1. All questions are compulsory.
2. Q. 1 to 5 are Very short Answer type questions (1 Mark each.)
3. Q. 6 to 12 are short Answer type questions. (2 Marks each.)
4. Q. 13 to 24 are short answer questions (3 Marks each.)
5. Q. 25 to 27 are Long Answer type questions, (5 marks each.)
6. Please write down the serial number of the question before attempting it.
7. You may use the following values of physical constants where ever necessary:

Permittivity in free space (ε_0) = 8.85×10^{-12} F/meter

Permeability in free space (μ_0) = $4\pi \times 10^{-7}$ T m A^{-1}

Mass of Proton (m_p) = 1.67×10^{-27} kg

Mass of electron (m_e) = 9.1×10^{-31} kg.

Charge on electron or proton (e) = 1.6×10^{-19} C

Velocity of Light (C) = 3×10^{8} m/sec

Avogadro's Number (N) = 6.023×10^{23}

Plank's Constant (h) = 6.626×10^{-34} J. Sec

8. Use of calculators is not permitted. However, you may ask log table for Mathematical tables.

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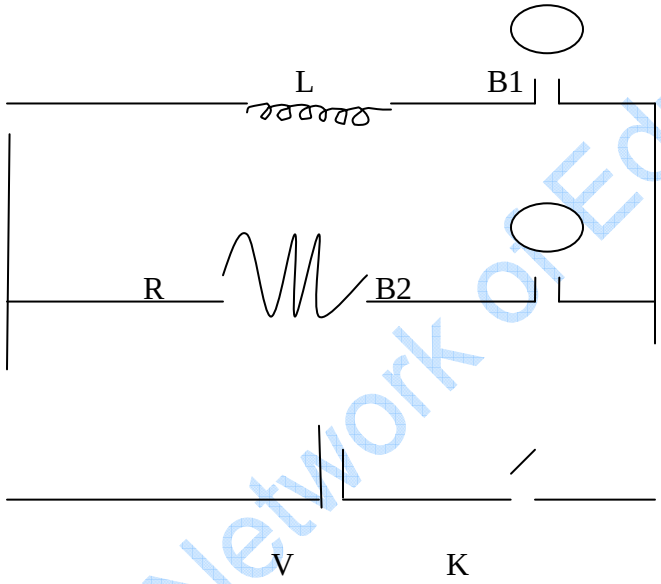
1. How does the collector current change in a junction transistor, if the base region has large width?

2. The wavelength of electromagnetic radiation is doubled. What will happen to the energy of the photons?

3. In a given circuit, inductor L and resistor R have identical resistance. Two similar electric lamps B1 and B2 are connected as shown. When switch S is closed. (i) Which one of the lamp lights up earlier (ii) will the lamps be equally bright after some time? **Justify your answer**s.



4. What is the nature of waves used in radar? What is their wavelength range?

5. What is de-Broglie wavelength of an atom at absolute temperature T K

6. Electromagnetic radiations with wavelength:

   1): λ_1 are used to kill germs in water purifiers.

   2): λ_2 are used in T.V communication system.

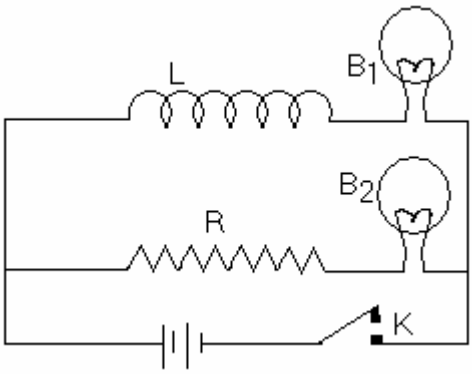
7. Initially the number of nuclei of a radioactive substance are 100. At t=1s these numbers become 80. Find the number of nuclei undecayed at t=2s.

8. How does the forbidden energy gap of an intrinsic semiconductor vary with the increase in temperature?

9. An air-core solenoid is connected to an a.c source and a bulb. If an iron-core is inserted in the solenoid, how does the brightness of a bulb change? Give reasons

10. Using Gauss's theorem, prove that charges reside entirely on the outer surface of an insulated conductor.

11. Figure shows an inductor L and a resistance R connected in parallel to a battery through a switch. The resistance R is same as that of the coil that makes L. Two identical bulbs are put in each arm of the circuit.



Which of the bulbs lights up earlier, when K is closed?

Will the bulbs be equally bright after same time?

12. How does the self inductance of a coil change, when Number of turns in the coil is decreased. An iron rod is introduced into it.

13. Draw a ray diagram to illustrate image formation by a Newtonian type telescope.

14. State the conditions for sustained interference of light Draw the variation of intensity with position in the interference pattern of Young's double slit experiment.

