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Roll No.

- Please check that this question paper contains 11 printed pages.
- Code number given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- Please check that this question paper contains 35 questions.
- Please write down the Serial Number of the question before attempting it.
- 15 minute time has been allotted to read this question paper. Students will read the question paper only and will not write any answer on the answer-book during this period.

I–PRE BOARD EXAMINATION

PHYSICS (THEORY)

TIME : 3 hrs.   *MM : 70*

General Instructions :

(i)   There are 35 questions in all. All questions are compulsory

(ii)   This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(iii)   Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.

(iv)   There is no overall choice. However, internal choices have been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

(v)   Use of calculators is not allowed.

--- Page 1 ---

1. Which of the following is correct for light diverging from a point source ? [1]

   (a) The intensity decreases in proportion with the distance squared.

   (b) The wave front is parabolic.

   (c) The intensity of the wave does not depend on the distance.

   (d) None of these.

2. The effective resistance between C and D in given circuit is: [1]

   (a) R

   (b) 3R

   (c) 2R/3

   (d) R/3
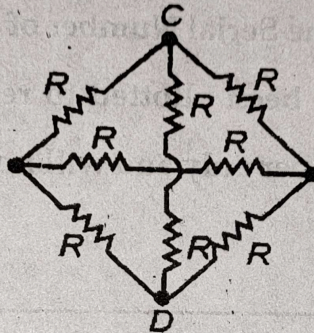
3. The de-Broglie wavelength of an electron moving with a speed of 6.6×10^{15} ms^{-1}

   is nearly equal to: [1]

   (a) 10^{-11} m

   (b) 10^{-9} m

   (c) 10^{-7} m

   (d) 10^{-5} m

4. In Bohr's model of the hydrogen atom, the ratio between the period of revolution of

   an electron in the orbit n = 1 to the period of revolution of electron in the orbit n = 2

   is : [1]

   (a) 1/2

   (b) 1/4

   (c) 1/8

   (d) 2

5. In Einstein's picture of Photoelectric emission, the photoelectric emission does not take place by [1]

    (a) continuous emission of energy from radiation

    (b) continuous absorption of energy from radiation

    (c) discrete absorption of energy from radiation

    (d) discrete emission of energy from radiation

6. The phenomena which is not explained by Huygen's construction of wavefront: [1]

    (a) reflection

    (b) diffraction

    (c) refraction

    (d) origin of spectra

7. Which one of the following graph represents correctly the variation of maximum kinetic energy E_{max} with the intensity of incident radiations having a constant frequency? [1]
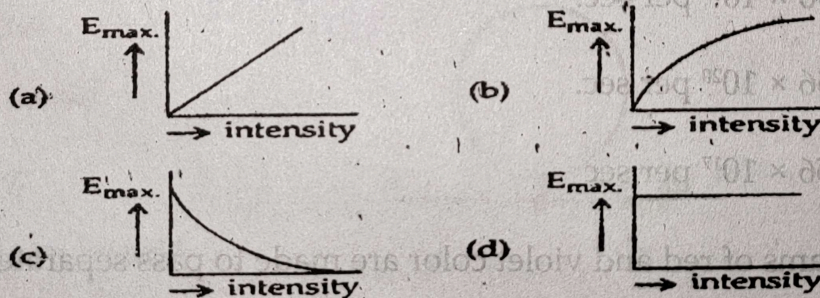
8. The conductivity of semiconductors like Ge and SI: [1]

    (a) increases when it is doped with pentavalent impurity.

    (b) increases when it is doped with trivalent impurity.

    (c) increases when it is doped with pentavalent or trivalent impurity.

    (d) none of the above

9. When the number of nucleons in nuclei increases, the binding energy per nucleon numerically: [1]

   (a) Increases continuously with mass number.

   (b) Decreases continuously with mass number.

   (c) First increases and then decreases with increase of mass number.

   (d) Remains constant with mass number.

