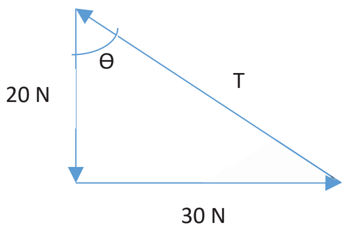
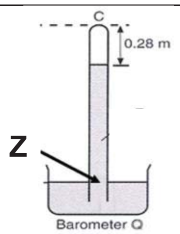
<u>**ANSWER**</u>

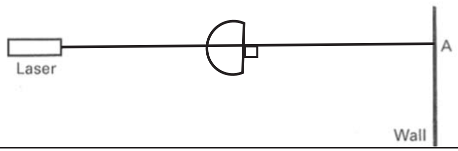
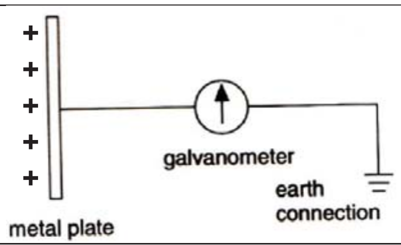
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
C	A	D	B	A	D	B	C	C	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
C	C	B	B	D	C	B	D	C	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
A	C	A	A	A	B	C	B	B	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
B	B	A	C	D	A	D	C	A	D

ANSWER

Section A

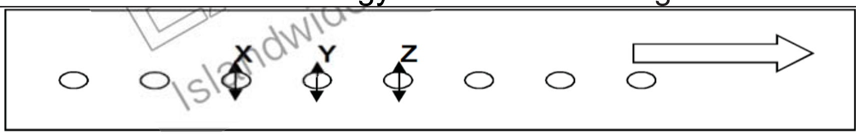
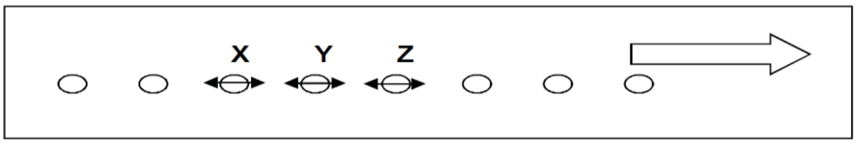
Qns	Answer	Marks
1a	Maximum height = area under the v-t graph = ½ x 110 x 1000 = 55000 m **<u>or</u>** 55km	 B1
b	Acceleration due to gravity on planet = (v-u) / t = (0-1000) / (110-10) = -10.0 m/s^2 **<u>or</u>** 10.0 m/s^2	 B1
c	From 0-10 s, rocket **moves upwards** from **rest to 1000 m/s** with **constant acceleration**. From 10-110 s, rocket **moves upwards** from **1000 m/s to 0 m/s** with **constant deceleration**.	 B1 B1
		Q1: 4 marks
2a	An object is in equilibrium if there is **no resultant force** acting on it and there is **no resultant moment** acting on it.	 B1
b	 Scale: 1cm: 10 N By measurement, $T = 36.1N$ (accept 34.0 – 38.0 N) $\theta = 56.3°$ (accept 53.5 – 59.0°)	B1 – correct diagram with arrows & scale B1 – to 1 d.p. B1 – to 1 d.p.
c	Disagree. Tension and the weight of the pendulum are **<u>not</u>** action-reaction pair since they are two different types of forces acting on the same object.	B1 (Provided reason correct) B1
		Q2: 6 marks
3a	Electronic balance	B1
b	Let m_g be the mass of gold, m_c be the mass of copper, V_g be the volume of gold and V_c be the volume of copper. $m_g + m_c = 78$ $m_c = 78 – m_g$ --- eqn 1 $V_g + V_c = 5.0$ $(m_g/19.3) + (m_c/8.92) = 5.0$ --- eqn 2 Sub eqn 1 into eqn 2 and solve for mg: $m_g = 62.102 = 62.1$ g percentage purity = 62.102/78 x 100% = 79.6%	 M1 M1 A1
		Q3: 4 marks

