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Time: 2 Hour Total Marks: 70

Class : XII

Subject : Physics

MCQ SINGLE CORRECT

1. An EM wave radiates outwards from a dipole antenna, with E_o as the amplitude of its electric field vector. The electric field E_o which transports significant energy from the source falls off as

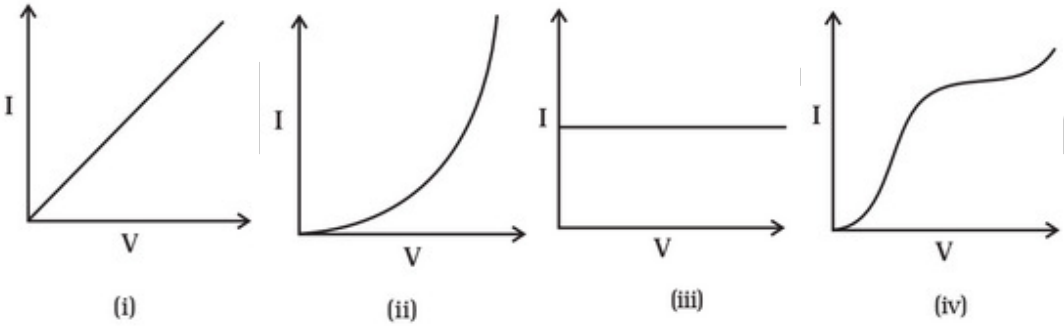
(a) $\frac{1}{r^3}$

(b) $\frac{1}{r^2}$

(c) $\frac{1}{r}$

(d) remains constant.

2. I-V characteristics of four devices are shown in Fig.



Identify devices that can be used for modulation:

(a) 'i' and 'iii'.

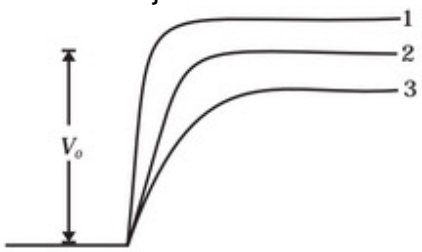
(b) only 'iii'.

(c) 'ii' and some regions of 'iv'.

(d) All the devices can be used.

All The Best!!!

3. In the given fig. V_o is the potential barrier across a p-n junction, when no battery is connected across the junction



(a) 1 and 3 both correspond to forward bias of junction

(b) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction

(c) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction.

(d) 3 and 1 both correspond to reverse bias of junction.

4. The radius of curvature of the curved surface of a plano-convex lens is 20 cm. If the refractive index of the material of the lens be 1.5, it will

(a) act as a convex lens only for the objects that lie on its curved side.

(b) act as a concave lens for the objects that lie on its curved side.

(c) act as a convex lens irrespective of the side on which the object lies.

(d) act as a concave lens irrespective of side on which the object lies.

5. A metal rod of length 10 cm and a rectangular cross-section of $1\text{cm} \times \frac{1}{2}\text{ cm}$ is connected to a battery across opposite faces. The resistance will be

(a) maximum when the battery is connected across $1\text{cm} \times \frac{1}{2}\text{ cm}$ faces.

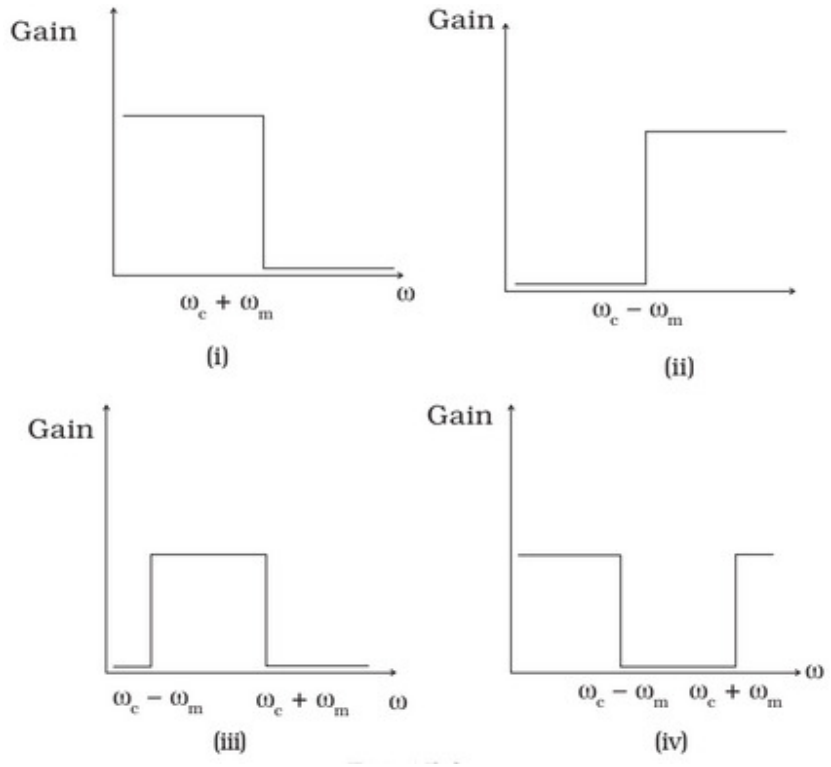
(b) maximum when the battery is connected across 10 cm × 1 cm faces.

