Some energy in the gravitational potential store is transferred to the internal store of the surroundings due to air resistance.	
	(b)(i)	The air resistance is increasing	
	(ii)	W = mg = 92 kg x 10N/kg = 920 N	
2	(a)(i)	▪ Block moves with uniform acceleration. ▪ Resultant force of 0.6 N acting to the right.	
	(ii)	▪ Block moves at **constant velocity**/same speed same direction ▪ Force X = total resistive force. **Zero <u>resultant force</u>** acting on the block.	
	(b)	Power = Force x velocity 2.0 W = 0.80 N x *v* v = 2.5 ms^{-1} Distance = 2.5 ms^{-1} x 3.0 s = 7.5 m	
	(c)	During the first three seconds, the power delivered is not constant since the velocity is changing while in (b), the velocity is constant and the power delivered is constant.	
3	(a)	1 Frictional force acting at the rod 2 Normal (Reaction) Force acted on card by rod	
	(b)	Since the direction and magnitudes of the two forces In (b) are different/ are of different nature/acting on the same body they do not satisfy the conditions for action-reaction pair.	
4	(a)	▪ The uneven bombardment on all sides by air particles ▪ The random/ erratic and continuous movement is caused by to the resultant force on the smoke particle at any position	
	(b)(i)	The number of erratic paths compared to that at the lower temperature will be more	
	(ii)	▪ Air particles impacted the smoke particles at higher velocities. The frequency of collisions also increased. ▪ The greater force of impact and frequent collisions resulted in more frequent change in direction of the particle in shorter intervals compared to that at lower temperature, thus explaining the more erratic movement * Reject in increase in pressure / average force per unit area as these leads to pressure of the gas.	
5	(a)(i)	The angle of incidence in the glass block has exceeded critical angle of glass.	
	(ii)	When the critical angle is reached, the beam is at B. Using trigonometry, Critical angle, c = 90° - $tan^{-1}(\frac{1.68}{1.50})$ = 90° – 48.2° = 41.8° Refractive index = $\frac{1}{\sin c}$ = $\frac{1}{\sin 41.8^o}$ = 1.50	
	(iii)	Higher refractive index→smaller critical angle. Hence AB will be shorter.	

Qn	Part	Answer	Remark
	(b)(i)		
	(ii)	To enable the formation of an upright image on the screen/to give an image that is right side up.	
6	(a)	From $I = \frac{V}{R}$ $= \frac{3.6\ V}{5800\Omega}$ $= 6.2 \times 10^{-4}$ A	
	(b)	From $R = V/I$ $3400\Omega + R_{thermistor} = 6.0\ V/6.2 \times 10^{-4}$ A $R_{thermistor} = 6277\ \Omega$ $= 6.3 \times 10^{3}\ \Omega$ (2 s.f.)	
	(c)(i)	Temperature decreases	
	(ii)	Current decreases	
	(iii)	Potential difference increases	
7	(a)	Random - cannot predict when a radioactive nucleus will emit radiation and in which direction/time between emissions is unpredictable/emission can occur at any time in any direction	
	(b)(i)	Atoms of the same element that have the same number of protons but different number of neutrons	
	(ii)	$a = 1$; $b = 0$; $x = 56$; $y = 92$	3 correct 1 m
	(iii)	Proton number = 90 ; Nucleon number = 235	
8	(a)	South/ S-pole	
	(b)(i)	Anticlockwise (1st minute)	
	(ii)	The coil will now rotate clockwise. In the 2nd minute, F is negative. Current now flows from S to R and from Q to P. The forces acting on both arms are now reversed	
	(iii)	The force acting on each arm of the coil is a constant.	
	(iv)	The coil will rotate continuously in one direction since the forces acting on each arm changes direction every half-cycle of rotation / one minute	
9	(a)(i)	From $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ $\Rightarrow \quad N_s = \frac{6V}{240V} \times 480$ $= 12$	
	(ii)		

