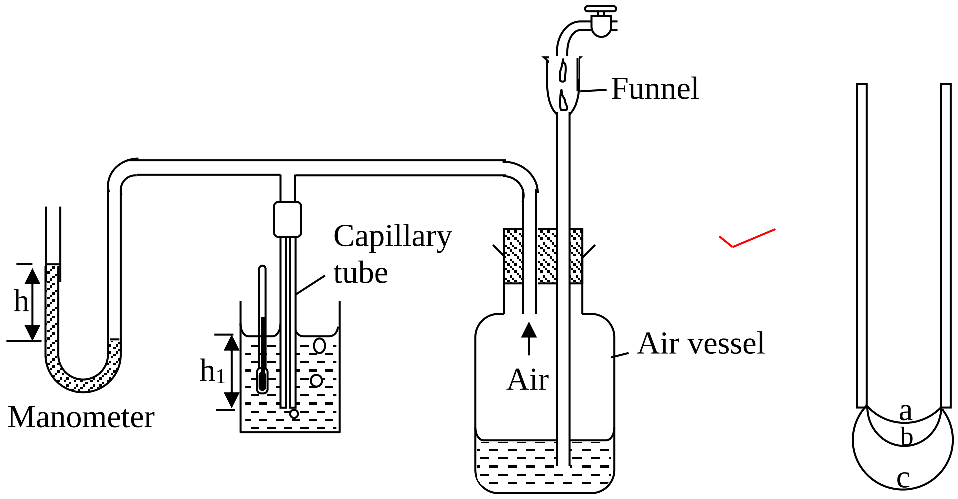
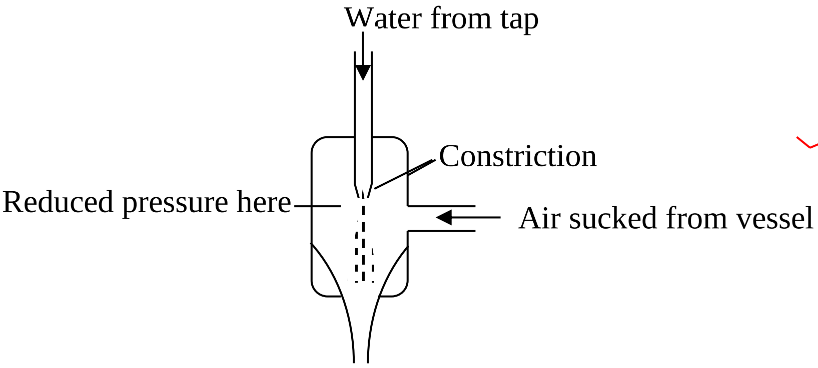
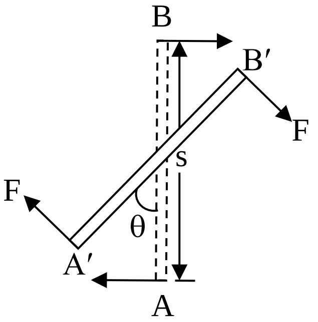
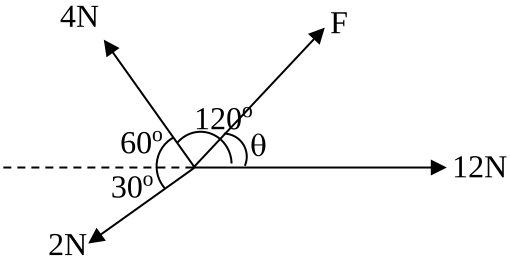
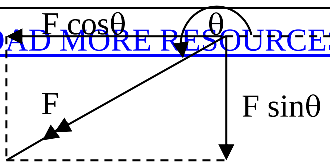
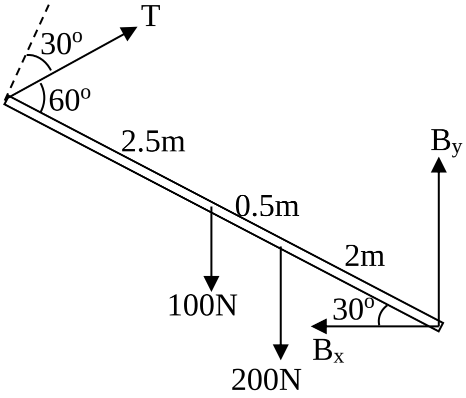
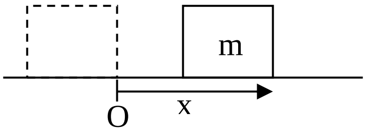
Qn	Answer	Marks
1 (a)	(i) …. the force per metre length acting in the surface at right angles to one side of a line drawn in the surface. ✓	1
	(ii) The powder moves away from the centre to the sides. ✓ This is because the soap solution reduces the surface tension at the centre. ✓ So, there is a resultant force acting away from the centre. ✓ This carries the powder away from the centre.	1 1 1
(b)	 ✓ - The apparatus is set up as shown, with a capillary tube connected an air vessel and a manometer containing a suitable liquid. - The lower end of the capillary tube is dipped into a beaker containing a liquid. ✓ - The temperature of the liquid is read and noted. ✓ - Water from a tap is slowly run into the air vessel while observing the manometer levels. The height h is observed to rise to maximum before collapsing. The maximum value of h is noted. ✓ Now the manometer height is maximum when the diameter of the bubble in the liquid inside the air vessel is minimum. i.e. when the diameter of the bubble equals that of the capillary tube. Let P = atmospheric pressure ρ = density of liquid in the manometer h_1 = depth of end of the capillary tube below the liquid surface ρ_1 = density of the liquid in the beaker. Then, inside pressure = $P + h\rho g$ Pressure outside the bubble = $P + h_1\rho_1 g$ Excess pressure = $(P + h\rho g) – (P + h_1\rho_1 g)$ ✓ = $(h\rho – h_1\rho_1)g$	1 ½ ½ 1

