12505

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Register Number

12 REVISION EXAMINATION (PROBLEMS) – FEBRUARY 2023

PART – III
PHYSICS

Time Allowed : 3.00 Hours]   [Maximum Marks : 70

Instructions : (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.

(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.
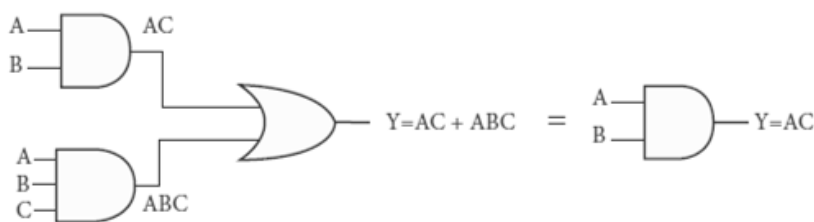
PART – II

Note : Answer any fourteen questions. Question No. 20 is compulsory. 14x2=28

1. Consider a point charge +q placed at the origin and another point charge -2q placed at a distance of 9 m from the charge +q. Determine the point between the two charges at which electric potential is zero.

2. When two objects are rubbed with each other, approximately a charge of 50 nC can be produced in each object. Calculate the number of electrons that must be transferred to produce this charge.

3. A copper wire of cross-sectional area 0.5 mm² carries a current of 0.2 A. If the free electron density of copper is 8.4×10^{28} m^{-3} then compute the drift velocity of free electrons.

4. Calculate the equivalent resistance for the circuit which is connected to 24 V batteries and also find the potential difference across 4 Ω and 6 Ω resistors in the circuit.

5. The repulsive force between two magnetic poles in air is 9×10^{-3} N. If the two poles are equal in strength and are separated by a distance of 10 cm, calculate the pole strength of each pole.

6. Two materials X and Y are magnetized, whose intensity of magnetization are 500 Am^{-1} and 2000 Am^{-1}, respectively. If the magnetizing field is 1000 Am^{-1}, then which one among these materials can be easily magnetized?

7. The self-inductance of an air-core solenoid is 4.8 mH. If its core is replaced by iron core, then its self-inductance becomes 1.8 H. Find out the relative permeability of iron.

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8.   A 200 turn coil of radius 2 cm is placed co-axially within a long solenoid of 3 cm radius. If the turn density of the solenoid is 90 turns per cm, then calculate mutual inductance of the coil.

9.   Compute the speed of the electromagnetic wave in a medium if the amplitude of electric and magnetic fields are 3×10^4 N C^{-1} and 2×10^{-4} T, respectively.

10. A pulse of light of duration 10^{-6} s is absorbed completely by a small object initially at rest. If the power of the pulse is 60×10^{-3} W, calculate the final momentum of the object.

11. Pure water has refractive index 1.33. What is the speed of light through it?

12. Light travelling through transparent oil enters in to glass of refractive index 1.5. If the refractive index of glass with respect to the oil is 1.25, what is the refractive index of the oil?

13. A diffraction grating consisting of 4000 slits per centimeter is illuminated with a monochromatic light that produces the second order diffraction at an angle of 30^0. What is the wavelength of the light used?

14. Light of wavelength of 5000 Å produces diffraction pattern of the single slit of width 2.5 μm. What is the maximum order of diffraction possible?

15. What should be the velocity of the electron so that its momentum equals that of 4000 Å wavelength photon.

16. How many photons of frequency 10^{14} Hz will make up 19.86 J of energy?

17. Calculate the number of nuclei of carbon-14 un-decayed after 22,920 years if the initial number of carbon-14 atoms is 10,000. The half-life of carbon-14 is 5730 years.

18. Half lives of two radioactive elements A and B are 20 minutes and 40 minutes respectively. Initially, the samples have equal number of nuclei. Calculate the ratio of decayed numbers of A and B nuclei after 80 minutes.

19. Determine the wavelength of light emitted from LED which is made up of GaAsP semiconductor whose forbidden energy gap is 1.875 eV. Mention the colour of the light emitted (Take h = 6.6×10^{-34} Js).

