

A. All **Questions** are compulsory. There are **26 Questions** in all. Study, Assignments, Solved Previous Year Papers. Questions and Answers. Free Forever.

B. This **Question Paper** has **Five** sections: **Section A**, **Section B**, **Section C**, **Section D** and **Section E**.

C. **Section A** contains **Five** questions of **One Mark** each.

D. **Section B** contains **Five** questions of **Two Marks** each.

E. **Section C** contains **Twelve** questions of **Three Marks** each.

F. **Section D** contains **One Value Based Question** of **Four Marks**

G. **Section E** contains **Three** questions of **Five Marks** each.

There is no overall choice. However, an **Internal Choice** has been provided in **one question** of **Two Marks**, **one question** of **Three Marks** and all the **Three Questions** of **Five Marks** weightage. You have to attempt only one of the choices in such Questions.

Section A

1

What is meant by capacitance? Give its SI unit.

[1]

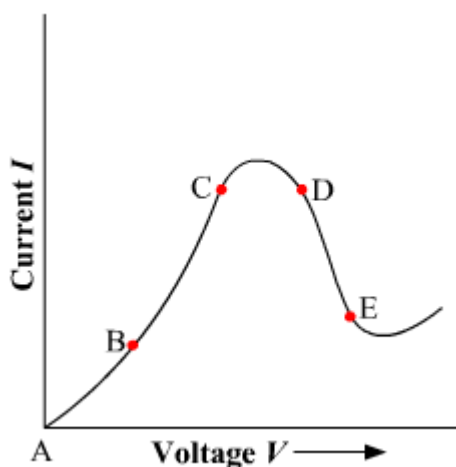
2

Graph showing the variation of current versus voltage for a material GaAs is shown in the figure.

Identify the region of

i) negative resistance

ii) where Ohm's law is obeyed.



[1]

3

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A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the

direction of electric and magnetic field vectors?

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[1]

4

How are side bands produced?

[1]

5

What is the value of refractive index of a medium of polarizing angle 60° ?

[1]

Section B

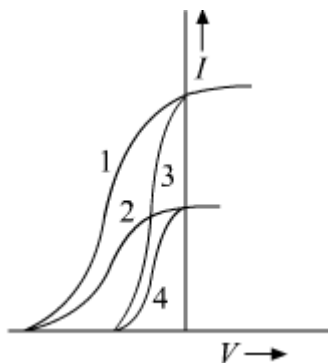
6

If the temperature of a good conductor decreases, how does the relaxation time of electrons in the conductor change?

[2]

7

The given graph shows the variation of photo-electric current (I) versus applied voltage (V) for two different photosensitive materials and for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials but same intensity of incident radiation.



[2]

OR

How does one explain, using de Broglie hypothesis, Bohr's second postulate of quantization of orbital angular momentum?

[2]

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8

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(i) Transducer

(ii) Repeater

[2]

9

Out of the two characteristics—the mass number (A) and the atomic number (Z) of a nucleus, which one does not change during nuclear α -decay?

[2]

10

How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced with red light?

[2]

Section C

11

Two capacitors of unknown capacitances C_1 and C_2 are connected first in series and then in parallel across a battery of 100 V. If the energy stored in the two combinations is 0.045 J and 0.25 J respectively, determine the value of C_1 and C_2 . Also, calculate the charge on each capacitor in parallel combination.

[3]

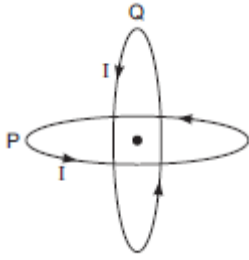
12

State the underlying principle of a potentiometer. Write two factors by which current sensitivity of a potentiometer can be increased. Why is a potentiometer preferred over a voltmeter for measuring the emf of a cell?

[3]

13

Two identical circular wires P and Q each of radius R and carrying current ' I ' are kept in perpendicular planes such that they have a common center as shown in the figure. Find the magnitude and direction of the net magnetic field at the common center of the two coils.



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[3]

14

The magnetic field of an electromagnetic wave oscillates parallel to a y-axis and is given by $B_y = B_0 \sin(kz - \omega t)$. (a) In what direction does the wave travel and (b) parallel to which axis does the associated electric field oscillate?

[3]

15

a) Write the expression for the magnetic force acting on a charged particle moving with velocity v in the presence of magnetic field B .

b) A neutron, an electron and an alpha particle, moving with equal velocities, enter a uniform magnetic field going into the plane of paper, as shown. Trace their paths in the field and justify your answer.

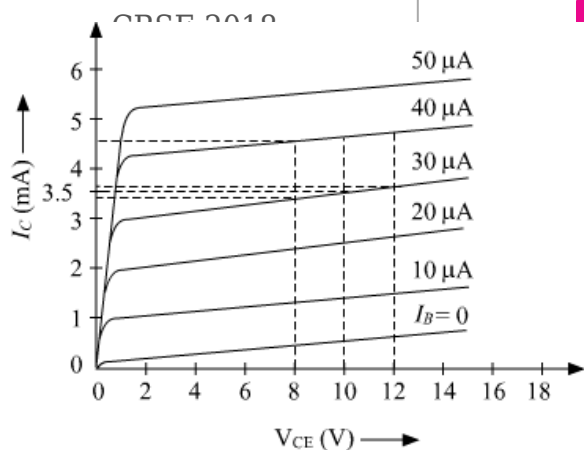


[3]

16

Output characteristics of an n-p-n transistor in CE configuration is shown in the figure. Determine:

- Dynamic output resistance
- DC current gain and
- AC current gain at an operating point $V_{CE}=10V$, when $I_B=30 \mu A$.