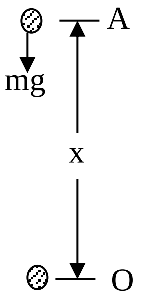
	$\therefore \quad \frac{2\gamma}{r} = (h\rho - h_1\rho_1)g$ $\therefore \quad \gamma = \frac{1}{2}rg(h\rho - h_1\rho_1)$ - The procedure is repeated for various temperatures of the liquid. The surface tension, γ, is found to be less at higher temperatures.	½ ½ 1 1
(c)	(i) For streamline motion of an incompressible non-viscous fluid, the sum of the pressure at any part, plus the kinetic energy per unit volume, plus the potential energy per unit volume there is always constant.	1
	(ii)  - The filter pump has a constriction in the middle so that the water from the tap jets out of the tube at high speed. - This makes the air in the region of the jet to move faster than that elsewhere. - This, according to Bernoulli's principle, leads to reduced pressure in that region. - So air is sucked from the vessel connected to the filter pump and is carried along with the flowing water.	1 ½ ½ ½ ½
(d)	(i) Total pressure = Static pressure + dynamic pressure i.e. $P_{tot} = P_{stat} + \frac{1}{2}\rho v^2$ $\therefore \quad v = \sqrt{\frac{2}{\rho}(P_{tot} - P_{stat})}$ $= \sqrt{\frac{2}{10^3}(1.30 - 1.25)10^5}$ $= \mathbf{3.16\ m\ s^{-1}}$	1 1 1

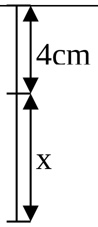
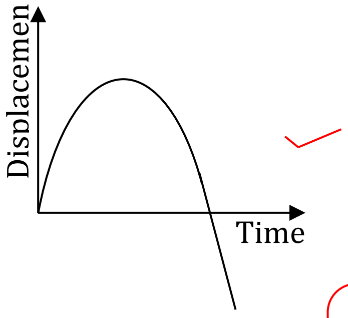
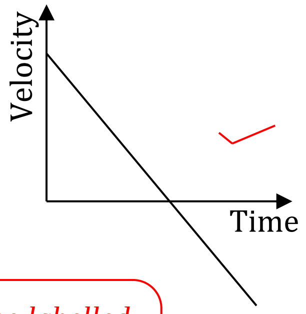
		1
	(ii) Mass flow rate = $A v \rho$ ✓ = $30 \times 10^{-4} \times 3.16 \times 1000$ = **9.48 kg s^{-1}** ✓	1 1
	Total =20	
2 (a)	(i) ….a pair of equal unlike parallel forces having different lines of action on a ✓ body.	1
	(ii) Work is said to be done when the point of application of a force moves in the direction of the force. ✓ It is measured by the product of the force and the distance moved in the direction of the force.	1
(b)	Let the lines of action of the forces, F, be separated by a distance s.  Suppose the body AB rotates through an angle θ to position A′B′. Thenthe distance moved by each of the forces, F, is $\frac{1}{2}s\theta$ ✓ The total work done by the two forces is $W = 2 \times F \times \frac{1}{2}s\theta$ ✓ $= F.s\theta$ ✓ But F.s is the torque of the couple ∴ **Work done by a couple = torque x angle of rotation** ✓	1 1 1 1
(c)	Let the required force be F at an angle θ to the 12 N force.  Then, for equilibrium $F\cos\theta + 12 - 4\cos 60^o - 2\cos 30^o = 0$ ✓ ∴ $F\cos\theta = 4 \times 0.5 + 2 \times 0.866 - 12 = -8.27$ N ✓ and $F\sin\theta + 4\sin 60^o - 2\sin 30^o = 0$ ✓ ∴ $F\sin\theta = 2 \times 0.5 - 4 \times 0.866 = -2.46$ N ✓	1 ½ 1 ½