20. Simplify the Boolean identity AC + ABC = AC

PART – III

Note :   Answer **any fourteen** questions. **Question No. 40** is compulsory.   **14x3=42**

21. Calculate the electric flux through the rectangle of sides 5 cm and 10 cm kept in the region of a uniform electric field 100 NC^{-1}. The angle θ is 60^0 . If θ becomes zero, what is the electric flux?

22. A parallel plate capacitor has square plates of side 5 cm and separated by a distance of 1 mm. (a) Calculate the capacitance of this capacitor. (b) If a 10 V battery is connected to the capacitor, what is the charge stored in any one of the plates? (The value of ε_o = 8.85 x 10^{-12} Nm^2 C^{-2}).

23. In a potentiometer arrangement, a cell of emf 1.25 V gives a balance point at 35 cm length of the wire. If the cell is replaced by another cell and the balance point shifts to 63 cm, what is the emf of the second cell?

24. The rod given in the figure is made up of two different materials

Both have square cross sections of 3 mm side. The resistivity of the first material is 4×10^{-3} Ωm and that of second material has resistivity of 5×10^{-3} Ωm. What is the resistance of rod between its ends?

25. Suppose a cyclotron is operated to accelerate protons with a magnetic field of strength 1 T. Calculate the frequency in which the electric field between two Dees could be reversed.

26. Compute the intensity of magnetization of the bar magnet whose mass, magnetic moment and density are 200 g, 2 A m2 and 8 g cm^{-3}, respectively.

27. A fan of metal blades of length 0.4 m rotates normal to a magnetic field of 4 x 10^{-3} T. If the induced emf between the centre and edge of the blade is 0.02 V, determine the rate of rotation of the blade.

28. An ideal transformer has 460 and 40,000 turns in the primary and secondary coils respectively. Find the voltage developed per turn of the secondary if the transformer is connected to a 230 V AC mains. The secondary is given to a load of resistance 10^4 Ω. Calculate the power delivered to the load.

29. A transmitter consists of LC circuit with an inductance of 1 μH and a capacitance of 1 μF. What is the wavelength of the electromagnetic waves it emits?

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30.   If the relative permeability and relative permittivity of the medium is 1.0 and 2.25, respectively. Find the speed of the electromagnetic wave in this medium.

31.   An object of 4 cm height is placed at 6 cm in front of a concave mirror of radius of curvature 24 cm. Find the position, height, magnification and nature of the image.

32.   The angle of minimum deviation for a prism is 37^0. If the angle of prism is 60^0, find the refractive index of the material of the prism.

33.   The ratio of maximum and minimum intensities in an interference pattern is 36: 1. What is the ratio of the amplitudes of the two interfering waves?

34.   A monochromatic light of wavelength of 500 nm strikes a grating and produces fourth order bright line at an angle of 30^0. Find the number of slits per centimeter.

35.   Calculate the energies of the photons associated with the following radiation:
        (i) Violet light of 413 nm (ii) X-rays of 0.1 nm.

36.   A radiation of wavelength 300 nm is incident on a silver surface. Will photoelectrons be observed?

37.   Assuming that energy released by the fission of a single $_{92}U^{235}$ nucleus is 200MeV, calculate the number of fissions per second required to produce 1 Watt power.

38.   Calculate the time required for 60% of a sample of radon undergo decay.
        (Given $T_{1/2}$ of radon =3.8 days.)

39.   A transmitting antenna has a height of 40 m and the height of the receiving antenna is 30 m. What is the maximum distance between them for line-of-sight communication? The radius of the earth is 6.4×10^6 m.
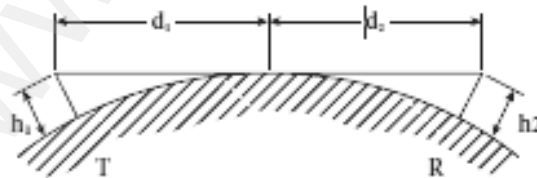
40.   Calculate the range of the variable capacitor that is to be used in a tuned-collector oscillator which has a fixed inductance of 150 μH. The frequency band is from 500 kHz to 1500 kHz.

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