[3]

17

Write three characteristic features in photoelectric effect that cannot be explained on the basis of wave theory of light, but can be explained only using Einstein's equation.

[3]

18

(i) State law of Malus.

(ii) Draw a graph showing the variation of intensity (I) of polarised light transmitted by an analyser with angle (θ) between polarizer and analyser.

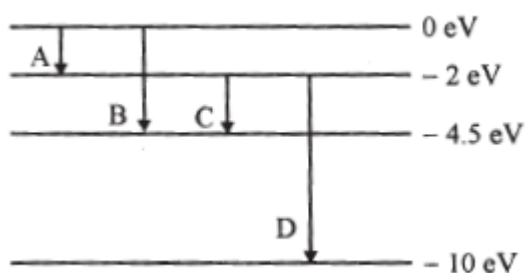
(iii) What is the value of refractive index of a medium of polarising angle 60° ?

[3]

19

The energy levels of a hypothetical atom are shown below. Which of the shown transitions will result in the emission of a photon of wavelength 275 nm?

Which of these transitions correspond to emission of radiation of (i) maximum and (ii) minimum wavelength?



[3]

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Write the nuclear reactions for the following:

(i) α -decay of Po_{84}^{204}

(ii) β - decay of P_{15}^{32}

(iii) β^+ decay of C_{6}^{11}

[3]

20

Write the two processes that take place in the formation of a p-n junction. Explain with the help of a diagram, the formation of the depletion region and barrier potential in a p-n junction.

[3]

21

Write any two factor which justify the need for modulating a signal.

Draw a diagram showing an amplitude modulated wave by superposing a modulating signal over a sinusoidal carrier wave.

[3]

22

Ultraviolet radiations of different frequencies ν_1 and ν_2 are incident on two photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$) respectively. The kinetic energy of the emitted electrons is same in both the cases. Which one of the two radiations will be of higher frequency?

[3]

Section D

23

One day Chetan's mother developed a severe stomach ache all of a sudden. She was rushed to the doctor who suggested for an immediate endoscopy test and gave an estimate of expenditure for the same. Chetan immediately contacted his class teacher and shared the information with her. The class teacher arranged for the money and rushed to the hospital. On realizing that Chetan belonged to a below average income group family, even the doctor offered concession for the test fee. The test was conducted successfully.

Answer the following questions based on the above information:

(a) Which principle in optics is made use of in endoscopy?

(b) Briefly explain the values reflected in the action taken by the teacher.

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(c) In what way do you appreciate the response of the doctor on the given situation?

[4]

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Section E

24

(a) Explain, using suitable diagrams, the difference in the behaviour of a

(i) conductor and

(ii) dielectric in the presence of external electric field. Define the terms polarization of a dielectric and write its relation with susceptibility.

(b) A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $Q/2$ is placed at its centre C and another charge $+2Q$ is placed outside the shell at a distance x from the centre as shown in the figure. Find

(i) the force on the charge at the centre of shell and at the point A ,

(ii) the electric flux through the shell.

[5]

OR

Two point charges $4Q, Q$ are separated by 1 m in air. At what point on the line joining the charges is the electric field intensity zero?

Also calculate the electrostatic potential energy of the system of charges, taking the value of charge,

$$Q = 2 \times 10^{-7} \text{ C.}$$

[5]

25

Derive an expression for the impedance of a series LCR circuit connected to an AC supply of variable frequency.

Plot a graph showing variation of current with the frequency of the applied voltage.

Explain briefly how the phenomenon of resonance in the circuit can be used in the

Tuning mechanism of a radio or a TV set.

[5]

OR

An LC circuit contains a 20 mH inductor and a $50\text{ }\mu\text{F}$ capacitor with an initial charge of 10 mC . The resistance of the circuit is negligible. Let the instant the circuit is closed be $t = 0$.

(a) Write the total energy stored initially. Also, give the expression for the energy in the capacitor at any time t .

(b) What is the natural frequency of the circuit?

(c) At what time is the energy stored

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(i) completely electrical (i.e., stored in the capacitor)?

(ii) completely magnetic (i.e., stored in the inductor)?

(d) At what times is the total energy shared equally between the inductor and the capacitor?

(e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat?

[5]

26

(a) Obtain lens makers formula using the expression

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$$

Here the ray of light propagating from a rarer medium of refractive index (n_1) to a denser medium of refractive index (n_2) is incident on the convex side of spherical refracting surface of radius of curvature R .

(b) Draw a ray diagram to show the image formation by a concave mirror when the object is kept between its focus and the pole. Using this diagram, derive the magnification formula for the image formed.

[5]

OR

Describe Young's double slit experiment to produce interference pattern due to a monochromatic source of light. Deduce the expression for the fringe width.

[5]