1 **(a)** a vector quantity: **displacement** OR **force** OR **acceleration OR** relevant answer

a scalar quantity: **distance** OR **time** OR relevant answer · **A1** [1]

(b) **(i)** **magnitude** of velocity is **constant.** · **B1**

direction changes / rotate 360⁰, velocity changes. · **B1** [2]

ANALYSIS
- *Candidate shall recall that velocity is a vector with both magnitude and direction.*
- *As the flyer is rotating, the magnitude of speed = magnitude of velocity = constant.*
- *While rotating, the direction of movement of the point is changing, so its velocity changes as well.*
- *When the point returns to the original starting point, its velocity returns to original value, so there is no change in velocity eventually.*

CAUTION
- *Do not confuse between speed and velocity.*
- *Speed is constant throughout but the velocity is changing.*

(ii) $C = \pi D = \pi (2r)$

$r = \dfrac{C}{2\pi} = \dfrac{(0.24)(30)(60)}{2\pi} = 68.75 \text{ m} = 69 \text{ m (2 s.f.)}$ · **M1**

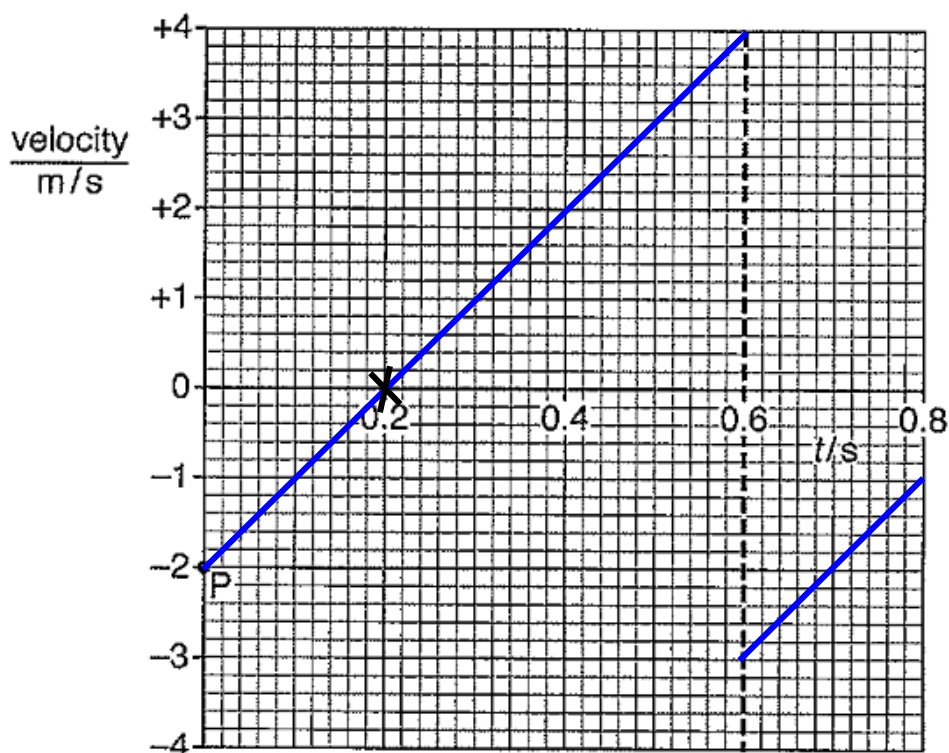radius = **69 m** OR **68.8 m** · **A1** [2]

CAUTION
- *Most students are taught to put 3 s.f. for all their answers in the school. In fact, this is a very serious misconception.*
- *Ensure your final answer is in 2 s.f. because the final answer shall follow the "lower s.f. rule".*

2 **(a)** acceleration   A1   [1]

(b) **(i)**

correct shape   B1

correct plotted points   B1   [3]

same gradient for both lines   B1

CAUTION
- *Many candidates drawn the second part wrongly and didn't realise that velocity is negative when it changes in the opposite direction.*

(ii) **As shown in (i)**   A1   [1]

[5 MARKS]

3 **(a)** net / resultant force = 0   **B1**

OR   **OR**

upward/ thrust force = downward force / weight / gravitational force   **(B1)**   [1]

ANALYSIS
- *When the main remains stationary in mid-air, (downwards) weight = upward force.*

(b) **(i)** mass is total amount of substance / resist change in velocity   **M1**

weight is gravitational force / force of gravity acting on a body.   **A1**

OR   OR

mass is constant everywhere while   **(M1)**

weight depends on gravity / gravitational field strength / location   **(A1)**

OR   OR

mass is a scalar quantity while   **(M1)**

weight is a vector quantity   **(A1)**

OR   OR

mass has unit kilogram while   **(M1)**

weight has unit newton.   **(A1)**   [2]