(c) maximum when the battery is connected across 10 cm $\times \frac{1}{2}\text{ cm}$ faces

(d) same irrespective of the three faces.

MCQ MULTIPLE CORRECT

6. The frequency response curve (Fig. for the filter circuit used for production of AM wave should be



(a) (i) followed by (ii).

(b) (ii) followed by (i).

(c) (iii).

(d) (iv).

7. Photons absorbed in matter are converted to heat. A source emitting n photon/sec of frequency v is used to convert 1kg of ice at 0°C to water at 0°C. Then, the time T taken for the conversion

(a) decreases with increasing n, with v fixed.

(b) decreases with n fixed, v increasing

(c) remains constant with n and v changing such that nv = constant.

(d) increases when the product nv increases.

8. A parallel plate capacitor is connected to a battery as shown in Fig. Consider two situations:
A: Key K is kept closed and plates of capacitors are moved apart using insulating handle.
B: Key K is opened and plates of capacitors are moved apart using insulating handle.
Choose the correct option(s).

(a) In A : Q remains same but C changes.

(b) In B : V remains same but C changes.

(c) In A : V remains same and hence Q changes.

(d) In B : Q remains same and hence V changes.

9. Consider an npn transitor with its base-emitter junction forward biased and collector base junction reverse biased. Which of the following statements are true?.

   (a) Electrons crossover from emitter to collector.

   (b) Holes move from base to collector.

   (c) Electrons move from emitter to base.

   (d) Electrons from emitter move out of base without going to the collector.

10. Consider an extended object immersed in water contained in a plane trough. When seen from close to the edge of the trough the object looks distorted because

    (a) the apparent depth of the points close to the edge are nearer the surface of the water compared to the points away from the edge.

    (b) the angle subtended by the image of the object at the eye is smaller than the actual angle subtended by the object in air.

    (c) some of the points of the object far away from the edge may not be visible because of total internal reflection.

    (d) water in a trough acts as a lens and magnifies the object.

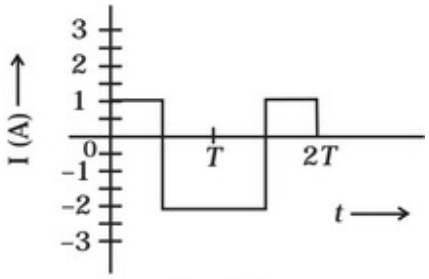
FILL IN THE BLANKS

11. The size of the atom in Thomson's model is ____ the atomic size in Rutherford's model.
12. In the ground state of ____ electrons are in stable equilibrium, while in ____ electrons always experience a net force.
13. A classical atom based on _____ is doomed to collapse.
14. The positively charged part of the atom possesses most of the mass in ____
15. An atom has a nearly continuous mass distribution in a ____ but has a highly non-uniform mass distribution in ____

VERY SHORT DESC

16. What is the ratio of the number of holes and the number of conduction electrons in an intrinsic semiconductor?
17. In a transistor, current gain for common basic and common emitter configuration are α and β respectively. What is the relation between α and β?
18. The discharging current in the atmosphere due to the small conductivity of air is known to be 1800 A on an average over the globe. Why then does the atmosphere not discharge itself completely in due course and become electrically neutral? In other words, what keeps the atmosphere charged?
19. Name the type of biasing of a p-n junction diode so that the junction offers very high resistance.

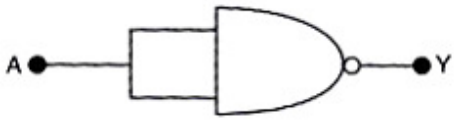
20. The alternating current in a circuit is described by the graph shown in Fig . Show rms current in this graph.



21. Using the concept of electron and hole current, write an expression for the conductivity of a semiconductor.
22. A man fixes outside his house one evening a two metre high insulating slab carrying on its top a large aluminium sheet of area 1m^2. Will he get an electric shock if he touches the metal sheet next morning?
23. What meaning would you give to the capacitance of a single conductor?
24. Long distance radio broadcasts use short wave bands. Why?
25. Name two factors on which electrical conductivity of a pure semiconductor at a given temperature depends.

SHORT DESC - 25 WORDS

26. Write the truth table for a NAND gate connected as given in figure.



Hence identify the exact logic operation carried out by this circuit.

27. A small telescope has an objective lens of focal length 144 cm and an eyepiece of focal length 6.0 cm. What is the magnifying power of the telescope? What is the separation between the objective and the eyepiece?
28. A small telescope has an objective lens of focal length 140 cm and an eyepiece of focal length 5.0 cm. What is the magnifying power of the telescope for viewing distant objects when
(a) the telescope is in normal adjustment (i.e. when the final image is at infinity)
(b) the final image is formed at the least distance of distinct vision (25 cm)?
29. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is $B_0 = 510\ \text{nT}$. What is the amplitude of the electric field part of the wave?
30. Give expression for average value of a.c. voltage $V = V_0 \sin \omega t$ over time interval t = 0 to $t = \frac{\pi}{\omega}$.