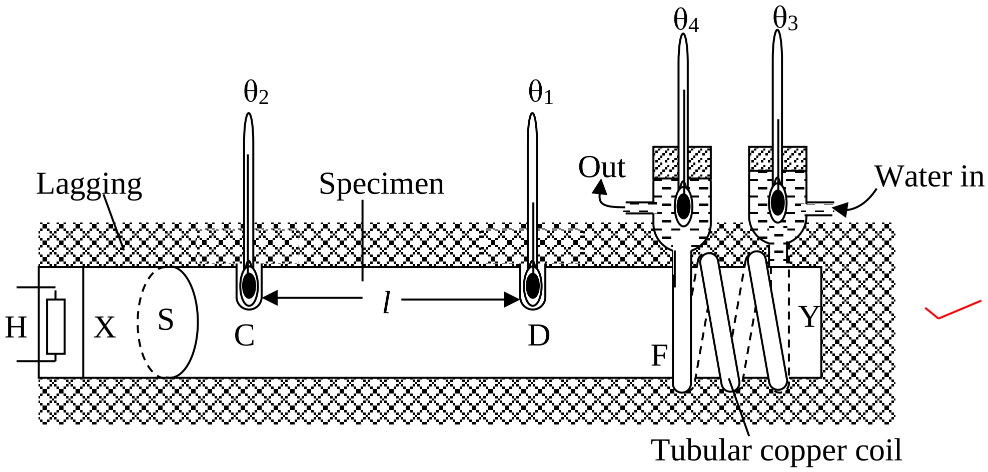


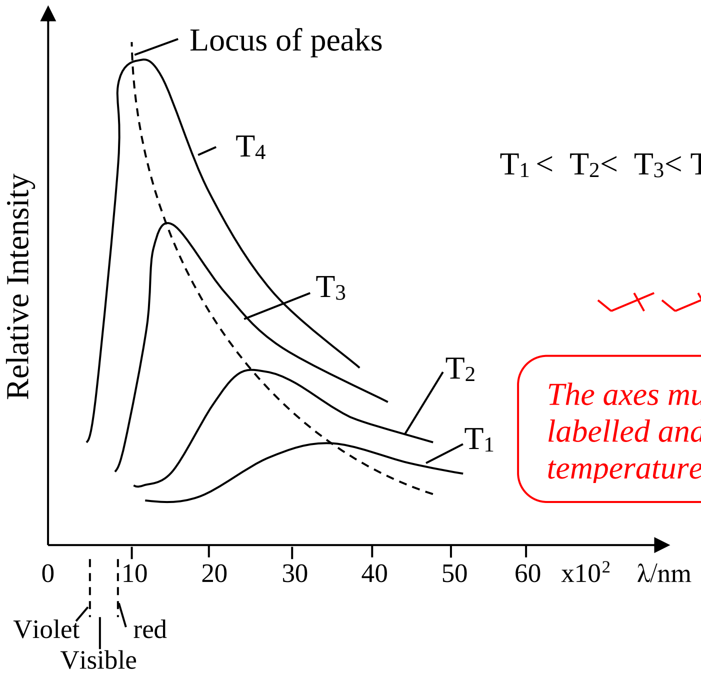
	∴ F = $\sqrt{8.27^2+2.46^2}$ = **8.63 N** ✓ θ = $\tan^{-1}\left(\frac{-2.46}{-8.27}\right)$ ✓ = **196.6°** **(163.4°)** ✓	1 1 1
(d)	 (i) Taking moments about the hinge T cos30° x 5 = 200 x 2 cos30° + 100 x 2.5 cos30° ✓ ∴ 5T = 400 + 250 ✓ ∴ T = **130 N** ✓	1 1 1
	(ii) Now, B_x = T cos30° = 130 x 0.866 = 112.6 N ✓ B_y + T sin30° = 100 + 200 ✓ ∴ B_y = 300 – 65 = 235 N ✓ ∴ Reaction = $\sqrt{B_x^2+B_y^2}$ = $\sqrt{112.6^2+235^2}$ ✓ = **260.6 N** ✓	1 1 1 1 1
	Total = 20	
3 (a)	(i) See P1 S5 Exam Nov 2009 Q3(a)(ii) ✓ ✓ ✓	3
	(ii) The frictional force provides the centripetal force on the coin ∴ $mr\omega^2 = \mu mg$ ✓ $r(2\pi f)^2 = ug$ ✓ ∴ $f = \frac{1}{2\pi}\sqrt{\frac{\mu g}{r}}$ ✓ $= \frac{1}{2\pi}\sqrt{\frac{0.5 \text{ x } 9.8}{5 \text{ x } 10^{-2}}}$ = **1.58 Hz** ✓	1 ½ ½ 1

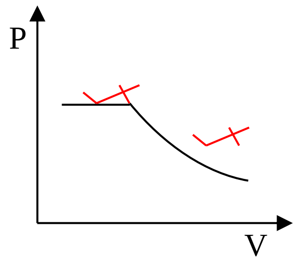
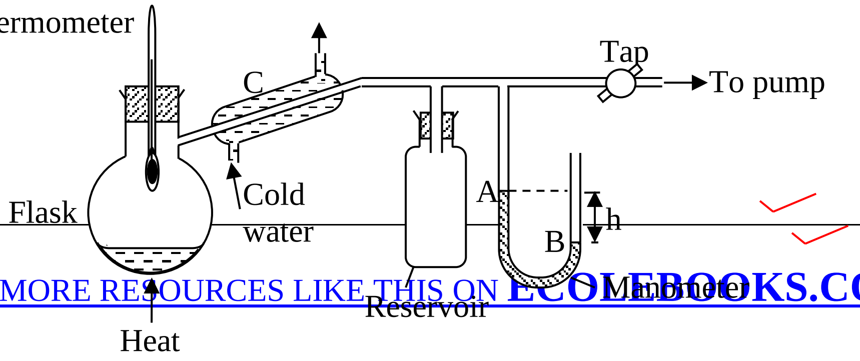
(b)	(i) …the work done in moving a mass of 1 kg from infinity to a point. ✓	1
	(ii) Total energy, E $= \text{p.e} + \text{k.e}$ ✓ $= \frac{-GMm}{R} + \frac{1}{2}mv^2$ But $\frac{mv^2}{R} = \frac{GMm}{R^2}$, the centripetal force $\therefore \quad \frac{1}{2}mv^2 = \frac{GMm}{2R}$ ✓ $\therefore \quad E = \frac{-GMm}{R} + \frac{GMm}{2R} = \frac{-GMm}{2R}$ ✓	1 1 1
	(iii) Due to friction in the Earth's atmosphere, the satellite energy decreases and consequently it falls to an orbit of smaller radius, say r_1. ✓ So its total energy changes from $\frac{-GMm}{2r_o}$ to $\frac{-GMm}{2r_1}$ ✓ In particular its kinetic energy changes from $\frac{GMm}{2r_o}$ to $\frac{GMm}{2r_1}$ ✓ Since $r_1 < r_o$, the final kinetic energy is greater. So the satellite speeds up and may heat up and even burn unless precautions are taken. ✓	1 1 1 1
(c)	(i) …the motion of a particle whose acceleration is directed towards a fixed point in its path and is directly proportional to the particle's displacement from that point. ✓	1
	(ii) Let k = constant of the combination When a force, say F, is applied to the combination, the total extension, $e = \frac{F}{k} = \frac{F}{k_1} + \frac{F}{k_2}$ (the springs experience the same force) ✓ $\therefore \quad k = \frac{k_1 k}{k_1 + k_2}$ ✓  Suppose that at an instant, m is at a displacement x from the equilibrium position, O. Then, if a is the acceleration of m, considered positive away from O, we have that $ma = -kx$ ✓	½ 1 1 ½

