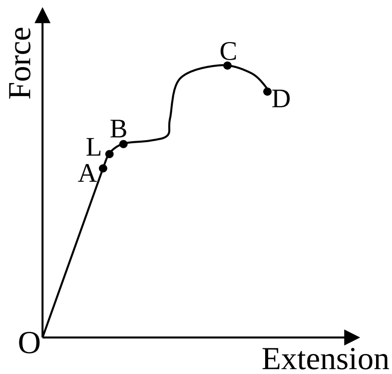
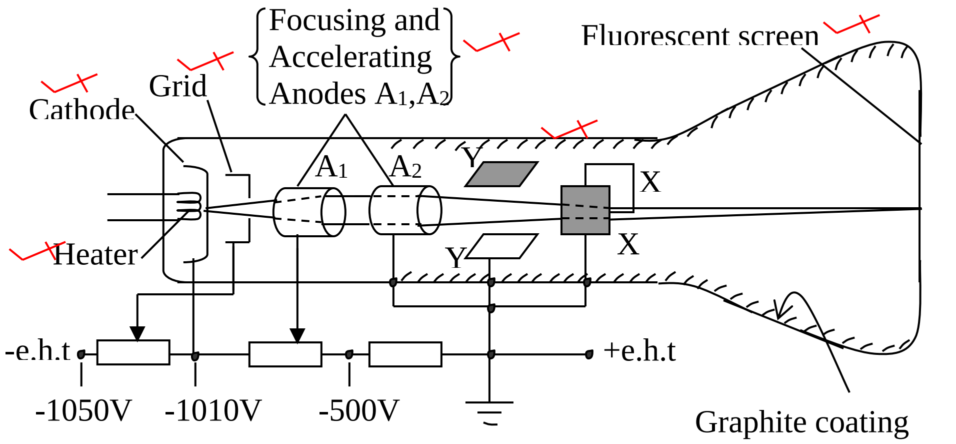
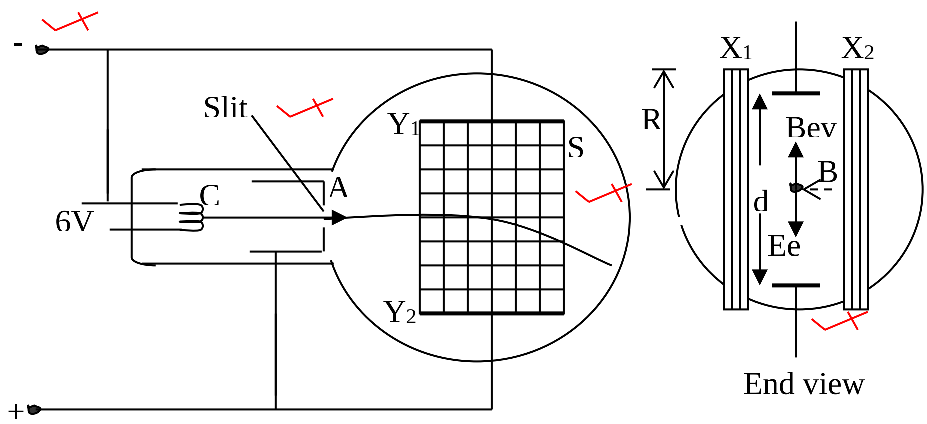
Qn	Answer	Marks
1. (a)	Elastic limit is the maximum stress a material can be subjected to and still regain its original dimensions when released. Young's modulus is the ratio of the tensile stress to tensile strain.	1 1
(b)	(i) Wire stretched elastically: - The distance between the molecules (or atoms) is increased. - So the net force between the molecules is attractive - The work done is stored as potential energy of the molecules, which is released when the material is unloaded	 1 1 1
	(ii) Wire stretched plastically; - Molecules slide over each and across so that heat is generated. - So in addition the work done is converted into heat at this stage	 1 1
(c)	(i)  *Axes must be labelled* A = ***Proportional Limit***: In the region OA the extension is proportional to the load. L = ***Elastic Limit***: This is the maximum load a body can experience and still regains its original dimensions when released. In the region AL the wire returns to its original dimensions when unloaded, but the extension is no longer proportional to the load. B = ***Yield Point***: At this value of the load, the molecules of the wire begin to slide across each other, so that the material becomes ***plastic***. C = ***Breaking Stress***: (Ultimate stress). It is the maximum stress a material can withstand without snapping.	1 1 ½ 1 ½
	(ii) $E = \frac{Fl}{Ae} = \frac{120 \times 10^3}{0.0030 \times 4 \times 10^{-4}} =$ $\mathbf{1.0 \times 10^{11}\ N\ m^{-2}}$	3
	(iii) 80,000 kN m^{-2} would be the stress if the cross-sectional area remained the same. At breaking, the cross-sectional area has become much smaller. So the actual stress is much bigger than this value.	1 1
	(iv) Estimated work $= \frac{1}{2} Fe$ $= \frac{1}{2} \times 240 \times 10^3 \times 4 \times 10^{-2} =$ **4800 J**	1 2

	The actual work is greater because some energy is converted into heat and is not stored as mechanical energy	1
	Total = 20	
2. (a)	(i) Cathode rays are a stream of fast-moving electrons accelerated by a p.d in vacuum.	1
	(ii) They: - travel in straight in lines - cause fluorescence of certain substances - possess kinetic energy (produce heat on striking a metal) - can be deflected by both electric and magnetic fields - produce x-rays on striking matter *Any four @½*	2
