Quantum Physics

PHYSICS - XII

test 27/1

Name :..... M.M.: 70

Time : 3 Hr. Date: 27/1/2018

Q1. What is difference between ohmic and non-ohmic devices. 1

Q2. What is the geometrical shape of the wavefront of the light diverging from a point source? Sketch the wavefronts corresponding to diverging rays. 1

Q3. Ultraviolet radiations of different frequencies ν_1 and ν_2 are incident on two photosensitive materials having work functions ϕ_1 and ϕ_2 ($\phi_1 > \phi_2$) respectively. The kinetic energy of the emitted electrons is same in both the cases. Which one of the two radiations will be at the higher frequency? 1

Q4. What is the ratio of radii of the orbits corresponding to first excited state and ground state, in a hydrogen atom? 1

Q5. Write the truth table for an *AND gate*. 1

Q6. A wire of 15Ω resistance is gradually stretched to double its original length. It is then cout into two equal parts. These parts are then connected in parallel across a 3.0V battery. Find the the curren drawn from the battery. 2

Q7. What is critical angle? Give one application of total internal reflection. 2

Q8. Draw a labelled circuit diagram for detection of amplitude modulated wave. 2

Q9. A conductor of length *L* is connected to a d.c. source of e.m.f. *E*. If this conductor is replaced by another conductor of same material and same area of cross-section but of length 3 *L*. How will the drift velocity change? 2

Q10. Explain, how Rutherford's experiment of scattering of a-particles led to the estimation of the size of the nucleus? 2

Q11. A thin conducting spherical shell of radius *R* has charge *Q* spread uniformly over its surface. Using Gauss's law, derive an expression for an electric field at a point outside the shell. Draw a graph of electric field *E*(*r*) with distance *r* form the centre of the shell for $0 \le r \le \infty$. 3

Q12. Two cells of e.m.f. 1.5 V and 2.0 V and internal resistances 1 Ω and 2 Ω respectively are connected in parallel so as to send current in the same direction through a resistance of 5 Ω. (a) Draw the circuit diagram. (b) Using Kirchhoff's laws, find current through each branch of the circuit and potential across the 5 Ω resistance. 3

Q13. Using a labeled diagram show the elements of earth's magnetic field. Obtain relation between them. 3

Q14. Calculate the value of an inductance, which should be connected in series with a capacitance of 5 μF, resistance of 10 ohm and a.c. source of 50 Hz, so that the power factor of the circuit is unity. **3**

Q15. A conducting rod of length l with one end pivoted is rotated with a uniform angular speed ω in a vertical plane, normal to a uniform magnetic field B. Deduce expression for the e.m.f. induced in this rod. **3**

Q16. Discuss Maxwell's modification of Ampere's law. **3**

Q17. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment. **3**

(a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

(b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?

The distance between the slits is 2 mm and the distance between the plane of the slits and screen is 120 cm.

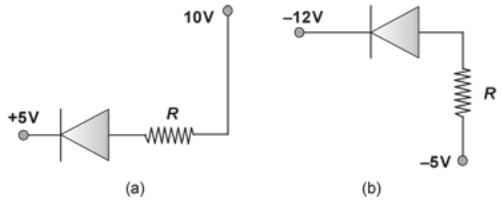
Q18. The sun subtends an angle $\alpha = 0.5°$ at the pole of a concave mirror. The radius of curvature of the concave mirror is $R = 1.5$ m. Calculate the size of the image. **3**

Q19. (a) Ultraviolet light of wavelength 2271 Å from a 100 W mercury source is incident on a photocell made of molybdenum metal. If the stopping potential is 1.3 V, estimate the work function of the metal. **3**

(b) How would the photocell respond to high intensity (10^5 Wm^{-2}) red light of wavelength 6328 Å produced by He-Ne laser?

Q20. Distinguish between nuclear-fission and nuclear-fusion. **3**

Q21. In the following circuits, which of the diodes is forward biased and which is reverse biased? **3**



Q22. (a) Define the terms (i) 'amplitude modulation' and (ii) 'modulation index'. **3**

(b) If a low frequency signal in the audio frequency range is to be transmitted over long distances, explain briefly the need of translating this signal to high frequencies before transmission.

Q23. White travelling back to his residence in the car, Dr. Pathak was caught up in a thunderstorm. It became very dark. He stopped driving the car and waited for thunderstorm to stop. Suddenly he noticed a child walking alone on the road. He asked the boy to come inside the car till the thunderstorm stopped. Dr. Pathak dropped the boy at his residence. The body insisted that Dr. Pathak should meet his parents. The parents expressed their gratitude to Dr. Pathak for his concern for safety of the child. **4**

Answer the following questions based on the above information:

(a) Why is it safer to sit inside a car during a thunderstorm?

(b) Which two values are displayed by Dr. Pathak in his action?

(c) Which values are reflected in parents' response to Dr. Pathak?

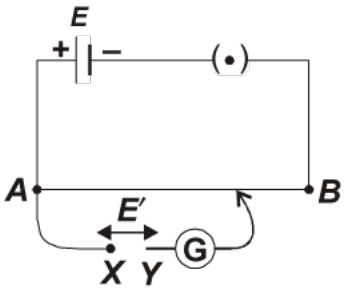
(d) Give an example of similar action on your part in the past from everyday life.

Q24. Define the term dipole moment. Derive expression for the total work done in rotating the dipole through an angle θ in a uniform electric field and find the P.E. **5**

Q25. (a) State the principle of a step-up transformer. Explain, with the help of a labeled diagram, its working. **5**

(b) Describe briefly any two energy losses, giving the reasons for their occurrence in actual transformers.

Q26. Define internal resistance and e.m.f. of a cell for the potentiometer circuit shown in the given figure, points *X* and *Y* represent the two terminals of an unknown emf *E′*. A student observed that when the jockey is moved from the end *A* to the end *B* of the potentiometer wire, the defection in the galvanometer remains in the same directions. **5**



What may be the two possible faults in the circuit that could result in this observation?

If the galvanometer deflection at the end *B* is (a) more (b) less, than that at the end *A*, which of the two faults, listed above, would be there in the circuit?

Given reasons in support of your answer in each case