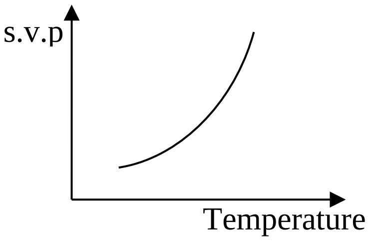
	∴ $a = -\frac{k}{m}x$ ✓ The negative sign means that the acceleration, a, is towards a fixed point O; and since k and m are constant, it follows that $a \propto x$ ⇒ simple harmonic motion. ✓ The expression may be written as $a = -\omega^2 x$, where $\omega = \sqrt{\frac{k}{m}}$ = angular frequency If T is the period, $\omega = \frac{2\pi}{T}$ ✓ $\therefore \frac{2\pi}{T} = \sqrt{\frac{k}{m}}$ $\therefore T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{m(k_1 + k_2)}{k_1 k_2}}$ ✓	½ ½ 1
	Total = 20	
4 (a)	(i) A force is termed conservative if the work it does in moving a body depends only on the original and final positions of the body irrespective of the path taken. ✓	1
	(ii) Suppose a particle of mass m moving vertically upwards passes the datum level, O, with a velocity u.  Then the particle's mechanical energy at O is m.e = k.e + p.e $= \frac{1}{2}mu^2 + 0 = \frac{1}{2}mu^2$ ✓ When the particle is at point A its potential energy = mgh and its velocity, v, is given by $v^2 = u^2 - 2gx$. ✓ Thus, its kinetic energy is $\frac{1}{2}mv^2 = \frac{1}{2}m(u^2 - 2gx)$ ✓ Hence, the total mechanical energy of the particle at A is m.e = k.e + p.e $= \frac{1}{2}m(u^2 - 2gx) + mgx$ ✓ $= \frac{1}{2}mu^2$ ✓ Which is the same as the total mechanical energy at O.	1 ½ 1 1 ½
(b)	(i) $k = \frac{0.4 \times 9.8}{0.04} = 98\ n\ m^{-1}$ ✓ Let x = maximum extension of the spring p.e lost by the spring = elastic energy of the spring	1

	 ∴ $mg(0.04 + x) = ½kx^2$ ✓ ∴ $0.1 \text{ x } 9.8(0.04 + x) = ½ \text{ x } 98x^2$ ∴ $0.04 + x = 50x^2$ ∴ $50x^2 – x – 0.04 = 0$ ✓ ∴ $x = \frac{1 \pm \sqrt{1+8}}{100} = \mathbf{0.04 \text{ m}}$ ✓	1 1 1
	(ii) As the mass moves up, the energy of the spring is converted into potential energy and kinetic energy. At the initial position of the pan, it has risen 0.04 m. Let v = its velocity there Then $½mv^2 + mgx = ½kx^2$ ✓ ∴ $v^2 = \frac{k}{m}x^2 – 2gx = \frac{98}{0.1} \text{ x } 0.04^2 – 2 \text{ x } 9.8 \text{ x } 0.04$ ✓ $= 0.784$ ∴ $v = \sqrt{0.784} = \mathbf{0.885 \text{ m s}^{-1}}$ ✓	1 1 1
(c)	(i) …equal changes of velocity in equal time intervals. ✓	1
	(ii)  ✓  ✓ *Axes must be labelled*	2
(d)	(i) 72 km h^{-1} = 20 m s^{-1} and 18 km h^{-1} = 5 m s^{-1} Let t = time taken between A and B Then $½(20 + 5)t = ½ \text{ x } 2.5t^2$ ✓ ∴ $25 = 2.5t$ ✓ ∴ $t = \mathbf{10 \text{ s}}$ ✓	1 1 1
	(ii) Distance AB $= ½ \text{ x } 2.5 \text{ x } 10^2$ ✓ $= \mathbf{125 \text{ m}}$ ✓	1 1
	Total = 20	
5 (a)	(i) …the heat flow rate per unit area per unit temperature gradient. ✓	1

