MARIS STELLA HIGH SCHOOL
SECONDARY 4 SCIENCE(PHYSICS)
2024 PRELIMINARY EXAMINATION

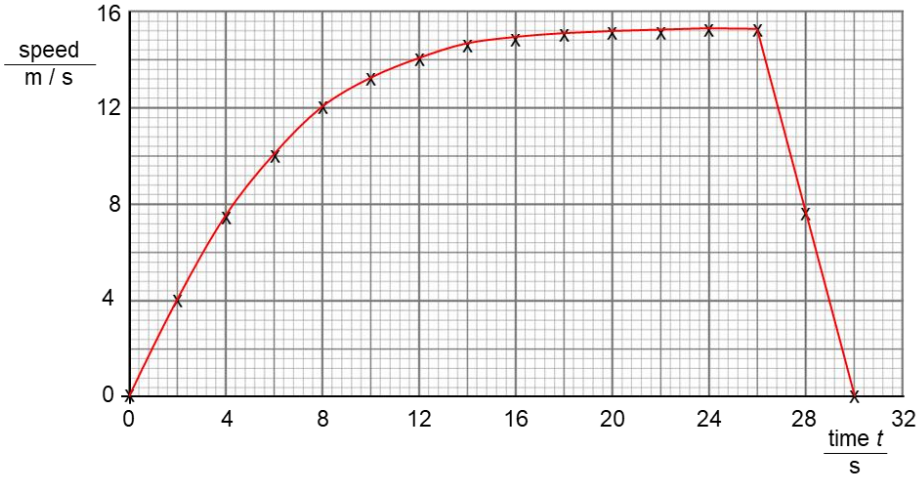
Deduction of 1 m per occurrence (cap of 1 m per type of error for the entire paper):

- Incorrect or unclear presentation **(P)** or Incorrect or missing formula **(F)**
- Incorrect or missing units **(U)**
- Incorrect no. of significant figures **(SF)**

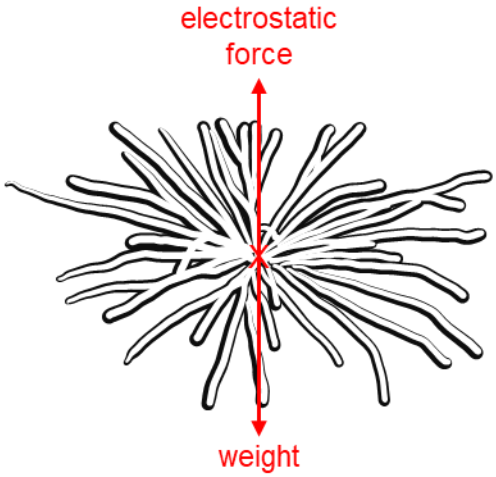
Paper 1 [20 marks]

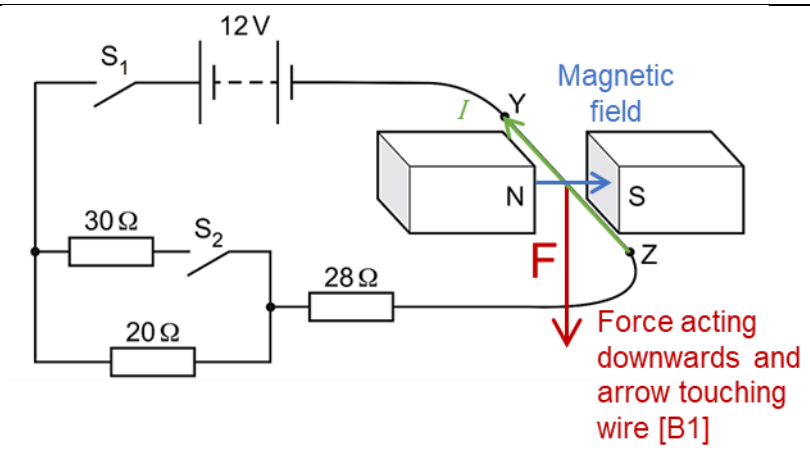
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
D	A	D	A	A	C	A	D	A	D
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	C	B	B	B	B	A	C	B	C

Paper 2
Section A [55 marks]
Answer **all** the questions in this section.

