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| **Qn** | **Answer** | **Marks** |
| 1. (a) | (i) …the ratio the velocity of light in vacuum to the velocity of light in the medium | 1 |
| (ii)…the angle of incidence for which the refracted ray grazes the boundary. | 1 |
| (b) | (i) Consider an object O below the surface of the medium of refractive index n. A ray OM from O perpendicular to the surface passes straight into the air along MS.  air  S T  *r*  M *r* N  glass  I  *i*  *i*  t  d  O  A ray ON, very close to OM, is refracted at  N away from the normal along NT so that to an observer directly overhead the object O appears to be at I.  Now, nsin i = 1 x sin r  i.e. n =  =  =  Since the observer is directly above O, the raysON and IN are very close to the normal OM.Hence ON is approximately equal to OM and IN = IM.  Thus n = | 1  1  1  1  ½  ½ |
| (ii) Atravelling microscope is used (See diagram)  The traveling microscope M is focused on a mark made on a sheet of white paper and the reading on the scale, say x cm, is noted.  M  T  B  O  I  The sided glass slab is placed over the mark (preferably with its longest side vertical) and the microscope is adjusted until the mark is focused again. The reading on the scale, say y cm, is noted.  Some lycopodium particles are then sprinkled on top of the glass slab and the microscope is raised until they are focused.The reading, say z cm, on the scale is noted.  Then real depth of O = OB = (z-x) cm Apparent depth = IB = (z-y) cm | 1  1  1  1 |
| (c) | (i) 1. The incident ray, the refracted ray and the normal at the point of incidence, all lie in same plane.   1. Snell’s law: For two given media, the ratio of sin of the angle of incidence to the angle of refraction is a constant. | 1  1 |
| (ii) Imagine a ray PO in air incident at O at an angle ia with the normal. If the boundaries are parallel, the emergent ray RS is parallel to PO.  Let ig, iw respectively be the angles made with the normals in glass and water media    P  *i*a  Air  Glass  O  *i*g  *i*w  Water  *i*w  R  S  Air  *i*a  Thensin ia = angsin ig ................. (1)  Also sin ia = anwsin iw................(2)  Hence, from (1) and (2)  sin ia = angsin ig = anwsin iw  Since na = 1, ang = ng and anw = nw, we can write  nasin ia = ngsin ig = nwsin iw  Therefore **nsin i = constant** | 1  1  1  1 |
| (d) | Glass  Water  N  A  ***iw***  O  Water  Glass  *iw*is the angle turned through by the slab  Since the boundaries are parallel, n sin I = constant  ∴ nw sin *iw* = 1 x sin 90o  ∴ sin *iw* =  = 0.741  ∴ *iw* = **47.8o** | 1  ½  ½  1 |
| ***Total = 20*** | | |
| 2. (a) | (i) …the ratio of the magnitude of charge on either plate to the potential difference between the plates. | 1 |
| (ii) …the ratio of the capacitance with the dielectric in between the plates to the capacitance when the space between the plates is vacuum. | 1 |
| (b) | (i) - Distance between the plates:  The greater the distance the lower the capacitance  - Overlapping area of the plates:  The larger the area the higher the capacitance  *Any two*  - The dielectric employed:  Different dielectrics result in different capacitances | ½  ½  ½  ½ |
| (ii) Effect of distance between the plates:  This factor can be investigated using a vibrating-reed switch arrangement.  The capacitor C is in form of large metal plates M and N separated by polythene spacers of known thickness d.  M  N  *d*  Spacers  The circuit is connected as follows  V  *C*  Sensitive galvanometer  Vibrating-reed switch  Protective resistor  X Y  G  - The supply is switched on and the current, I, registered by the galvanometer is noted.  Now, if f is the frequency of the reed switch and Q the charge acquired by C and discharged through G, the current I =fQ. Thus for a given frequency and voltage V,  Q ∝ I, implying that CV ∝ I, or C ∝I .  - The experiment is repeated using spacers of thickness 2d, 3d, 4d, and so on to change the distance x between the plates.  - A graph of I against  is plotted. It is a straight line through the origin.  So I ∝⇒ C ∝  *Another method could be used* | ½  ½  1  ½  ½  ½  1  ½ |
| (iii)  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  +  -  When a p.d is applied between the plates, the molecules of the dielectric get polarised, with their positive ends facing the negative plate, and their negative ends facing the positive plate.  Charge inside the material cancel each other’s influence but the surfaces adjacent to the plates develop charge opposite to that on the near plate.  This arrangement reduces the positive potential of the positive plate and does the same on the negative potential of the negative plate.  So the potential difference between the plates is lowered.  Electrons are then drawn from the positive plate and get deposited on the negative one to restore the potential difference to that of the supply.  This way the dielectric assists the plates to store charge. | 1  ½  ½  ½  ½  ½  ½ |
| (c) | (i)   * As B vibrates, it repeatedly decreases and then increases the distance between the plates. * When the distance is decreased, the capacitance is increased. So charges flows to the capacitor. * When the distance is increased, the capacitance is decreased. So charge flows away from the capacitor. * The flow of charge to and then from the capacitor repeatedly is an alternating current in the circuit | 1  ½  ½  1 |
| (ii) When the supply is disconnected, the p.d across the plates remains 12V at a plate separation of 2 mm.  Now, C ∝, where C is capacitance and x is the plate separation.  So when the separation is doubled to 4 mm, the capacitance is halved.  Since the charge on the capacitor remains constant as Q = CV, the voltmeter will read V = 2 x 12 = **24V** | ½  ½  1 |
| (iii) To restore the p.d from 24V back to 12V we need to double the capacitance.  So the dielectric material should have a dielectric constant of 2 | 1  1 |
| ***Total = 20*** | | |