	(ii) In metals conduction is predominantly due to freely moving electrons (in addition to lattice vibration).	1
	When a part of a metal is heated, the free electrons gain thermal energy and their velocities increase.	1
	They distribute this energy by collision with positive ions in the lattice and increase the ions' vibrational energy.	½
	Because electrons are light, they are able to move quickly to the cooler parts of the solid.	½
	(iii) 	1
	Thespecimen XY is long compared with its diameter. All this is aimed at achieving a steep temperature gradient with a measurable heat flow rate.	1
	- The diameter of the bar is measured to determine its cross-sectional area, A, and the apparatus is set up as shown.	½
	- To measure the temperature gradient, thermometers are placed in holes C and D bored in the bar at a measured distance, *l*, apart. These holes are filled with mercury for good thermal contact.	½
	- The specimen is heated at end X while it is cooled by circulating water at Y. The setup is kept running until all the temperatures have become steady and they are measured.	1
	- Then the cooling water circulating is collected over a measured time interval and the mass of it, m, flowing per second is found.	½
	Calculations:	

	Let k = thermal conductivity of the specimen Then the heat flow rate, q = $\frac{kA(\theta_2 - \theta_1)}{l}$ ✓ This heat is carried away by the cooling water. If c_w is the specific heat capacity of water, then $\frac{kA(\theta_2 - \theta_1)}{l} = mc_w(\theta_4 - \theta_3)$ ✓ ∴ $k = \frac{mc_w(\theta_4 - \theta_3)l}{A(\theta_2 - \theta_1)}$	½ 1
(b)	(i) …a body which absorbs all radiation falling on it, without reflecting or transmitting any of it. ✓	1
	 ✓ ✓ ✓ ✓ *The axes must be labelled and the temperatures compared*	2
	(ii) At first the ball is invisible. ✓ It becomes dull red, then bright red and finally less red tending to white. ✓ This is because, as the temperature rises, the intensity of the shorter wavelength increases more rapidly. ✓	½ 1 1

	So the peak intensity shifts from the red end of the spectrum into the visible spectrum, which is a narrow band.	½
(c)	When the temperature is steady Power radiated by the filament = power generated $\therefore \quad 0.85\sigma AT^4 = 1800$ $\therefore \quad T^4 = \frac{1800}{0.85\pi dl\sigma} = \frac{1800 \times 10^8}{0.85 \times 1.5 \times 10^{-2} \times 0.3 \times 5.7}$ = **1273 K**	
Total = 20		
6 (a)	(i) – The molecules are so far apart that the attraction for each other is negligible. - The total volume of the molecules themselves is negligible compared to the volume occupied by the gas.	1 1
	(ii) At the surface of the liquid it is the most energetic molecules that do escape to the air leaving behind the less energetic ones. So the average k.e of the molecules in the bulk of the liquid falls.	1 1
(b)	(i) The pressure of a saturated vapour is independent of volume A saturated vapour does not obey the gas laws	1 1
	(ii)  *Both axes must be* - Before all the liquid evaporates the space contains saturated vapour. - So the pressure remains constant as the volume is increased. - When all the liquid has evaporated the vapour becomes unsaturated. - So it obeys Boyle's law approximately.	½ ½ ½ ½ ½ ½
	(iii) Thermometer 	1

	- The apparatus is set up as shown. - This method applies the fact that a liquid boils at the temperature at which its saturated vapour pressure is equal to the outside pressure. Hence, observation of the temperatures at which boiling occurs under different temperatures give corresponding readings of temperature and saturated vapour pressure. - Variation of pressure is achieved by using a pump through a tap (shown), when it is opened. If H = atmospheric pressure then the pressure inside is p = (H – h) if level B is lower than A, and (H + h) if B is higher than A, where h is the manometer. - At each setting of the pressure the boiling point of the liquid in the flask is noted. - In each case the pressure set inside will be the s.v.p of the liquid at the boiling temperature. - Several sets of saturated vapour pressure and temperature obtained and a graph of s.v.p against temperature is plotted. 	1 1 ½ ½ ½ 1 ½
(c)	Total pressure, $p = p_{air} + p_{vap}$ $\therefore \quad p_{air} = p - p_{vap} = (2.00 - 1.013) \times 10^5$ Pa at 100°C $= 9.87 \times 10^4$ Pa Let p_2 = air pressure at 20°C Then $p_2 = \frac{T_2}{T_1} p_1 = \frac{293}{373} \times 9.87 \times 10^4$ $= 7.75 \times 10^4$ Pa $\therefore$ final pressure $= 7.75 \times 10^4 + 0.23 \times 10^4$ **$= 7.98 \times 10^4$ Pa**	1 ½ 1 ½ 1 1
Total = 20		
7 (a)	(i) …. the quantity of heat required to change unit mass of a substance from solid to liquid without change of temperature	1