Qn		**Mark Scheme**	**Marks**
1	**(a)**	 Best fit curve from t = 0 s to t = 26 s [B1] Straight line through all 3 points from t = 26 s to t = 30 s [B1]	
	(b)	(i) $E_k = \frac{1}{2}mv^2$ $= \frac{1}{2}(46\ kg)(15.2\ m/s)^2$ $= 5313.92\ J$ $= 5300\ J\ (to\ 2\ s.f.)$	C1 A1
		(ii) $a = gradient\ of\ v-t\ graph$ $= \frac{0-15.2}{30-26}$ $= -3.8\ m/s^2$ deceleration = 3.8 m/s^2	C1 A1
		(iii) $F = ma$ $= (46+9\ kg)(3.8\ m/s^2)$ $= 209\ N$ $= 210\ N\ (to\ 2\ s.f.)$	C1 A1

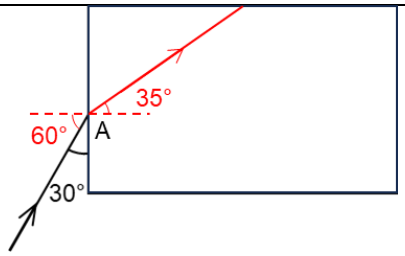
		(iii) Energy is transferred from the **kinetic store** and **gravitational potential store** of the child and sledge to **internal energy** of surroundings through a **mechanical pathway**.	B1 B1
2	**(a)**	(i) $\rho = \frac{m}{V}$ $1000\ kg/m^3 = \frac{m}{2.5\ \times\ 10^{-4}\ \times 0.12\ \mathrm{m}^3}$ $\mathrm{m} = 0.030\ \mathrm{kg}$	(F) C1 A1
		(ii) $P = \frac{F}{A}$ $= \frac{(0.030\ kg\ \times 10\ N/kg)}{2.5\ \times\ 10^{-4}\ m^2}$ $= 1200\ N/m^2$	(F) C1 A1
		(iii) $P = \frac{F}{A}$ $1200\ N/m^2 = \frac{(\rho \times 2.5\ \times\ 10^{-4}\ \times 0.15\ \mathrm{m}^3 \times 10\ N/kg)}{2.5\ \times\ 10^{-4}\ m^2}$ $\rho = 800\ kg/m^3$	C1 A1
	(c)	Turn the clamp so that the **U-tube is directly above the base** of the retort stand OR **Lower the clamp** so that the centre of gravity of the set up is lowered.	B1
3	**(a)**	(i) newton-meter OR spring balance (ii) measuring tape	B1 B1
	(b)	(i) The principle of moments states that when a **body is in equilibrium**, the **sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot**	B1 B1
		(ii) In equilibrium, taking moments about the pivot, Sum of clockwise moments = sum of anti-clockwise moments $F \times 5.000\ m = 52.0\ N \times 0.250\ m$ $F = 2.6\ N$	 (P) C1 A1
4	**(a)**	Heat is transferred via **conduction** Copper is a **good conductor** of heat as it has **free electrons**.	B1 B1
	(b)	The water around the copper pipe is **cooled**, contracts and **becomes denser**, allowing it to **sink** to the bottom. Warmer water rises to take its place forming **convection currents**. Since water is a poor conductor of heat, this cools the water below efficiently allowing **less dense room temperature water to remain above**.	B1 B1
	(c)	As temperature of the liquid decreases, the **molecules lose average kinetic energy**, they **slide over one another at lower speeds**.	B1 B1
5	**(a)**	(i) 340 m/s	A1
		(ii) $v = f\lambda$ $340\ m/s = 485\ Hz \times \lambda$ $\lambda = 0.70\ m$	(F) E1 A1
		(iii) Sound waves of different frequencies travel at the **same speed in the same medium**.	B1

