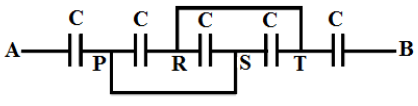
Questions: 15 | Time: 01:00 hh:mm | Marks: 45

Q1. A cyclotron's oscillator frequency is 10MHz. What should be the operating magnetic field for accelerating protons? If the radius of its 'dees' is 60 cm, calculate the kinetic energy (in MeV) of the proton beam produced by the accelerator. **3 Marks**

Q2. 1. Calculate the frequency of a photon of energy 6.5×10^{-19}J. **3 Marks**
2. Can this photon cause emission of an electron from the surface of Cs of work function 2.14 eV? If yes, what will be maximum kinetic energy of the photoelectron?

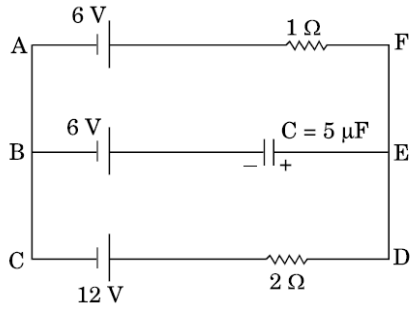
Q3. 1. Calculate the energy and momentum of a photon in a monochromatic beam of wavelength 331.5nm. **3 Marks**
2. How fast should a hydrogen atom travel in order to have the same momentum as that of the photon in part(a)?

Q4. 1. Find equivalent capacitance between A and B in the combination given below. Each capacitor is of 2 μF capacitance. **3 Marks**

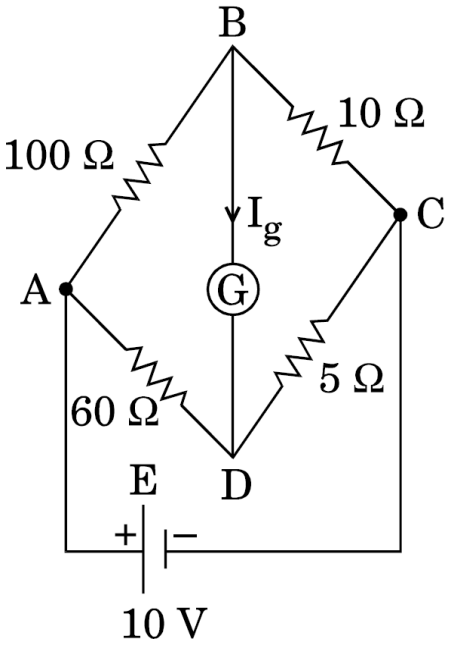


2. If a dc source of 7 V is connected across AB, how much charge is drawn from the source and what is the energy stored in the network?

Q5. In the given circuit, with steady current, calculate the potential difference across the capacitor and the charge stored in it. **3 Marks**



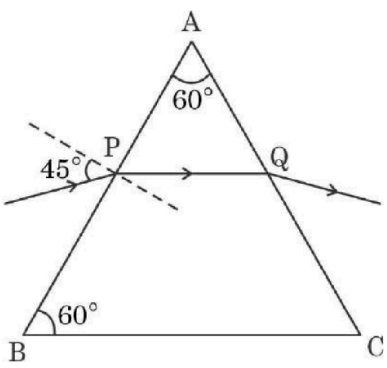
Q6. Using Kirchhoff 's rules, calculate the current (I_g) that flows through the galvanometer of resistance 15Ω in the circuit diagram shown in the figure. **3 Marks**



Q7. A diver looking up through water $\left(\mu = \frac{4}{3}\right)$ sees the outside world contained in a circular area on the surface of water. If the diver's eyes are $\sqrt{7}\text{m}$ below the surface of water, then calculate the area of the circle. **3 Marks**

Q8. 1. Differentiate between self inductance and mutual inductance. **3 Marks**
2. The mutual inductance of two coaxial coils is 2H. The current in one coil is changed uniformly from zero to 0.5A in 100ms. Find the:
1. Change in magnetic flux through the other coil.
2. emf induced in the other coil during the change.

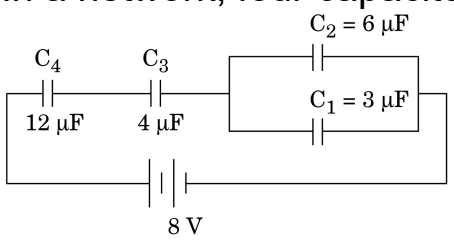
Q9. A ray of light is incident on a prism at an angle of 45° and passes symmetrically as shown in the figure. **3 Marks**
Calculate:



1. The angle of minimum deviation.
2. The refractive index of the material of the prism, and.
3. The angle of refraction at the point P.

Q10. Find the two possible positions of an object kept in front of a lens of + 5.0 D, so that the image formed in both cases is four times magnified. **3 Marks**

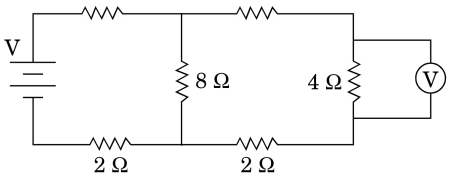
Q11. In a network, four capacitors C_1, C_2, C_3 and C_4 are connected as shown in the figure. **3 Marks**



1. Calculate the net capacitance in the circuit.
2. If the charge on the capacitor C_1 is $6\mu C$ (i) calculate the charge on the capacitors C_3 and C_4 , and (ii) net energy stored in the capacitors C3 and C4 connected in series.

Q12. What are matter waves? Find the ratio of de Broglie wavelengths associated with proton and alpha particles when both particles: **3 Marks**
1. Are accelerated through the same potential difference.
2. Have same velocity.

Q13. In the circuit given below, find the voltmeter reading across a 4Ω resistor. **3 Marks**



Q14. 1. Two cells of emf E_1 and E_2 have their internal resistances r_1 and r_2, respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other. **3 Marks**
2. In case the two cells are identical, each of emf E = 5V and internal resistance $\mathrm{r} = 2\Omega$, calculate the voltage across the external resistance $\mathrm{R} = 10\Omega$.

Q15. The de-Broglie wavelength associated with an electron is 0.30nm. Calculate: **3 Marks**
1. the speed, and
2. the kinetic energy (in eV), of the electron.