Qn	Part	Answer	Remark
	(iii)	From $P_{primary} = P_{secondary}$ $I_{primary} = \frac{440\ V\ x\ 200\ A}{11000\ V}$ = 8.0 A	
	(b)(i)	rate of change of flux linkage/changing flux linkage *reject answer with no mention of rate of change/ changing magnetic field.	
	(ii)	▪ Increasing rate of change of flux linkage when pushed down →increased reading ▪ Magnet stop moving → Magnetic field stationary*→no change in flux linkage→hence no induced e.m.f. *reject magnetic field not changing	
10	(a)(i)	**EITHER** ▪ Compression – higher pressure region ; rarefaction – lower pressure region **OR** ▪ Compression – higher particle density ; rarefaction – lower particle density	
	(ii)	1. Wavelength is the distance between any compressions 2. The number of oscillations a layer of air made in one second/number of compressions that passes a point in one second	
	(b(i)	Low temperature→particles closer→smaller compressions → $\lambda\downarrow$, $v\ (= f\ \lambda) \downarrow$	
	(ii)	Heavier molecule→bigger inertia to move/more slower→ less displacement→smaller compressions → $\lambda\downarrow$, $v\ (= f\ \lambda) \downarrow$	
	(c)(i)	Frequency = 1/0.04 s = 25 Hz	
	(ii)	Wavelength = 16 cm	
	(iii)	$v = f\ \lambda$ = 25 Hz x 16 cm = 400 cms^{-1}	
	(iv)		

SECTION B(10 m)

Qn	Part	Answer	Remark
11	EITHER		
	(a)(i)	The product of the force with the perpendicular distance measured from the line of action of the force to the pivot or axis about which moment is taken	
	(a)(ii)	Moment of F = 8200 N $\times$ 0.050 m = 410 Nm clockwise	
	(a)(iii)	As the crankshaft rotates through a small angle, the perpendicular distance from the line of action for the force to the axis of rotation is reduced. This causes the moment of F to decrease.	
	(b)(i)	$(P_{gas} - P_{atm}) \times 0.0067\ m^2 = 8200\ N$ $\Rightarrow$ $P_{gas} = 1.0 \times 10^5\ Nm^{-2} + 8200\ N / 0.0067\ m^2$ $= 1.3 \times 10^6\ Nm^{-2}$	
	(b)(ii)	There is work done against friction between the moving piston and walls of the cylinder. This resulted in a bigger opposing force, resulting in a bigger pressure.	
	(c)	▪ Number of particles per unit volume decreases with expansion, resulting in decrease in the frequency of collisions with the inner walls of the cylinder ▪ Average force per unit area decreases, resulting in a drop in pressure of the gas. The downward F therefore decreases	
	(d)	▪ molecules move faster at higher temperatures/kinetic energy increases ▪ molecules collide harder and more frequently (with walls) resulting in increase in the average force of collision with per unit area of the inner walls. Higher pressure results.	
12	OR		
	(a)(i)	The total resistive force acting in the direction opposite to his motion is equal to his applied force. He does not undergo any acceleration as the resultant force is zero.	
	(ii)	When the centre of gravity is not in the same straight line as the point of wheel contact with the ground, the weight of the cyclist will produce a clockwise or anticlockwise moment, thus toppling him.	
	(b)	Overall stopping distance = Area under-v-t graph = ½ (7.0 m/s)(0.4s + 2.4 s) = 9.8 m	
	(c)(i)	Horizontal line at 8.0 m/s; Slope line meeting t-axis at 2.05 s  	
	(c)(ii)	Deceleration = (8/1.65) ms^{-2} = 4.8 ms^{-2} (2 s.f.)	
	(d)(i)	F = 1.2 x $10^6\ Nm^{-2}$ x 5.0 x $10^{-5}\ m^2$ = 60 N	

Qn	Part	Answer	Remark
	(d)(ii)	Piston S on either side has a larger cross sectional area compared to Piston R. Since is same pressure is transmitted through the oil, the same pressure multiplied by a bigger cross-sectional area will produce a bigger force at S.	