10. In which case is the junction diode forward biased: [1]

   (a) +6V ---|>|--- +12V   (b) -2V ---|>|--- -2.5 V

   (c) 0 V ---|>|--- 2V   (d) -2V ---|>|--- 0 V
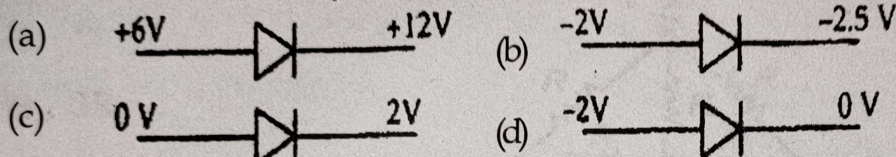
11. The energy released in the fission of a single $_{92}U^{235}$ nucleus is 200 MeV. The fission rate of $_{92}U^{235}$ fuelled reactor operating a power level of 5 Watt is: [1]

   (a) 1.56×10^{14} per sec.

   (b) 1.56×10^{17} per sec.

   (c) 1.56×10^{20} per sec.

   (d) 1.56×10^{17} per sec

12. Two beams of red and violet color are made to pass separately through a prism (angle of the prism is 60°). In the position of minimum deviation, the angle of refraction will be: [1]

   (a) 30° for both the colours

   (b) greater for the violet colour

   (c) greater for the red colour

   (d) equal but not 30° for both the colours

13. Two conducting spheres A and B of radii a and b respectively, are at the same potential, the ratio of surface charge densities of A and B is : [1]

(a) a/b (b) b/a

(c) a^2/b^2 (d) b^2/a^2

14. The electric mains supply in our homes and offices is a voltage that varies like a sine function with time such a voltage is called ... A... and the current driven by it in a circuit is called as ... B... Here, A and B refer to [1]

(a) DC voltage, AC current

(b) AC voltage, DC current

(c) AC voltage, DC voltage
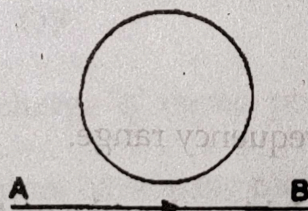
(d) AC voltage, AC current

15. In the given figure current from A to B in the straight wire is decreasing. The direction of induced current in the loop is A: [1]

(a) Clockwise

(b) anticlockwise

(c) changing

(d) nothing can be said

From Q. 16 to Q. 18, two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true and R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false and R is also false

16. **Assertion :** To convert a galvanometer into an ammeter a small resistance is connected in parallel with it. [1]

   Reason : The small resistance increases the combined resistance of the combination.

17. **Assertion :** An electric bulb becomes dim, when the electric heater in parallel circuit is switched on. [1]

   Reason : Dimness decreases after sometime.

18. **Assertion :** According to Huygen's principle, no backward wave-front is possible. [1]

   Reason : Amplitude of secondary wavelet is proportional to $(1 + \cos \theta)$ where θ is the angle between the ray at the point of consideration and the direction of secondary wavelet.
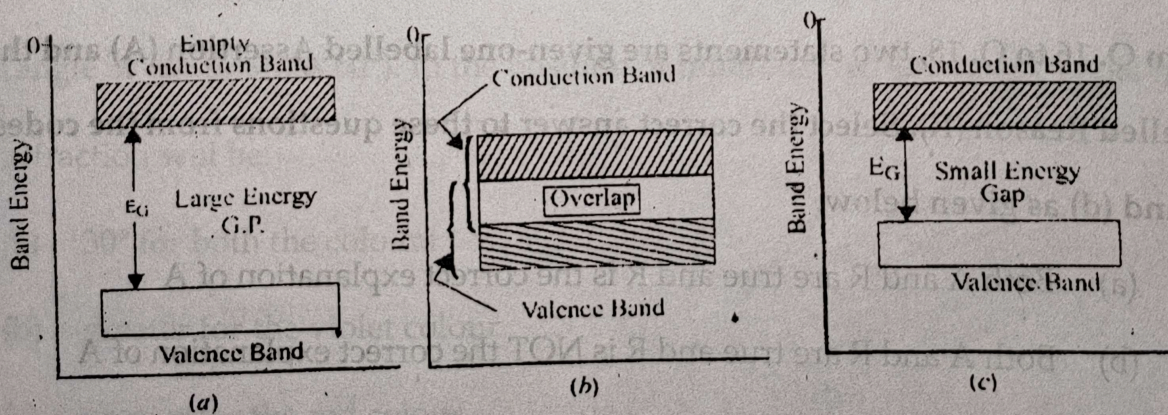
SECTION –B

19. Identify the part of electromagnetic spectrum used in: [2]

   (a) Radar

   (b) Eye Surgery

   Also write their frequency range.

