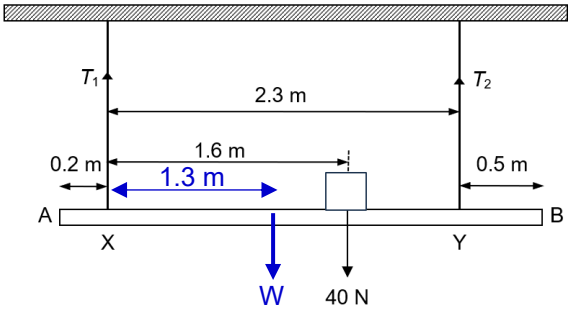


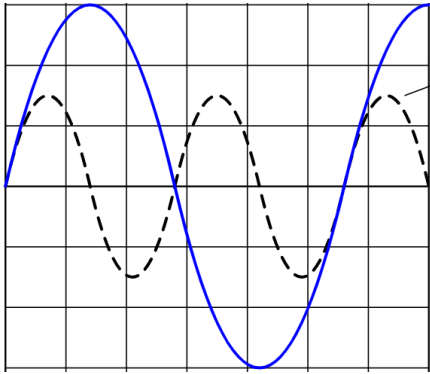
MARK SCHEME FOR 2026 4G3 PHYSICS PRELIM EXAM PAPER 2

SECTION A

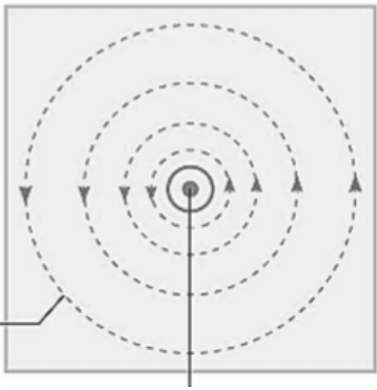
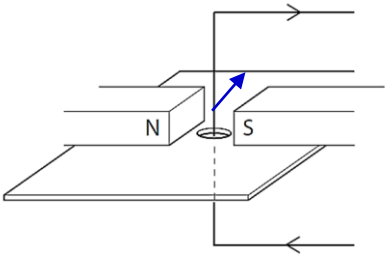
QN.	SUGGESTED SOLUTION	MARK(S) AWARDED
1a	A to B: decreasing acceleration or accelerating at a decreasing rate B to C: constant velocity or zero acceleration	1 m 1 m
1b	Area of straight-line triangle from A to B = $\frac{1}{2} \times 6.6 \times 40 = 132 \text{ m}$ Since <u>area under the curved line AB is greater than area of triangle (132 m)</u> , hence distance must be more than 130 m.	1 m for calculation 1 m for explaining based on area under v-t graph to distance
2a	- One downward arrow (from centre) labelled "weight" or "W". - One upward arrow labelled "thrust" or "motor force"	1 m 1 m
2b	$W = mg$ $W = 2.8 \times 10^6 \times 10 = 2.8 \times 10^7 \text{ N}$	1 m for calculation and correct ans
2c	$F_R = ma = 2.8 \times 10^6 \times 1.4 = 3.92 \times 10^6 \text{ N}$ constant force = $F_R + W$ constant force = $3.92 \times 10^6 \text{ N} + 2.8 \times 10^7$ $= 3.192 \times 10^7 \text{ N} \approx 3.2 \times 10^7 \text{ N}$	1 m for finding F_R 1 m for correct answer
2d	<u>upward force by the exhaust gases on the rocket</u>	1 m for correct answer
2e	The <u>overall mass/ weight of the rocket decreases</u> as fuel is burned or <u>air resistance decreases</u> as the atmosphere becomes less dense Hence <u>upward resultant force becomes larger</u> and acceleration increases.	1 m for decrease in weight or air resistance 1 m for larger resultant force
3a	$W = Fs = (47 \times 10) \times 13$ $= 6110 \text{ J} \approx 6100 \text{ J}$	1 m for correct working 1 m for correct ans
3bi	$E = IVt = 5.6 \times 230 \times 11$ $14\,168 \text{ J} \approx 14\,000 \text{ J}$	1 m for correct working 1 m for correct ans
3bii	There is <u>energy transferred (lost) thermally to the motor</u> or There is <u>work done against friction in the cables/ air resistance</u> as the boxes are lifted	1 m for valid reason
3c	Using COE, $GPE = KE + \text{energy lost}$ Since 15% of energy is lost, $KE = 0.85 \text{ GPE}$ Energy converted to KE = $0.85 \times 6110 = 5193.5 \text{ J}$ $\frac{1}{2}mv^2 = 5193.5 \text{ J}$ $v = \sqrt{\frac{5193.5(2)}{47}} = 14.866 \text{ m/s} \approx 15 \text{ m/s}$	1 m for 0.85 or calculating energy loss 1 m for correctly applying COE formula 1 m for final answer