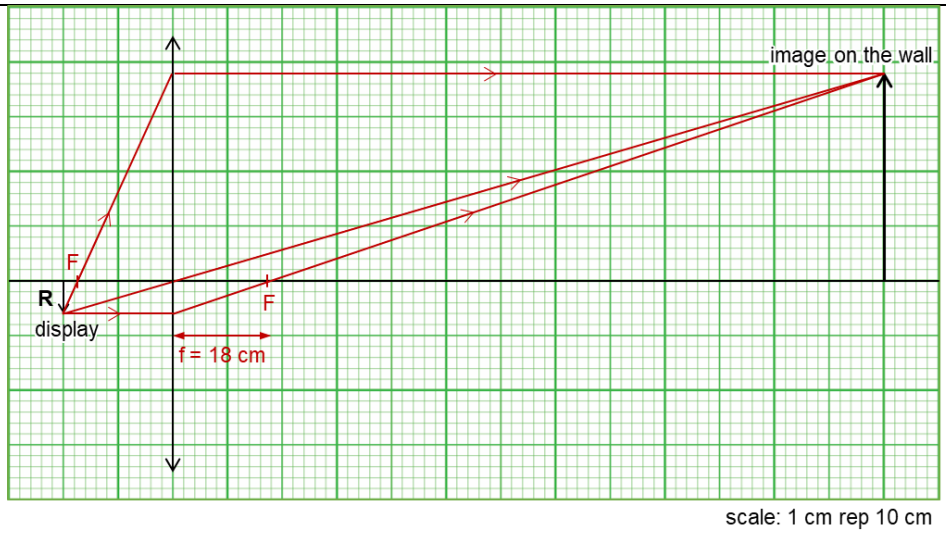
	(b)	As **speed of sound in metal is greater than in air**, the sound will take a shorter time to travel the same distance and hence timer will have a **smaller reading**.	B1
6	**(a)**	The fur **<u>lost negative charges</u>** to become positively charged. The plastic **<u>gained negative charges</u>** to become negatively charged.	B1 B1
	(b)	(i) $W = mg$ $= 0.015\ kg \times 10\ N/kg$ $= 0.15\ N$	(F) C1 A1
		(ii)  force arrows act from centre, in opposite directions but same magnitude and correctly labelled [B1]	
7	**(a)**	Q, +1.6 × 10^{-19} C or +1 charge	B1
	(b)	Q and S	B1
	(c)	(i) R and S	B1
		(ii) 99 years = 3 × $t_{1/2}$ $fraction = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$ $= \frac{1}{8}\ OR\ 0.125$	C1 A1
		(iii) β-particles can pass through the paper depending on its thickness, while α-particles would be blocked and γ-particles can pass through the paper freely.	B1
8	**(a)**	(i) Current is the rate of flow of electric charge.	B1
		(ii) $I = \frac{V}{R}$ $I = \frac{12\ V}{20 + 28\ \Omega}$ $= 0.25\ A$	(F) C1 A1
		(iii) The **magnetic field due to the current interacts with the magnetic field of the permanent magnets**. This causes a **stronger field** to be set up **above the wire** and **weaker field** set up **below the wire**. Hence YZ experiences a downward force from **stronger to weaker field**.	B1 B1

			
	(b)	(i) $\left(\frac{1}{30}+\frac{1}{20}\right)^{-1} = 12\ \Omega$ $12\ \Omega + 28\ \Omega = 40\ \Omega$	C1 A1
		(ii) When S_2 is closed, **current through the wire increases**, causing the force on YZ to **increase in magnitude** OR **become stronger**.	B1 B1

Section B

Answer **one** question from this section.

9	**(a)**	$v = f\lambda$ $3.0 \times 10^8\ m/s = f \times 589 \times 10^{-9}\ m$ $f = 5.093 \times 10^{14}\ Hz$ $= 5.1 \times 10^{14}\ Hz\ (to\ 2\ s.f.)$	(F) C1 A1
	(b)	(i) $n = \frac{\sin i}{\sin r}$ $1.5 = \frac{\sin 60°}{\sin r}$ $r = 35°\ (to\ 2\ s.f.)$	(F) C1 A1
		(ii)  Drawn using ruler and protractor where r matches answer in (b) [B1]	
		(iii) $n = \frac{c}{v}$ $v = \frac{3.0 \times 10^8\ m/s}{1.5}$ $= 2.0 \times 10^8\ m/s$	(F) C1 A1

	(c)	 scale: 1 cm rep 10 cm Correct ray diagram (any 2 correct rays with direction) [B1] Accept f = 16 – 19 cm [B1]	
		(ii) The focal length of the lens decreases.	B1
10	**(a)**	(i) $P = VI$ $3000\ W = 240\ V\ \times I$ $I = 12.5\ A$	(F) C1 A1
		(ii) 13 A	E1
		(iii) $cost = Pt \times rate$ $= 3\ kW \times \frac{10}{60}\ h\ \times 30 \times \$0.2989$ $= \$4.48\ (to\ nearest\ cent)$	(F) C1 A1
	(b)	(i) wire X: neutral wire Y: live wire Z: earth	B1 B1 B1
		(ii) The earth wire is **connected to the live terminal**. This causes the **metal casing to be live** and anybody who touches it can get an **electric shock**.	B1 B1