20. Identify the material in a, b and c on the basis of energy band as given below: [2]

21. The amplitude of light waves from two slits in Young's experiments are in ratio $\sqrt{2} : 1$ What is the ratio of slit width? [2]

OR

Determine the potential difference across the plates of the capacitor 'C_1' of the network shown in the figure. [Assume $E_2 > E_1$] [2]
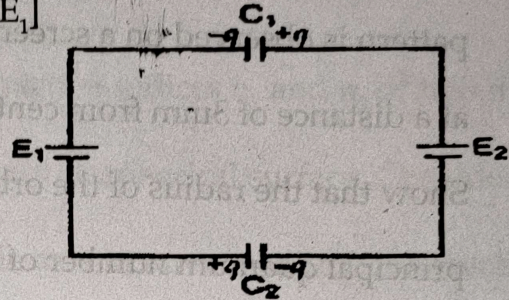
22. A uniform wire is cut in to 3 parts with their lengths in the ratio 2:3:6. The ends of each three parts are connected across an ideal battery of 10V. If a current of 5 ampere is drawn from battery then find the initial resistance of the wire. [2]

23. Plot a graph showing the variation of induced e.m.f with the rate of change of current flowing through a coil. [2]

OR

The given graph shows variation of charge 'q' versus potential difference 'V' for two capacitors C_1 and C_2. Both the capacitors have same plate separation but plate area of C_2 is greater than that of C_1. Which line (A or B) corresponds to C_1 and why? [2]
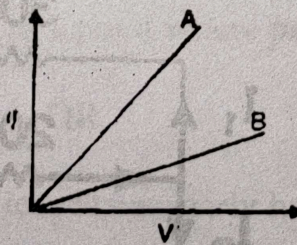
24. Two metallic rods, each of length L, area of cross A_1 and A_2 having resistivities ρ_1 and ρ_2 are connected in parallel across a D.C. battery. Obtain the expression for the effective resistivity of this combination. [2]

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25. In a single slit diffraction experiment, the slit is immersed in water. How will the

   (i) size and (ii) intensity of central bright band be affected? Justify your answer. [2]
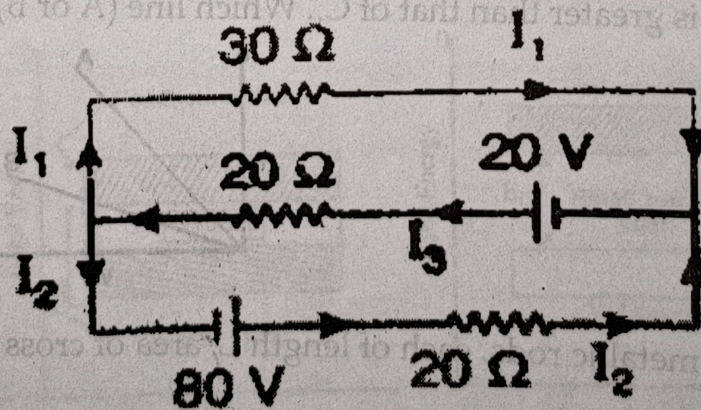
SECTION – C

26. A parallel beam of light of 600 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.2 m away. It is observed that the first minimum is at a distance of 3mm from centre of the screen. Calculate the width of the slit. [3]

27. Show that the radius of the orbit in hydrogen atom varies as n^2. Where n is the principal quantum number of the atom. [3]

28. Using Ampere's circuital law, obtain an expression for the magnetic field along the axis of a long current carrying solenoid of length ℓ and having N number of turns. [3]