QN.	SUGGESTED SOLUTION	MARK(S) AWARDED
4a	The <u>sum of anticlockwise moments is equal to the sum of clockwise moments about the same pivot.</u>	1 m for correct definition
4b		1 m for correct label and position
4c	Taking moments about X, total clockwise moments = total anti-clockwise moments $T_2(2.3) = 40(1.6) + 10(1.3)$ $F_B = 33.478 \text{ N} \approx 33 \text{ N}$	1m for correct working 1m for correct answer
4d	T_2 decreases. Smaller perpendicular distance from 40 N to pivot, hence total clockwise moments decrease, A smaller anti-clockwise moment is required to keep the rod in equilibrium and hence smaller T_2 .	1 m for decrease in T_2 1 m for decrease in total clockwise moments
5a	Because atmospheric pressure acting on the mercury in the dish is equal to the pressure exerted by a 76 cm column of mercury	1 m
5b	$P = h\rho g$ $= 0.76 \times 13600 \times 10$ $= 1.0 \times 10^5 \text{ Pa}$	1m for correct working 1m for correct answer
5ci	Mercury level <u>increases</u> .	
5cii	When the container of air is heated, the molecules move at higher speeds. They collide with the walls of the container with a larger force and higher frequency. This results in higher force/ area or pressure	1 m for greater force and frequency 1 m for larger force/ area or pressure
6a	identify $r = 180^\circ - 45^\circ - 30^\circ - 90^\circ = 15^\circ$ $(2.2)\sin 15^\circ = (1)\sin i$ $i = 35^\circ$	1 m for correct working 1 m for correct answer
6b	$n = \frac{1}{\sin c}$ $2.2 = \frac{1}{\sin c}$ $c = 27^\circ$ Since angle of incidence at boundary (60°) is greater than critical angle (27°), the light ray is totally internally reflected at X.	1 m for correct working of c 1 m for correct explanation of TIR
6c	$2.2 = \frac{3.0 \times 10^8}{v}$ $v = 1.4 \times 10^8 \text{ m/s}$	1 m for correct answer

QN.	SUGGESTED SOLUTION		MARK(S) AWARDED
7a	The water around the ice cube gets cooled, contracts, becomes denser and sinks. The warmer, less dense water rises. This forms a convection current that cools down all the water.		1 m for density and motion of water 1 m for convection currents
7bi	$Q = mc\Delta\theta$ $Q = (100)(4.2)(40 - 34) = 2520 \text{ J} \approx 2500 \text{ J}$		1 m for correct answer
7bii	$Q = mc\Delta\theta$ $Q = (5)(4.2)(34 - 0) = 714 \text{ J} \approx 710 \text{ J}$		1 m for correct answer
7biii	$Q_{\text{lost by water}} = Q_{\text{gained by ice}} + ml_f$ $2520 = 714 + (5)(l_f)$ $l_f = \frac{1806}{5} = 360 \text{ J/g}$		1 m for correct working (ecf from bi and bii) 1 m for correct answer
8a	When temperature rises, the resistance of the thermistor decreases and the voltage across the thermistor decreases. Since the sum of the p.d. across the thermistor and the $1.6 \text{ k}\Omega$ resistor is fixed at 6.0 V, voltage across the $1.6 \text{ k}\Omega$ resistor increases and voltmeter reading increases.	When temperature rises, the resistance of the thermistor decreases and the voltage across the thermistor decreases. The current in the circuit increases and since $V_{1600\Omega}$ resistor is proportional to current, voltmeter reading increases	1 m for decrease in thermistor's resistance 1 m for voltage relationship in series circuit
8bi	At 20°C, $V = 2.2 \text{ V}$ or 2.25 V $I = \frac{2.2}{1600}$ $I = 0.0014 \text{ A}$		1 m for identifying voltage 1 m for correct answer
8bii	At 50°C, $V = 4.1 \text{ V}$ $4.1 = \left(\frac{1600}{1600 + R_T} \right) 6.0$ $(1600 + R_T)(4.1) = 6.0(1600)$ $4.1R_T + 6560 = 9600$ $R_T = 741 \Omega \approx 740 \Omega$		1 m for reading from graph 1 m for correct potential divider working 1 m for correct answer
9a	Air particles near the tuning fork vibrate more vigorously and collide with their neighbours and cause them to vibrate parallel to the direction of wave travel. Sound wave is transmitted through a series of compressions and rarefactions.		1 m for vibration and collision 1 m for compressions and rarefactions
9bi	2.5 waves in 50 ms		1 m for correct working

