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| **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) | O  A  L  B  C  D  Force  Extension  (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 =  = **1.0 x 1011 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 = Fe  =  x 240 x 103 x 4 x 10-2 = **4800 J**  The actual work is greater because some energy is converted into heat and is not stored as mechanical energy | 1  2  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   *Any four @½*   * possess kinetic energy (produce heat on striking a metal ) * can be deflected by both electric and magnetic fields * produce x-rays on striking matter | 2 |
| (b) | Focusing and  Accelerating  Anodes A1,A2  Fluorescent screen  A1 A2  Y  Grid  Cathode  Heater  X  Y  X  -e.h.t  +e.h.t  -1050V -1010V -500V  Graphite coating   * 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  3 |
| (c) | S  Y1  Y2  A  C  6V  Slit  +  -  R  X1 X2  Bev  d  Ee  End view  X1,X2 = Helmholtz coils  B  - A vacuum-type cathode-ray tube, connected as shown, is used, with the accelerating p.d, V, also applied between the parallel deflecting plates Y1Y2 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 = Magnetic force produced by the  Y1Y2 on an electron current in the Helmholtz coils  Let d = distance between plates Y1  v = velocity of electrons on e  B = magnetic field density    and ½ mv2  = eV ,where m = mass of electron ………..(2)    where N = no. of turns in one coil | ½  ½  ½  ½  ½  ½  ½  ½  ½  ½ |
| (d) | Given: D = 4.0 x10-2 m, d = 4.0 x 10-2 m, V = 12V, v = 1.0 x 106 ms-1,  The horizontal velocity remains the same = v  The time taken between the plates is t =  and the acceleration, a =  Let vy = the vertical velocity  Then, using v = u + at, where u = 0, we have  vy =  Now, tan θ =  =  = 2.11  ∴ θ = **64.6o** | ½  ½  ½  ½  1  1  1 |
| ***Total = 20*** | | |