MED DESC - 50 WORDS

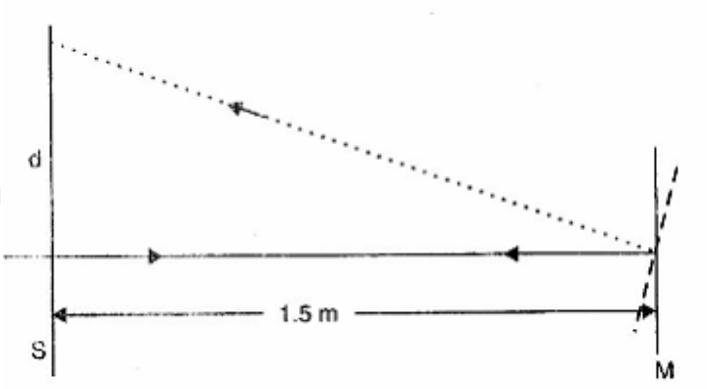
31. An electron traveling west to east enters a chamber having a uniform electrostatic field in north to south direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

32. A compass needle free to turn in a horizontal plane is placed at the centre of circular coil of 30 turns and radius 12 cm. The coil is in a vertical plane making an angle of 45° with the magnetic meridian. When the current in the coil is 0.35 A, the needle points west to east.
(a) Determine the horizontal component of the earth's magnetic field at the location.
(b) The current in the coil is reversed, and the coil is rotated about its vertical axis by an angle of 90° in the anticlockwise sense looking from above. Predict the direction of the needle. Take the magnetic declination at the place to be zero.

33. A $100\mu F$ capacitor in series with a 40Ω resistance is connected to a 110 V, 60 Hz supply.
(a) What is the maximum current in the circuit?
(b) What is the time lag between current maximum and voltage maximum?

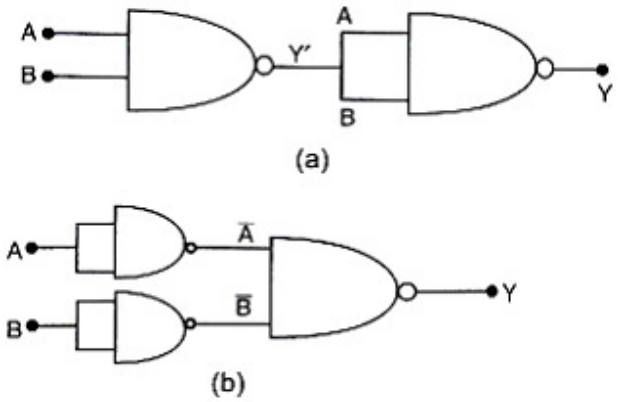
34. The binding energy per nucleon of $^{16}_{8}O$ is 7.97 MeV and that of O^{17} is 7.75 MeV. Calculate the energy required to remove a neutron from $^{17}_{8}O$

35. Light incident normally on a plane mirror attached to a galvanometer coil retraces backwards as shown in figure A current in the coil produces a deflection of 3.5° of the mirror. What is the displacement of the reflected spot of light on a screen placed 1.5 m away?



LONG DESC - 100 WORDS

36. You are given two circuits as shown in figure, which consists of NAND gates. Identify the logic operation carried out by the two circuits.



37. The plates of a parallel plate capacitor have an area of $90\ cm^2$ each and are separated by 2.5 mm. The capacitor is charged by connecting it to a 400 V supply.

(a) How much electrostatic energy is stored by the capacitor?
(b) View this energy as stored in the electrostatic field between the plates, and obtain the energy per unit volume u. Hence arrive at a relation between u and the magnitude of electric field E between the plates.

38. In a p-n junction diode, the current I can be expressed as

$$I = I_0 \exp\left(\frac{eV}{2k_BT} - 1\right)$$

where I_0 is called the reverse saturation current, V is the voltage across the diode and is positive for forward bias and negative for reverse bias, and I is the current through the diode, k_B is the Boltzmann constant $(8.6 \times 10^{-5}\ eV/K)$ and T is the absolute temperature. If for a given diode $I_0 = 5 \times 10^{-12}\ A$ and T = 300 K, then

(a) What will be the forward current at a forward voltage of 0.6 V?
(b) What will be the increase in the current if the voltage across the diode is increased to 0.7 V?
(c) What is the dynamic resistance?
(d) What will be the current if reverse bias voltage changes from 1V to 2 V?

39. Two charges $-q$ and +q are located at points $(0, 0, -a)$ and (0, 0 , a) respectively.
(a) What is the electrostatic potential at the points (0, 0, z) and (x, y, 0)?
(b) Obtain the dependence of potential on the distance r of a point from the origin when r/a> > 1.
(c) How much work is done in moving a small test charge from the point (5, 0, 0) to $(-7, 0, 0)$ along the x-axis? Does the answer change if the path of the test charge between the same points is not along the x-axis?

40. Derive an expression for the maximum force experienced by a straight conductor of length l, carrying current I and kept in a uniform magnetic field B.