(ii) $m_{\text{total}} = m_{man} + m_{jetpack} = \mathbf{75} + \dfrac{\mathbf{160}}{\mathbf{10}} = 91 \text{ kg}$ **M1**

mass = **91 kg** OR **91.0 kg**   **A1**   [2]

(iii) $F - mg = ma$

$F = ma + mg = m(a + g) = \mathbf{91}(\mathbf{0.20} + \mathbf{10}) = 928.2 \text{ N}$ **M1**

Force = **928 N** OR **930 N**   **A1**   [2]

4 **(a)** **product of force and distance / displacement**   M1

           moved in the direction of the force.   A1   [2]

     (b) loss of **gravitational potential energy**   B1

           & loss of **kinetic energy** are   B1

           converted to **thermal energy / heat & sound**.   B1   [3]

           CAUTION

           Most students mentioned about "GPE converted to KE", but the shuttle cock slows down actually, as mentioned in the question. So, it should be the loss of GPE and KE that is converted to heat and sound.

     (c) $KE = \dfrac{1}{2}mv^2$

           $\dfrac{1}{2}\left(5.0 \times 10^{-3}\right)v^2 = 0.36$ M1

                                      speed = **12 m s^{-1}**   A1   [2]

5 **(a)** **higher filament resistance** (than connecting wire). **M1**

higher heat / thermal energy / power dissipation leading to higher temperature, so it glows. **A1** [2]

ANALYSIS
- *As filament lamp has smaller cross-sectional area as compared to the connecting wires, filament lamp has greater resistance.*
- *Larger resistance implies greater heat dissipation using $P = I^2R$.*
- *This causes higher temperature of filament lamp.*
- *When a material experiences rise of temperature, it will emit EM radiation such as the infrared. If temperature keep rising, it will emit all sorts of colors including those in the visible spectrum and finally it glows white when all colors are emitted.*

(b) **filaments heat up surrounding gas molecules**. **B1**

hot molecules expand, becomes **less dense** and **rises.** **M1**

colder air above is **denser** and **falls,** **A1** [3]

sets up convection current transferring thermal energy inside the lamp.

(c) **glass is solid / closely packed**, so energy is transferred via vibration / collision from hot to colder neighbouring glass molecules. **B1** [1]

ANALYSIS
- *Conduction only can occur in solid.*
- *Convection only occurs in flowing medium such as liquid and gas.*
- *Radiation doesn't require medium.*

6 **(a)** **(i)**

name of component	wavelength / m		
Ultraviolet / UV	1×10^{-7}	**A1**	
infrared	1×10^{-5}	**A1**	[2]

(ii) **x-ray** OR **gamma ray** **A1** [1]

(ii) **radioatherapy / chemotherapy / kill cancer cells** OR

damage biological molecules / abnormal cell division OR

sterilising / disinfect medical equipment OR

food preservation OR

detect cracks in metal OR **A1** [1]

locate leaks from underground OR

security scan OR

dental scan OR

bone diagnosis

(b) **(i)** **transverse waves** OR **carry no charge** OR **obey law of reflection /** **A1** [1]
refraction OR **no need medium/ travel in vacuum**

(ii) $f = \dfrac{v}{\lambda} = \dfrac{\textbf{3.0 x 10}^{\textbf{8}}}{\textbf{2 x 10}^{\textbf{-2}}} = 1.5 \times 10^{10}$ Hz **M1**

frequency = **1.5 x 10^{10} Hz OR 1.50 x 10^{10} Hz** **A1** [2]

7 **(a)** **(i)** electrons / negative charges flow / move / transferred from screen to cloth. B1 [1]

(ii) unlike charges attract B1

positive charges (on screen) attract negative charges of dust near to screen B1

attractive force is greater than repulsive force B1 [3]

ANALYSIS
- *As TV screen is positively charged, it attracts the negative charges in the dust particles. However, they are insulators so there is no transfer of charges between them, instead the charges stay on its surfaces.*
- *Dust particles are neutral. While the left side of dust particles are negatively charged, the right side of the particles are positively charged to maintain its neutrality.*
- *Attractive force between positive charges on screen & negative charges on dust is greater than repulsive force between negative charges on screen and dust particles., so the dust particles stick to the TV screen.*