QN.	SUGGESTED SOLUTION	MARK(S) AWARDED
	$\text{In 1 s, no of waves} = \frac{1}{50 \times 10^{-3}} (2.5) = 50$ $f = 50 \text{ Hz}$	1 m for correct answer
9bii	$v = f\lambda$ $340 = (50)\lambda$ $\lambda = 6.8 \text{ m}$	1 m for correct working (ecf from 9bi) 1 m for correct answer
9c		1 m for correct amplitude 1 m for correct frequency (1.25 waves)
9d	• EM waves are transverse waves while sound waves are longitudinal waves. • EM waves do not need medium to travel while sound waves require a medium for its transmission. • EM waves travel at speed of $3 \times 10^8 \text{ m/s}$ in air while sound waves travel at a speed of approximately 330 m/s in air.	1 m for any correct comparison Total 2 marks
10a	Hydrogen-2 and hydrogen-3 both have the same number of protons (1) but different number of neutrons.	1 m for correct explanation
10b	${}_{15}^{32}\text{P} \rightarrow {}_{16}^{32}\text{S} + {}_{-1}^0\beta$	1 m for correct answer
10ci	technetium-99m	1 m
10cii	It emits gamma radiation, which can penetrate the body to be detected externally. It has a short half-life (6 hours), which reduces the patient's long-term exposure to radiation.	1 m for penetrating ability 1 m for safety reason
10di	No of protons decreases by 2 No of neutrons decreases by 2 or No of nucleons decreases by 4	1 m for proton 1 m for neutrons
10dii	$12/4 = 3 \text{ half lives}$ $\text{fraction remaining} = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$ $\text{No of atoms decayed} = (1 - \frac{1}{8})(7000) = 6125$	1 m for 3 half lives 1 m for correct answer Accept exact number
10diii	Radon emits alpha particles, which are highly ionising and can damage cells/DNA or causing cell mutations, when inhaled.	1 m for effects when inhaled as effects are damaging inside the body

SECTION B

QN.	SUGGESTED SOLUTION	MARK(S) AWARDED
11ai		1 m for magnetic field lines (lines are closer together nearer the wire) 1 m for direction (anticlockwise)
11aii	 Using Fleming's Left Hand Rule, magnetic field (index finger) is pointing from N to S and current (middle finger) is flowing upwards, thumb points into the plane of the paper.	1 m for correct direction drawn on figure 1 m for correct explanation of LHR
11aiii	The wire vibrates in and out of the plane of the paper 50 times a second.	1 m for motion and frequency
11bi	current in water heater = $\frac{P}{V} = \frac{2000}{230} = 8.7 \text{ A}$ combined current in both lamps = $\frac{P}{V} = 2 \times \frac{40}{230} = 0.35 \text{ A}$ Total current = $8.7 + 0.35 = 9.05 \text{ A}$ Fuse rating is not suitable as it higher than the operating current. Fuse will melt when all appliances are used together.	1 m for current in water heater 1 m for total current 1 m for choice of fuse and correctly reasoning
11bii	$E = Pt = \left(\frac{45}{60}\right)(2.0)(7) = 10.5 \text{ kWh}$ cost = $10.5 \times 28 = 294 \text{ cents}$	1 m for correct working 1 m for correct answer
12ai	As the magnet rotates, the magnetic field of the magnet cuts the coil and the coil experiences a changing magnetic flux. This changing magnetic flux induces an e.m.f. in the coil and current in the coil, lighting up the lamp.	1 m for changing magnetic flux 1 m for induced emf and current

QN.	SUGGESTED SOLUTION	MARK(S) AWARDED
12aii	According to Lenz's law, the induced current flows in a direction to oppose the approaching N-pole. End P becomes a North pole to repel the magnet. This requires the current to flow in the direction, based on right-hand grip rule.	1 m for end P becoming a N pole due to Lenz's Law 1 m for direction of current deduced from right hand grip rule
12aiii	• Rotate the magnet at a faster speed (or higher frequency). • Increase the number of turns in the coil. • Use a stronger magnet	1 m for any correct answer
12bi	$\frac{N_s}{N_p} = \frac{V_s}{V_p}$ $\frac{N_s}{400} = \frac{48000}{2400}$ $N_s = \frac{48000}{2400} \times 400 = 8000 \text{ turns}$	1 m for correct answer
12bii	$P_s = 0.85P_p$ $I(48000) = (0.85)0.12 \times 10^6$ $I = 2.1 \text{ A}$	1 m for correct working 1 m for correct answer
12biii	$A = \pi r^2 = \pi(8.0 \times 10^{-3})^2 = 2.0106 \times 10^{-4} \text{ m}^2$ $R = \frac{\rho L}{A} = \frac{3.2 \times 10^{-8} (20 \times 10^3)}{2.0106 \times 10^{-4}} = 3.2 \Omega$	1 m for correct working 1 m for correct answer