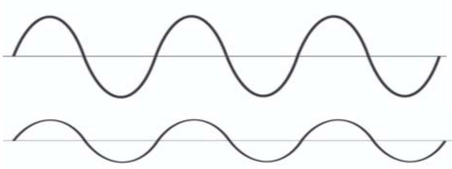
4a	It is the product of the force and the perpendicular distance from the line of action of the force to the pivot.	B1 (o.e)
b	Reading on spring balance A = 900 – 580 = 320 N	 B1
c	Let *d* m be the distance from spring A to the CG of the plank. Taking moment about spring A, at equilibrium, Clockwise moment = anti clockwise moment 900 x *d* = 580 x 1.7 d = 1.0956 m Distance of the centre of gravity from X = 1.0956 + 0.4 = 1.50 m	 M1 A1
		Q4: 4 marks
5a		B1
b	There could be gas trapped in the space above the mercury column in barometer **Q**.	B1
c	Difference in Pressure = (0.40 + 0.25) x 13 600 x 10 = 88.4 kPa **<u>Or</u>** Difference in Pressure = Pressure at X – Pressure at Y = 1.00 x 13600 x 10 – (1.00 – 0.40 – 0.25) x 13600 x 10 = 88.4 kPa	M1 A1
d	Mercury is denser compared to water. As such, lesser height of liquid column is required.	B1
		Q5: 5 marks
6a	Radiation and conduction.	B1
b	Pipe P. As the water at the absorption panel is heated, it expands and become less dense. Hence, it rises towards pipe P and flows into the water tank. The cold water which is more dense will flow down pipe Q to the absorption panel to replace the heated water, thereby giving rise to a convection current.	B1 B1
c	Rate at which energy is absorbed by the panel = 120 × 6 × 0.15 = 108 W Energy absorbed by water = 108 × 6 × 60 × 60 = 2.33 MJ	 M1 A1
d	Paint the surface of the absorption panel black.	B1
		Q6: 6 marks

7a	The balloon contains air particles with **very weak forces of attraction** between the air particles. Thus, the air particles can **move freely** and this **allows their arrangement to change** and take the shape of its container.	B1 B1
b	$P_1V_1 = P_2V_2$ $101 \times 80 = 45 \times V_2$ $V_2 = 180$ cm^3	 M1 A1
		Q7: 4 marks
8a		B1
b	Anticlockwise. As the glass block rotates in the anticlockwise direction, the angle of incidence increases and the **refracted ray bends further away from the normal** (or the angle of refraction increases), causing the bright spot to move down from **A** to **B**.	B1
c	The angle of incidence in the glass block at **O** exceeds the critical angle and the laser beam undergoes total internal reflection.	B1
d	When the spot is at B, $\tan\theta = \dfrac{1.68}{1.50}$ $\theta = 48.2°$ Critical angle = (180° − 90°) − 48.2° = 41.8° $\eta = \frac{1}{\sin 41.8°} = 1.50$	 M1 M1 A1
e	A lower refractive index will result in a **larger critical angle**. This will result in **longer** length of **AB**.	B1 B1
		Q8: 8 marks
9a	Both are transverse waves Both can travel in vacuum at 3x10^8 m/s Both do not require a medium Infrared has a higher frequency than microwaves. Microwave has a longer wavelength than infrared.	 B1 (any 1 of the 3) B1 (any 1 of the 2)
b	Speed of EM wave = 3 00000000 m/s Time = Distance / speed = 1200000 / 300000000 = 0.004 s	
c	Disagree as infrared light radiation falls outside the visual spectrum.	B1
		Q9: 4 marks
10a		B1

b	Free electrons in the metal plate are repelled by the negatively charged sphere and flow through the galvanometer to the earth. Such flow of electrons to the earth (until all the excess electrons flow to the earth) produce a current causing a momentary deflection in the galvanometer.	B1 B1
c	There is **no** deflection in the galvanometer if the metal sphere is held by a person's hand. The sphere will be discharged, as excess electrons will flow from the body to the earth, and become neutral.	B1
d	A positively charged metal sphere should be used.	B1
		Q10: 5 marks