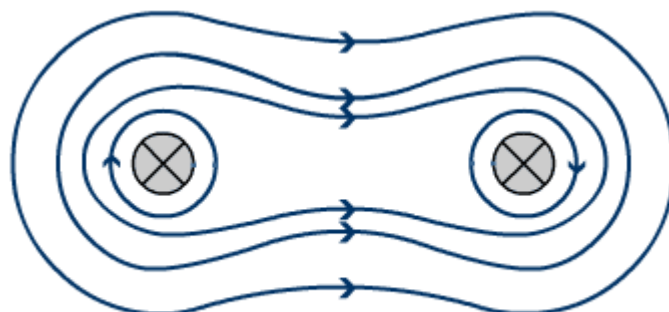**(b)** **(i)** plastic rod repels glass rod. B1 [1]

ANALYSIS
plastic rod is positively charged and like charges repel, exerts downward force on glass rod.

(ii) rod experience non-contact repulsive electric force B1 [1]

8 **(a)**

MARKING

correct direction of arrows — **B1**

correct shape — **B1**

circles with increasing distance — **B1** [3]

(b) **(i)** $V = IR$

Effective resistance for rods in parallel $= \dfrac{1}{\dfrac{1}{1} + \dfrac{1}{1}} = \mathbf{0.5\ \Omega}$ — **C1**

$\mathbf{12 = (6)(R + 0.5) = (6)(R + 0.5)}$ — **M1**

resistance = **1.5 Ω** — **A1** [3]

(ii) **Turns off faster** OR **can be reset** OR **can detect leakage of current to earth.** — **A1** [1]

NOTE

Please read Physics Compendium as the answers are there.

9 **(a)**

	switch S_1	switch S_2
Point P	**closed**	**closed**
Point R	**open**	**open / closed**

A1
A1
[2]

ANALYSIS
- *When S_1 and S_2 are closed, short circuit occurs and current flows will be maximum.*
- *When S_1 is opened, no current flows. So voltmeter reads e.m.f. E of the solar cell. As long as S_1 is opened, S_2 can be either closed or open as it doesn't affect the results needed.*

(b) **(i)** $V = 4 \times 0.59 = 2.36$ V

maximum voltage = **2.36 V** OR **2.4 V**

A1 [1]

ANALYSIS
- *Refer to Table 9.1, for a single solar cell, the maximum voltage is 0.59 V.*
- *When 4 solar cells are connected in series, we need to multiply the individual solar cell voltage by 4.*

(ii) $I = \dfrac{V}{R} = \dfrac{2.36}{2} = 1.18$ A

current = **1.18 A** OR **1.2 A**

A1 [1]

(c) **(i)** **ratio of output power to input power** and express in percentage. **B1**

OR **OR**

ratio of output energy to input energy and express in percentage. **(B1)** [1]

(ii) **At P, voltage is zero** **B1**

At R, current is zero **B1** [2]

ANALYSIS
- *Power = voltage x current.*
- *At P, voltage is zero, so power output is zero.*
- *At R, current is zero, so power output is zero.*
- *Efficiency is the ratio of power output to power input. So, both P and R have zero efficiency.*

(iii) **1.**

$$\text{efficiency} = \frac{\text{power output}}{\text{power input}} \times 100\%$$

$$0.18 = \frac{2}{\text{power input}}$$ **M1**

energy per second = **11.1 W** or **11 W** **A1** [2]

2.

$$\text{surface area} = \frac{11.1}{1000}$$

area = **0.0111 m^2** OR **0.011 m^2** **A1** [1]

(iv) **brightness is proportional to maximum power output.** **B1** [1]

ANALYSIS
- *Power input is proportional to brightness since brightness is power per unit area (area is a constant).*
- *From Table 9.1, brightness is proportional to maximum power output, which implies power output is proportional to power input.*
- *Efficiency is ratio of power output to power input, so efficiency is constant regardless of brightness.*

10 (a) (i) current reverses direction every half a cycle / revolution — **B1** [1]

(ii) **alternating current** in primary coil — **B1**

generates / produces alternating /changing magnetic flux in iron **core** — **M1**

secondary coil experiences changing magnetic flux, — **A1** [3]

so e.m.f. is induced in secondary coil.

