Question 1

(a) $[\ v\ ] = ms^{-1}$

while $[\ \rho\ ] = kg\ m^{-3}$

$[\ E\ ] = kg\ m^{-1}s^{-2}$ ……. [B1]

$$[\ E/\rho\ ]^2 = \left[\ \frac{kg\ m^{-1}s^{-2}}{kg\ m^{-3}}\ \right] = m^4s^{-4}$$ …… [M1]

since unit of v is different from the unit of $(E/\rho)^2$, hence this equation is not homogenous… [A1]

(b) (i)

$$V = \frac{\pi}{4}d^2h$$

$$\frac{\Delta V}{V} = \frac{2\Delta d}{d} + \frac{\Delta h}{h}$$

$$= \frac{2(1)}{16} + \frac{1}{28}$$ ……. [C1]

$$= 0.1607$$

$$= 16\%$$ ……. [A1]

(ii) The student may use vernier caliper instead of ruler to measure both diameter and height since the dimension is small ……..[B1]
OR:
the vernier caliper has smaller uncertainty of measurement / more precise …….. [B1]
OR
This can reduce the percentage of uncertainty of volume …….. [B1]

Question 2

(a) (i) (constant velocity) hence no resultant force/forces balanced/inequailibrium [B1]

Friction and (component of) weight diwn slope = tension (component) up slope [B1]

(ii) 1. 400 cos 40 [C1]

= 306 N [A1]

2. 40 *sin* 40 [C1]

= 257 N [A1]

(b) resultant force no longer zero/ forces no longer balanced [B1]

Accelerate (along the slope) / increase velocity [B1]

Question 3

(a) (i) force *x* perpendicular distance from pivot [B2]

(ii) (one) force *x* (perpendicular) distance between two forces [B1]

(b) (i) $\tau = Fd$

$= 25\ (30 \times 10^{-2})$ [C1]

$= 7.5$ Nm [A1]

(ii) (resultant force is zero), resultant turning effect is not zero/ the resultant moment is a clockwise moment [B1]

Not in equilibrium [B1]

Question 4

(a) Young modulus = stress/ strain [M1]
Within which Hooke's law is obeyed [A1]

(b) (i) $\frac{e}{l} = \frac{0.55 \times 10^{-3}}{1.8}$ [C1]

$= 3.06 \times 10^{-4}$ [A1]

(ii) $Y = \frac{Fl}{Ae}$

$F = 2 \times 10^{11} \times 3.1 \times 10^{-4} \times 1.2 \times 10^{-7}$ [C1]

$= 7.33$ N [A1]

(c) (i) Young modulus is half, extension will be twice [C1]

$e = 1.1$ mm

(iii) limit of proportionality not exceeded/ elastic limit is not exceeded [B1]

Question 5

a The microwaves are diffracted at the two slits. [1]
Beyond the slits, the waves interfere. A maximum signal is registered when the waves interfere constructively. [1]
A minimum signal is registered when the waves interfere destructively. [1]

b $\lambda = \frac{ax}{D}$ [1]

$x = \frac{\lambda D}{a} = \frac{2.8 \times 80}{4.0}$ [1]

$x = 56$ cm [1]

c i $x = \frac{\lambda D}{a} \propto \frac{1}{a}$; hence as a is halved, x is doubled (112 cm). [2]

ii $x = \frac{\lambda D}{a} \propto D$; hence as D is doubled, x is doubled (112 cm). [2]

Question 6

a $E = \dfrac{V}{d} = \dfrac{600}{3.0 \times 10^{-2}}$ [1]

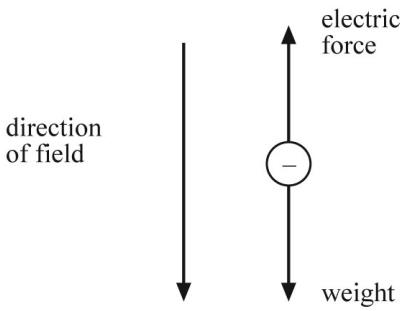
$E = 2.0 \times 10^4$ V m^{-1} [1]

The field acts towards the negative plate. [1]

b The electric field is uniform between the plates (except at the 'edges'). [1]

The electric field is at right angles to the plate. [1]

c **i**



Since the droplet is stationary, the electric force on the droplet must be equal and opposite to its weight. [1]

The electric force must act upwards, so the charge on the droplet must be negative. [1]

ii $E = \dfrac{F}{Q}$

$Q = \dfrac{F}{E} = \dfrac{6.4 \times 10^{-15}}{2.0 \times 10^4}$ [1]

$Q = 3.2 \times 10^{-19}$ C [1]

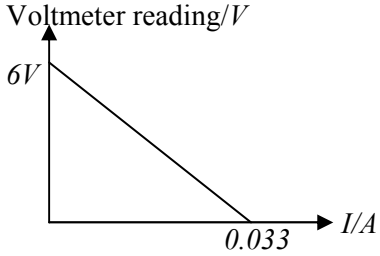
Question 7

a $V_{out} = \dfrac{R_2}{R_1 + R_2} \times V_{in}$ [1]

$V = \dfrac{200}{180 + 200} \times 6.0$ [1]

$V = 3.16$ V ≈ 3.2 V [1]

b As the resistance decreases, the p.d. across the variable resistor decreases. [1]



Correct values marked [1]

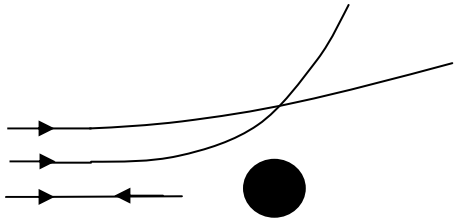
Correct straight line [-] gradient [1]

$E = V + Ir$

$V = -rI + E$

Question 8

a [1] mark for each line, middle line deviated more than top line [3]



(b) Initial k.e. of α-particle is greater when faster [1]
More work has to be done in approaching nucleus or more p.e. so closer [1]