(b)		3
	- The heater filament, supplied from a low voltage source, heats the cathode. - The cathode thermionically emits electrons. - The grid controls the number of electrons that reach the screen by virtue of the negative potential on it; hence it controls the brightness of the spot formed on the screen. - A system of anode arrangement accelerates the electrons and focuses the beam into a single spot on the fluorescent screen. - The fluorescent screen displays the spot where the beam strikes it. - A special circuit, known as the time base, is connected to the X-plates to control the horizontal deflection of the spot. - The signal to be studied is connected to the Y plates and this shifts the spot vertically.	3
(c)	 X_1,X_2 = Helmholtz coils	½ ½ ½ ½

	- A vacuum-type cathode-ray tube, connected as shown, is used, with the accelerating p.d, V, also applied between the parallel deflecting plates Y_1Y_2 which support a vertical fluorescent screen S set at an angle. - A fine flat electron beam, emerging through the slit, produces a fine trace on S as shown. - The current I in the Helmholtz coils, arranged as shown, is switched on and adjusted so that the trace suffers no deflection. Under these conditions: {The electric force produced by plates Y_1Y_2 on an electron} = {Magnetic force produced by the current in the Helmholtz coils} Let d = distance between plates Y_1 v = velocity of electrons on e B = magnetic field density Then $\frac{Ve}{d} = Bev$ ……………………………. (1) and $\frac{1}{2}mv^2 = eV$,where m = mass of electron ……….(2) Eliminating v from (1) & (2) $e/m = \frac{V}{2B^2d^2}$ The flux density B for the Helmholtz coils is given by $B = \frac{0.72\mu_o NI}{R}$ where N = no. of turns in one coil	½ ½ ½ ½ ½ ½
(d)	Given: $D = 4.0 \times 10^{-2}$ m, $d = 4.0 \times 10^{-2}$ m, V = 12V, $v = 1.0 \times 10^{6}$ ms^{-1}, The horizontal velocity remains the same = v The time taken between the plates is $t = \frac{D}{v}$ and the acceleration, $a = \frac{Ve}{dm}$ Let v_y = the vertical velocity Then, using v = u + at, where u = 0, we have $v_y = \frac{VeD}{dmv}$ Now, $\tan\theta = \frac{v_y}{v} = \frac{VeD}{dmv^2}$ $= \frac{12 \times 1.6 \times 10^{-19} \times 4.0 \times 10^{-2}}{4.0 \times 10^{-2} \times 9.11 \times 10^{-31} 1.0 \times 10^{12}} = 2.11$ ∴ θ = **64.6°**	½ ½ ½ ½ 1 1 1
	Total = 20	