(b) (i) $f = \dfrac{1}{T} = \dfrac{1}{40 \times 10^{-3}} = 25\,\text{Hz}$ — **M1**

frequency = **25 Hz** and **25.0 Hz** — **A1** [2]

(ii) $\dfrac{N_s}{N_p} = \dfrac{V_s}{V_p}$ — **A1** [1]

(iii) $V_s = 2 \times 5 = 10\,\text{V}$

$\dfrac{N_s}{N_p} = \dfrac{V_s}{V_p}$

$\dfrac{1}{4} = \dfrac{10}{V_p}$ — **M1**

amplitude = **40 V** — **A1** [2]

11   EITHER

(a)   ratio of   M1
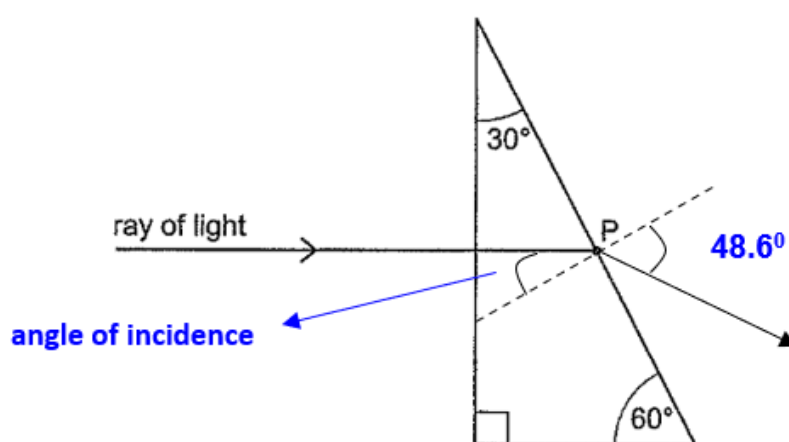
speed (of light) **in vacuum to speed** (of light) **in medium.**   A1   [2]

CAUTION

Do not write "real/apparent depth" or sin I / sin r as the question asked you to

define refractive index in term of speed.

(b)   (i)

B1

B1   [2]

(ii) $\eta = \dfrac{\sin i}{\sin r}$

$1.5 = \dfrac{\sin i}{\sin 30} \rightarrow$ angle of refraction = **48.6⁰**   B1

angle of deviation = **48.6⁰ – 30⁰** = 18.6⁰   M1

angle = **18.6⁰**   A1   [3]

(c) **(i)**
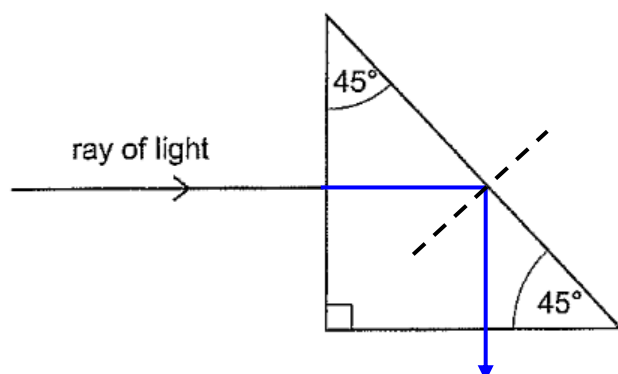
A1 [1]

(ii) angle of incidence is greater than critical angle — B1

ray travels from denser to less dense medium — B1 [2]

11 OR

(a) **measure resistance of wire when it is immersed in pure melting ice** at standard atmospheric pressure (ice point). — B1

measure resistance of wire when it is placed above steam / pure boiling water at standard atmospheric pressure (steam point). — M1

divide the interval between the two values of resistance **into 100 equal parts.** — A1 [3]

(b) **(i)** **J ^{0}C^{-1}** OR **J K^{-1}** OR **joule per degree celsius** OR **joule per kelvin** — A1 [1]

(ii) **1.** $Q = mc\Delta\theta = (1.2)(4200)(90 - 20) = 352800$ J

energy = **353000** J OR **350000** J OR **3.5 x 10^5** J OR **3.53 x 10^5** J

2. energy wasted per year = $\dfrac{352800 \times 365}{3.6 \times 10^6}$ — M1

energy = **35.8** kW h OR **36** kW h — A1 [2]

(iii) **some energy is used to increase the temperature of the kettle** — B1

some energy is lost to surroundings. — B1 [2]

WISH YOU SUCCESS IN A LEVEL 😊

FOR TEACHER REFERENCE

QUESTION NUMBER	TOTAL MARKS
QUESTION 1	5
QUESTION 2	4
QUESTION 3	7
QUESTION 4	7
QUESTION 5	6
QUESTION 6	7
QUESTION 7	6
QUESTION 8	7
QUESTION 9 (DATA ANALYSIS)	11
QUESTION 10	9
QUESTION 11 (EITHER)	10
QUESTION 11 (OR)	10
TOTAL MARKS	80