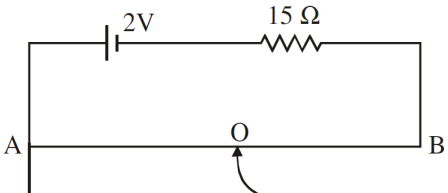
Q1. 1. Calculate the energy and momentum of a photon in a monochromatic beam of wavelength 331.5nm. **3 Marks**

2. How fast should a hydrogen atom travel in order to have the same momentum as that of the photon in part(a)?

Q2. 1. Write the principle of working of a metre bridge. **3 Marks**

2. In a metre bridge, the balance point is found at a distance l_1 with resistances R and S as shown in the figure.



An unknown resistance X is now connected in parallel to the resistance S and the balance point is found at a distance l_2. Obtain a formula for X in terms of l_1, l_2 and S.

Q3. 1. Define self-inductance. Write its SI units. **3 Marks**

2. A long solenoid with 15 turns per cm has a small loop of area 2.0 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 2.0 A to 4.0 A in 0.1 s, what is the induced emf in the loop while the current is changing?

Q4. 1. Define mutual inductance. **3 Marks**

2. A pair of adjacent coils has a mutual inductance of 1.5 H. If the current in one coil changes from 0 to 20 A in 0.5 s, what is the change of flux linkage with the other coil?

Q5. 1. State the principle of working of a potentiometer. **5 Marks**

2. In the following potentiometer circuit, AB is a uniform wire of length 1 m and resistance 10Ω. Calculate the potential gradient along the wire and balance length AO (= l).

Q6. 1. Draw a labelled diagram of a step-up transformer and describe its working principle. Explain any three causes for energy losses in a real transformer. **5 Marks**

2. A step-up transformer converts a low voltage into high voltage. Does it violate the principle of conservation of energy? Explain.

3. A step-up transformer has 200 and 3000 turns in its primary and secondary coils respectively. The input voltage given to the primary coil is 90V. Calculate:

- The output voltage across the secondary coil
- The current in the primary coil if the current in the secondary coil is 2·0 A.

Q7. 1. Draw a labelled diagram of a step-down transformer. State the principle of its working. **5 Marks**

2. Express the turn ratio in terms of voltages.

3. Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.

4. How much current is drawn by the primary of a transformer connected to 220V supply when it delivers power to a 110V - 550W refrigerator?

Q8. 1. Draw a labelled diagram of an ac generator. Obtain the expression for the emf induced in the rotating coil of N turns each of cross-sectional area A, in the presence of a magnetic field $\overrightarrow{\mathrm{B}}$ **5 Marks**

2. A horizontal conducting rod 10 m long extending from east to west is falling with a speed 5.0 ms^{-1} at right angles to the horizontal component of the Earth's magnetic field, 0.3×10^{-4} Wb m^{-2}. Find the instantaneous value of the emf induced in the rod.

Q9. Derive an expression for potential energy of an electric dipole $\overrightarrow{\mathrm{p}}$ in an external uniform electric field $\overrightarrow{\mathrm{E}}$ **5 Marks**
When is the potential energy of the dipole (1) maximum, and (2) minimum?
An electric dipole consists of point charges 1·0 pC and + 1·0 pC located at (0, 0) and (3 mm, 4 mm) respectively in x - y plane. An electric field $\overrightarrow{\mathrm{E}} = \left(\frac{1000\ \mathrm{V}}{\mathrm{m}}\right)\hat{\mathrm{i}}$ is switched on in the region. Find the torque $\overrightarrow{\tau}$ acting on the dipole.

Q10. 1. Derive the expression for the torque acting on the rectangular current carrying coil of a galvanometer. Why is the magnetic field made radial? **5 Marks**

2. An $\alpha-$particle is accelerated through a potential difference of 10kV and moves along x-axis. It enters in a region of uniform magnetic field B = 2×10^{-3}T acting along y-axis. Find the radius of its path. (Take mass of $\alpha-$particle = 6.4×10^{-27}kg).