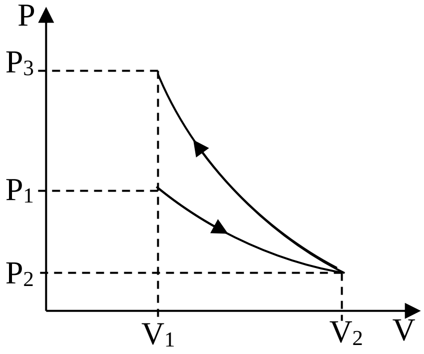
	(ii) - A calorimeter is first weighed and its mass, m_c, is noted - Some water is poured in the calorimeter, which is reweighed to find the mass, m_w, of the water. - The water is warmed to a temperature θ_1, a few degrees above room temperature, say 5^oC - The calorimeter is placed into its jacket and small lumps of dry ice are added to the calorimeter, while stirring, until the temperature falls to a value θ_2, as much below room temperature as θ_1 was above. This is to eliminate the cooling correction. - The calorimeter with its contents is reweighed to find the mass, m, of the ice added. Let c_c = specific heat capacity of the calorimeter c_w = specific heat capacity of water L = specific latent heat of fusion of ice Then $m_c c_c(\theta_1 - \theta_2) + m_w c_w(\theta_1 - \theta_2) = mL + mc_w(\theta_2 - 0)$ $\therefore \quad L = \left\{\frac{(m_c c_c + m_w c_w)(\theta_1 - \theta_2)}{m} - c_w\theta_2\right\}$	½ ½ ½ 1 ½ 1 1
(b)	(i) When a mole of gas is heated at constant volume, no external work is done ⇒ All the heat goes in increasing the internal energy. In this case if the rise in temperature is 1 K the heat required is C_v. If the temperature of the same gas is raised by 1K at constant pressure the increase in its internal energy is C_v. But because the gas expands, it does external work. So the heat required is greater than in the previous case.	1 ½ ½ 1
	(ii) Suppose 1 mole of gas is warmed through 1 K at constant volume (fig (i)). The heat required is C_v joules and it is all used in increasing the internal energy, U. Now, suppose 1 mole is warmed through 1 K at constant pressure (fig(ii)). It expands from volume V_1 to volume V_2 and does external work given by $W = p(V_2 - V_1)$ Since the internal energy, U, is independent of volume, the increase in U is C_v. Hence, from $\delta Q = \delta U + p.\delta V$, the total heat required is $C_p = C_v + P(V_2 - V_1)$ ……………….. (1) Using the equation of state, $PV_1 = RT$ ……………… (2) where R is the molar gas constant and $PV_2 = R(T + 1)$ ……….. (3) Equation (3) – equation (1): $P(V_2 - V_1) = R$ Therefore equation (1) becomes $C_p = C_v + R$ Or **$C_p - C_v = R$**	1 ½ ½ ½ ½ ½ ½

(c)

(i) – The process must be carried out quickly. 1

- The gas must be contained in a thick-walled poorly conducting vessel. 1

(ii)



$$P_2 = \frac{V_1}{V_2}P_1 = \frac{1}{2} \text{ x } 1.40 \text{ x } 10^5$$

$= 7.0 \text{ x } 10^4$ Pa 1

$TV^{\gamma-1}$ = constant

$\therefore T_3V_3^{\gamma-1} = T_2V_2^{\gamma-1}$ (But $V_3 = V_1$)

$\therefore \quad T_3 = \left(\frac{V_2}{V_3}\right)^{\gamma-1} T_2$ ($T_2 = T_1$) 1

$= 2^{0.4} \text{ x } 320$

$= 422$ K = **149°C** 1

$P_3 = P_2\left(\frac{V_2}{V_3}\right)^{\gamma} = 7 \text{ x } 10^4\left(\frac{2}{1}\right)^{1.4}$ 1

$= \mathbf{1.847 \text{ x } 10^5}$ **Pa** 1

Total = 20

8 (a)

(i)

X-RAYS	CATHODE RAYS
Electromagnetic waves produced when a metal is struck by high-energy electrons	A stream of fast-moving electrons accelerated by a p.d.
Carry no charge	Carry negative charge
Not affected by magnetic or electric fields	Deflected by both magnetic and electric fields

2

Take the first one and any other @1

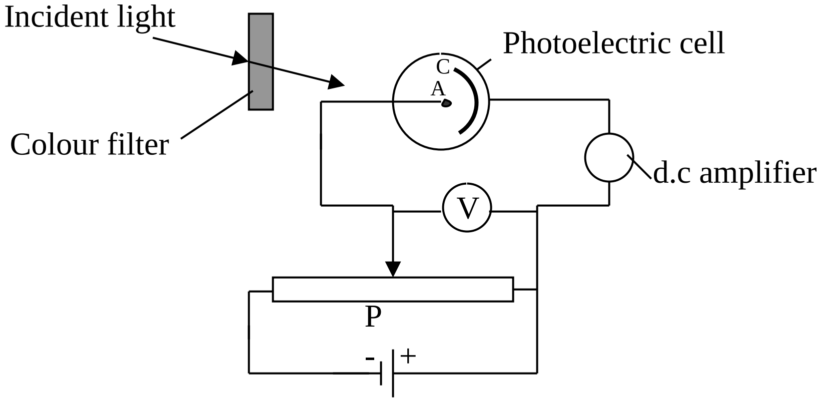
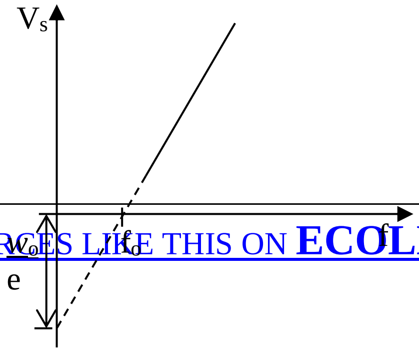
(ii) At the target more than 99% of the bombarding electrons' energy is converted into heat. 1

So the target is made of tungsten with a high melting point 1

The target is fitted in a thick anode made of copper so as to conduct away the heat as efficiently as possible. 1

To better the cooling process a liquid circulates in passages made in the anode block and the anode ends in fins outside. 1

(b)