OR

Using Huygens's principle, explain reflection of a plane wave front from a surface and verify law of reflection. [3]

29. A coil takes a current of 2.0A and 200 watt power from an alternating current source of 220 volt, 50 Hertz. Calculate the resistance and inductance of the coil. [3]

OR

Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure. [3]

30. Draw a ray diagram of an astronomical telescope in the normal adjustment position. State two drawbacks of this type of telescope. [3]

31. Draw a labelled diagram of a full wave rectifier circuit. State its working principle. Show the input-output waveforms. [5]

OR

Derive the mathematical relation between refractive indices n_1 and n_2 of two media and radius of curvature R for refraction at a convex spherical surface. Consider the object to be a point same lying on the principle axis in rarer medium of refractive index n_1 and a real image formed in the denser medium of refractive index n_2.

Hence, derive lens maker's formula. [5]

32. (i) In a single slit diffraction experiment, the width of the slit is reduced to half its original width. How would this affect the size and intensity of the central maximum?

(ii) In Young's double slit experiment using mono-chromatic light of wavelength X, the intensity of light at a point on the screen where path difference is X, is K units.

Find out the intensity of light at a point where path difference is $2\lambda/3$. [5]

OR

Write Einsten's photoelectric equation. State clearly how this equation is obtained using the photon picture of electromagnetic radiation. Write the three salient features observed in photoelectric effect which can be explained using this equation. [5]

33. (a) Using Biot-Savarts law, derive an expression for the magnetic field at the centre of a circular coil of radius R, number of turns N, carrying current i.

(b) Two small identical circular coils marked 1, 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O. [5]
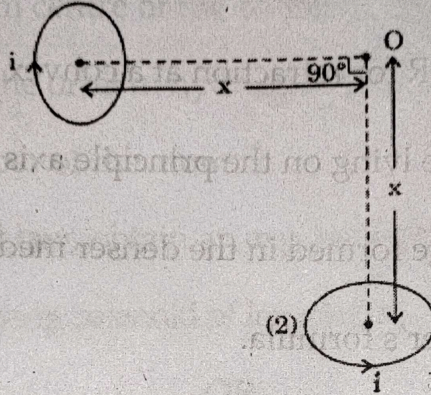
OR

(a). Derive an expression for drift velocity of electrons in a conductor & hence deduce Ohm's law.

(b) A wire whose cross-sectional area is increasing linearly from its one end to the other, is connected across a battery of V volts, which of the following quantities remains constant in the wire ?

Drift velocity, Current density, Electric current, Electric field. [5]

SECTION – E

34. *Case Study: Read the following paragraph and answer the questions.* [4]

Each point on a wave front is a source of new disturbance this is called secondary wavefront. They spread in all direction with speed of light. A wave front is locus of particles which are vibrating in same phase; rays are perpendicular to the wave fronts. Light will take time to travel from source to the observer. Speed of light in any medium is less than the speed of light in vacuum. This speed can be co-related the wave length of the wave also. Since the refractive index give the relation

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between speed of light in different media, the wave length in different media can be determine using the refractive index.

(i) What is the wave front of beam of parallel light?

(ii) Which characteristic of light remains unchanged after reflection or refraction?

(iii) What will be the speed of light in diamond ? $(\mu_d = 2.47)$

OR

(iii) Speed of light in two media is v_1 and v_2. What is the ratio of their wave lengths?

35. **Case Study: Read the following paragraph and answer the questions.** [4]

A p-n junction is the key to all semiconductor devices. When such a junction is made, a depletion layer is formed consisting immobile ion-cores devoid of their electrons and holes. This is responsible for a junction potential barrier. By changing the external applied voltage, junction barrier can be changed. In forward bias the barrier is decreased while increased in reverse bias. Hence in forward bias current is more (mA) while it is very small (μA) in reverse biased junction diode.

(i) Write the name of currents, which flows during the formation of depletion layer.

(ii) What will be the effect upon the depletion layer (a) in forward bias (b) in reverse bias.

(iii) In ideal condition what will be the resistance of reverse p-n junction.

OR

In ideal condition what will be the resistance of forward p-n junction.

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