15. On the basis of Huygen's principle explain the laws of reflection of light.

16. If electron, proton and helium have same momentum, then write relation between de-Broglie's wavelengths of the above particles.

17. The energy of a photon is equal to the Kinetic energy of proton. Let λ_1 be the de-Broglie wavelength of the proton and λ_2 be the wavelength of the photon. Find the ratio λ_1/λ_2 in terms of energy 'E' of photon.

18. The binding energy of an electron in the ground state of He is equal to 24.6 eV. What is the energy required to remove both the electrons?

19. Distinguish between diamagnetic and ferromagnetic materials in respect to their i) intensity of magnetization ii) behaviour in a non-uniform magnetic field and iii) Susceptibility.

20. The length of a potentiometer wire is 600 cm and it carries a current of

40 mA. For a cell of emf 2 V and internal resistance 10 ohm, the null

point is found to be at 500 cm. If voltmeter is connected across the cell, the balancing length is decreased by 10 cm. Find

i) the resistance of the whole wire ii) reading of the voltmeter

iii) resistance of voltmeter.

21. An alternating voltage E= 200 sin 300t is applied across a series combination of R= 10 Ω and an inductor of 800 mH. Calculate the

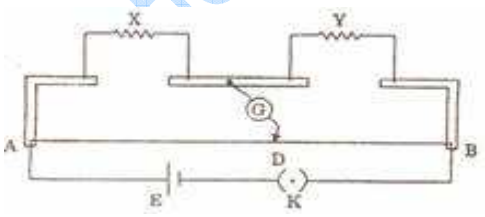
    i) impedance of the circuit

    ii) peak value of current in the circuit

    iii) power factor of the circuit.

22. Prove mathematically that the average power over a complete cycle of a.c through an ideal inductor is zero

23. In a metre bridge, the balance point is found to be at 39.5 cm from the end A, when the resistor Y is of 12.5 ohm. Determine the resistance of X. Why are the connections between resistors in a metre bridge made of thick copper strips? What happens if the galvanometer and cell are interchanged at the balance point of the bridge? Would the galvanometer show any current?



24. A ray of light when moves from denser to rarer medium undergo total internal reflection. Drive the expression for critical angle in terms of speed of light in the respective media.

25. In the fusion reaction $_1H^2 + _1H^2 \longrightarrow _2He^3 + _0n^1$, the masses of deuteron, helium and neutron expressed in amu are 2.015, 3.017 and 1.009 respectively. If 1 kg deuterium undergoes complete fusion, find the amount of total energy released.

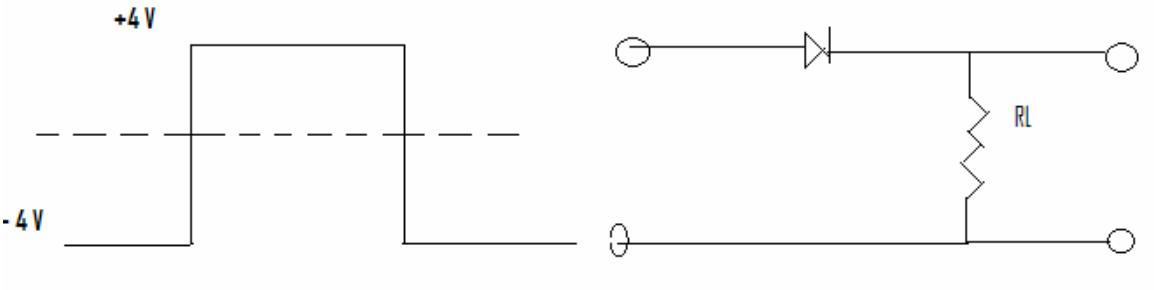
1amu = 931.5 MeV/c^2

26. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. Find the band gap of the semiconductor.

Given h= 6.63 x 10^{-34} js .

C= 3 x 10^8 m/s.

27. If in the p-n junction diode a square input signal is 8 V then find out the output signal across R_L



28. a) State the theorem which relates the enclosed charge, inside a closed surface, with the electric flux through it. Use this theorem to obtain the electric field at a point due to a uniformly charged thin plate.

b) An electric charge of 8.85 X 10^{-13} C is placed at the center of a sphere of radius 1m. what is the total electric flux linked with the sphere?

29. With the help of a labeled ray diagram show the image formation by a compound microscope. Derive an expression for its magnifying power.

(b) How does the resolving power of a compound microscope get affected on (i) decreasing the diameter of its objective and (ii) increasing the focal length of its objective?

30. What does the term LOS communication mean? Name the types of waves that are used for this Communication which of the two-height of transmitting antenna and height of receiving antenna - Can affect the range over which this mode of

communication remains effective? A transmitting antenna is 32 m high and the receiving antenna 100 m. Calculate the maximum. Distance between them for satisfactory communication in LOS mode. Assume radius of earth 6.4×10^6 m.