	(i) When a parallel beam of X-rays of wavelength λ falls on a crystal lattice of interatomic spacing d at a glancing angle θ, reinforcement of the reflected beam occurs only when $2d\sin\theta = n\lambda$, where n is an integer	1
	(ii) λ must be small compared to 2d	1
	(iii) The maximum order will be investigated by first making $\sin\theta = 1$ $\therefore \quad n = \frac{2d}{\lambda} = \frac{2 \times 3.00 \times 10^{-10}}{1.187 \times 10^{-10}} = 5.05$ So the maximum order is **5**	1 1 1
(c)	(i) …the minimum energy of incident light that will eject an electron from the metal surface concerned.	1
	(ii)  - The circuit is connected as shown in which P is a potential divider. - Using different colour filters, the frequency, f, of the incident light is varied. - For a given frequency the p.d V, picked from the potential divider P, is varied negatively until the current registered by the d.c amplifier just becomes zero. - The reading of the voltmeter is noted and it is the stopping potential, V_s, for the frequency f. - The procedure is repeated using different colour filters, each time noting the corresponding stopping potentials V_s. - A graph of V_s against f is plotted. A graph of V_s against f is plotted. 	1 1 ½ ½ ½ ½

From $V_s = \frac{h}{e}f - \frac{\omega}{e}$, the gradient of the graph is $\frac{h}{e}$ ✓ 1

∴ h = e x gradient

(iii) $\omega_o = hf_1 - eV_1$ ………… (1) ✓ ½

And $\omega_o = hf_2 - eV_2$ ………… (2) ✓ ½

Eq(1) x f_2: $\omega_o f_2 = hf_1f_2 - eV_1f_2$ ……… (3)

Eq(2) x f_1: $\omega_o f_1 = hf_1f_2 - eV_2f_1$ ……… (4)

Eq(3) – Eq(4): $\omega_o(f_2 - f_1) = eV_2f_1 - eV_1f_2$ ✓ ½

$$\therefore \omega_o = \frac{e(V_2f_1 - V_1f_2)}{f_2 - f_1} = \frac{1.6\times10^{-19}(2.2\times6-0.6\times10)}{10-6}$$ ✓ ½

= **2.88 x 10^{-19} J** ✓ 1

Total = 20

9 (a) (i)

RADIOACTIVITY	NUCLEAR FISSION
Spontaneous disintegration of the nucleus	An induced disintegration of the nucleus by bombardment with neutrons. ✓
Daughter nuclei are not of comparable masses	Daughter nuclei are of comparable masses ✓

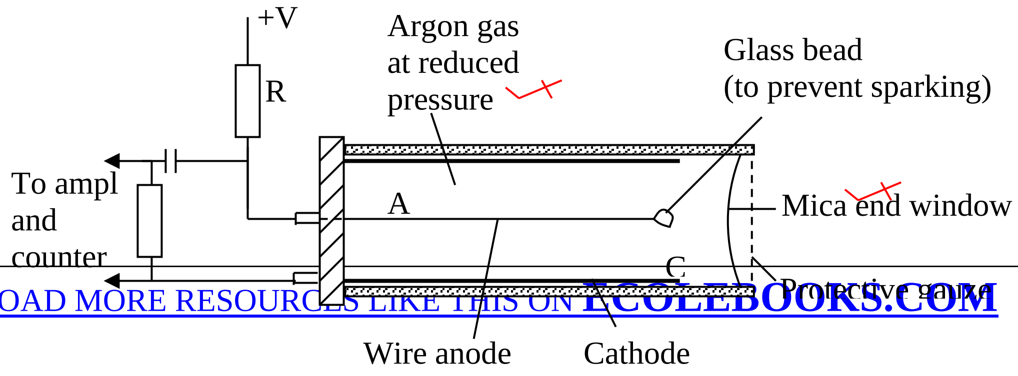
1

1

(ii) – Neutrons have no charge and therefore they are not repelled by the nucleus. ✓ 1

- The neutron-proton ratio increases hence making the nucleus unstable. ✓ 1

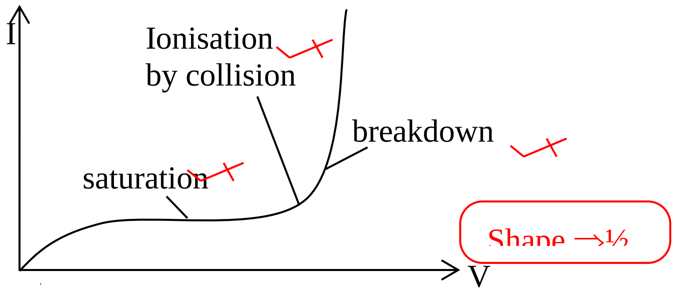
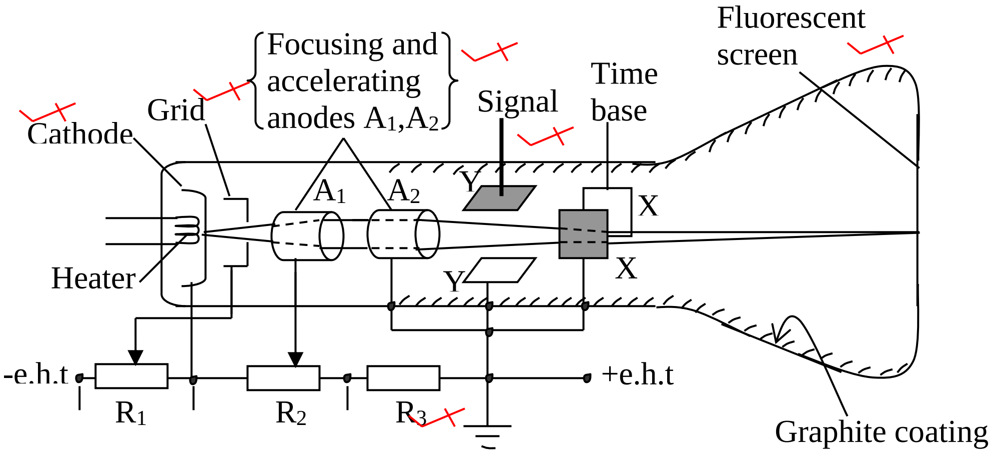
(b)