Section B

11a	Property: Electrical voltage or electromotive force (e.m.f.) Assumption: The e.m.f. varies linearly with temperature.	B1 B1
b	The amount of energy that is needed to raise the temperature of 1 kg of lead by 1 °C is 130 J.	B1
ci	Temperature rise = 8/10 = 0.8 °C	B1
ii	$Q = mc\Delta\theta$ $= 39.5/1000 \times 130 \times 0.8$ $= 4.11$ J	M1 A1
di	Let x °C be the final temperature of the lead target. Heat lost by lead target with pellet & water = Heat gain by ice $(mc\Delta\theta)_{lead} + (mc\Delta\theta)_{water} = (ml_f)_{ice} + (mc\Delta\theta)_{ice}$ $\frac{39.5+0.5}{1000} \times 130 \times (40.0 - x) + \frac{100}{1000} \times 4200 \times (25.0 - x) = \frac{20}{1000} \times 3.4 \times 10^5 + \frac{20}{1000} \times 4200 \times (x - 0)$ $x = 7.67$ °C	M1 (for correct sub of any $mc\Delta\theta$ or ml_f) M1 A1
ii	No thermal lost to the surrounding/container of icy water.	B1
12a	Both waves transfer energy without transferring the medium.	B1
b	 <u>Explanation:</u> Light is a **transverse wave** and the particles **vibrate perpendicularly** to the wave motion.  <u>Explanation</u>: Sound is a **longitudinal wave** and the particles **vibrate parallel** to the wave motion.	B1 (must draw all 3 particles) B1 B1 (must draw all 3 particles) B1
c	Let d m be the distance between the student and the lightning. $\frac{d}{330} - \frac{d}{3\times10^8} = 4.0$ <u>**or**</u> $\frac{d}{330} \approx 4.0$ $d = 1320$ The distance between the student and the lightning is 1320 m.	M1 A1

di	Let *f* m be the distance between the student and the building. $\frac{2f}{330} = 3.0$ $f = 495$ The distance between the student and the lightning is 495 m.	M1 A1
ii		B1 (waveform with smaller amplitude but same frequency)
13E		
a	Resistance is the ratio of the potential difference across a component to the current flowing through it. SI unit is ohm (Ω).	B1
b	As the temperature of the surrounding decreases, the resistance of the thermistor increases. Since the voltage across the thermistor is proportional to its resistance, the voltage increases.	B1 B1
c	Voltage across R = 6 – 2.5 = 3.5 V	M1 A1
di	500 Ω	B1
ii	$V_b = (R_t / R_t + R_R)\ V$ $2.5 = (500 / 500 + R_R)\ 6$ $R_R = 700\ \Omega$ Max resistance of R = 700 Ω	M1 A1
iii	I = V/R = 2.5/500 = 0.005 A	M1 A1
13O		
ai	It means that when an operating voltage of 240 V is applied across the heating element, it (converts electrical energy to thermal energy at a rate of 3000 W) **<u>or</u>** (operates with a power of 3000 W).	B1
ii	$P = V^2 / R$ $R = V^2 / P$ $= 240^2 / 3000$ $= 19.2\ \Omega$	M1 A1
iii	A larger cross-sectional area means that the wire has a lower resistance. Hence, the heat produced ($E = I^2Rt$) will be much lower and hence it remains relatively cooler.	B1 B1
bi	Rod moves out of the magnet / to the left / out of paper. Current flows from A to B / magnetic field from N to S and using Fleming's Left Hand Rule, the direction of the force on the rod is out of the magnet / to the left / out of paper.	B1 B1
ii	1. The rod moves into the curved part of magnet / to the right / in the opposite direction. 2. The rod moves out of the magnet at a slower rate / moves lesser outwards. 3. The rod remains stationary.	B1 B1 B1