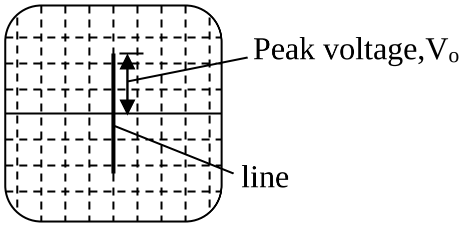
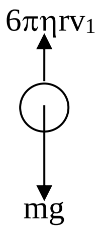
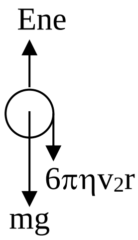


½

½

	- It consists of a cylindrical metal cathode C and a thin coaxial wire anode, A, containing argon at low pressure. - The anode, A, is kept at a positive potential V e.g 450V relative to the cathode, C. - When an ionising particle enters the tube, a few electrons and ions are produced in the gas. - If V is above the breakdown potential of the gas, the number of electrons and ions are enormously multiplied. In this case the electrons gain enough energy to cause further ionization leading to breakdown (avalanche) - The electrons move to the anode A and the positive ions towards the cathode C. - The current in the high resistance R produces a p.d which is amplified and passed to a counter such as scaler or ratemeter. - Argon mixed with a halogen helps to stop the discharge quickly.	1 ½ 1 1 ½ ½ ½
(c)	(i) Let N = number of radioactive atoms present r = distance of G-M from the source then, since $\frac{dN}{dt} = -\lambda N$ γ-radiation reaching the G-M per unit area per s is $\frac{\lambda N}{4\pi\pi^2}$ ∴γ-radiation per s incident on the window of area A is $\frac{\lambda N}{4\pi\pi^2}A$ = count rate $\therefore \quad N = \frac{4\times 11\pi r^2}{\lambda A} = \frac{44\pi\times 10^2\times 100\times 24\times 3600}{0.693\times 7}$ = **2.46×10^{10}**	1 2 1 1
	(ii) 1 radioactive atom is present in 10^{12} atoms of the sample. So the number of atoms in the sample = N x 10^{12} = 2.46 x 10^{22} atoms These give a mass of 1.2 g ∴ Mass number = $\frac{6.02\times 10^{23}\times 1.2}{2.46\times 10^{22}}$ = **29.4 g**	½ 1 ½
(d)	Mass of Pb and α-particle = 205.929 + 4.002 = 209.931 u Since the total mass of nuclei is less than that of the parent nucleus, the nucleus will undergo disintegration.	1 2

	Total = 20	
10 (a)	(i) 	2
	(ii) - The electrons, emitted from the cathode by photoelectric effect, are accelerated towards the anode. - As the p.d is increased more electrons reach the anode per second- This is depicted as increase in current. - When all the available electrons per second are reaching the anode, there is no more increase in current. The current is said to be saturated. - However, as the p.d is increased further, the electrons' kinetic energy is increased until they are able to ionize the gas atoms on their way. - The ions so formed move to the cathode while the additional electrons join in the flight to the anode – This process of ionization leads to increase in current. - The knocked–out electrons gain kinetic energy and produce more ions and electrons. Eventually, as the p.d is increased, a point is reached at which the current grows uncontrollably – This is a state of breakdown (avalanche)	½ ½ ½ ½ ½ ½
(b)	(i) C is a smoothening capacitor.	1
	(ii) V_d decreases while V_L increases -When electrons, they ionise the mercury atoms -The ions and electrons so formed make the valve a good conductor. -This reduces the voltage drop across the valve and allows more of the voltage from the supply to appear across the load.	1 1 ½ ½
(c)		3
	(ii) - First an a.c voltage of known peak value, V_0 say, is connected to the Y-plates	

	- The time-base is switched off, and the vertical line on the screen is centered	½
	- The length, l_o, of the trace on the screen is measured	½
		½
	Now l_o is proportional to twice the peak voltage, V_0	
	The known a.c voltage is disconnected and replaced by the voltage V to be measured. The length l of the line is measured	½
	Now $l \propto 2V$	½
	And $l_o \propto 2V_o$	
	$\therefore \quad \frac{V}{V_o} = \frac{l}{l_o}$	½
(d)	 (i) Before  (ii) After application of the field	
	Let n = number of electrons on the drop e = electronic charge E = electric intensity applied	
	In case (i): $6\pi\eta r v_1 = mg$……………………... (1)	1
	In case (ii): $Ene = mg + 6\pi\eta r v_2$ ………….. (2)	1
	Substituting for mg in Eq (2), we have $Ene = 6\pi\eta r(v_1 + v_2)$	
	$\therefore \quad n = \frac{6\pi\,\eta r}{Ee}(v_1 + v_2)$	1
	$= \frac{6\pi\times2.122\times10^{-5}\times6\times10^{-6}}{2\times10^{5}\times1.6\times10^{-19}}(12+4)\times10^{-5}$	1
	= **12**	1
	Total = 20	