

## General Instructions:

- All questions are compulsory. There are 37 questions in all.
- This question paper has four sections: Section A, Section B, Section C and Section D.
- Section A contains twenty questions of one mark each, Section B contains seven questions of two marks each, Section C contains seven questions of three marks each, and Section D contains three questions of five marks each.

## SECTION A

1. Magnetic Susceptibility of a diamagnetic substance

- a)  $>0$                       b)  $<0$                       c)  $\gg 0$                       d)  $\ll 0$

2. Q charge is placed at a corner of a cube(box). Total electric flux through the box

- a)  $q/8\epsilon_0$                       b)  $q/24\epsilon_0$                       c)  $q/6\epsilon_0$                       d)  $q/4\epsilon_0$

3.  $\alpha$  particle has

- a) 2 proton, 2n, 2e    b) 2p, 2e                      c) 2p, 2n                      d) 2n, 2e

4. In  $\gamma$ -ray emission from nucleus

- a) neutron number, proton number changes    b) no change    c) only neutron number changes    d) p number changes

5. Light is incident at an angle 60 degree at the interface of refracting medium, the reflected light becomes plane polarized. Refractive index of the medium is

- a)  $1/\sqrt{3}$                       b)  $1/2$                       c)  $\sqrt{3}/2$                       d)  $\sqrt{3}$

6. Which of the following is a universal gate

- a) AND                      b) OR                      c) NOT                      d) NAND

7. If two lenses of power +1.5D and +1.0D are placed in contact then the effective power of combination will be

- a) 2.5D                      b) 1.5D                      c) 0.5D                      d) 3.25D

8. For electron in 2<sup>nd</sup> orbit of hydrogen atom what is the moment of momentum as per the Bohr's model

- a)  $h/2\pi$                       b)  $2h/2\pi$                       c)  $h/2\pi$                       d)  $3h/2\pi$

9. Golden view of sea shell is due to

- a) Diffraction                      b) Polarisation                      c) Dispersion                      d) Reflection

10. Radio frequency choke has core of

- a) Air                      b) iron                      c) air and iron                      d) none

11. If  $\alpha, \beta, \gamma$  rays carry same momentum then which has the longest momentum \_\_\_\_\_

12. SI unit of permittivity is \_\_\_\_\_

13. The current gain for a transistor (common base) is 0.96. If the emitter current is 7.2, then the base current is \_\_\_\_\_

14. The magnetic flux linked with the coil (Wb)

$\Phi = 5t^2 + 3t + 16$  emf induced in 2s is \_\_\_\_\_

15. The Electric field inside a spherical shell of uniform surface charge density  $\sigma$  is \_\_\_\_\_

16. An electron is accelerated through a potential difference  $V$ . Write the expression for its final speed, if it was initially at rest.

17. Draw a graph showing the intensity distribution of fringes due to diffraction at single slit.

18. Define the power of a lens. Write its S.I. unit.

19. Nichrome and copper wires of same length and same radius are connected in series. Current  $I$  is passed through them. Which wire gets heated up more? Justify your answer.

20. Do electromagnetic waves carry energy and momentum?

## SECTION B

21. Unpolarised light is passed through a polaroid P1. When this polarised beam passes through another polaroid P2 and if the pass axis of P2 makes angle  $\theta$  with the pass axis of P1, then write the expression for the polarised beam passing through P2. Draw a plot showing the variation of intensity when  $\theta$  varies from 0 to  $2\pi$ .

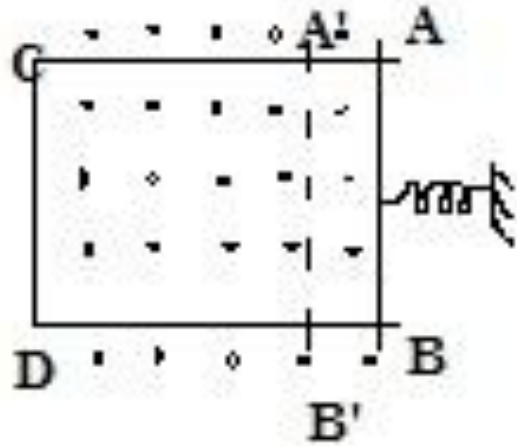
22. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced by red light? Give reason.

23. Identify the electromagnetic waves whose wavelengths vary as

a)  $10^{-12} \text{ m} < \lambda < 10^{-8} \text{ m}$     b)  $10^{-3} \text{ m} < \lambda < 10^{-1} \text{ m}$                       Write one use for each.

24. A 12.5 eV electron beam is used to excite a gaseous hydrogen atom at room temperature. Determine the wavelengths and the corresponding series of the lines emitted.

25. A rectangular frame of wire is placed in a uniform magnetic field directed outwards, normal to the paper. AB is connected to a spring which is stretched to A'B' and then released at time  $t = 0$ . Explain qualitatively



how induced e.m.f. in the coil would vary with time.  
(Neglect damping of oscillations of spring)

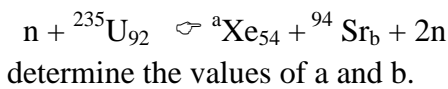
26. State Einstein's photoelectric equation explaining the symbols used.

27. Derive an expression for resonance frequency in LCR series circuit.

### SECTION C

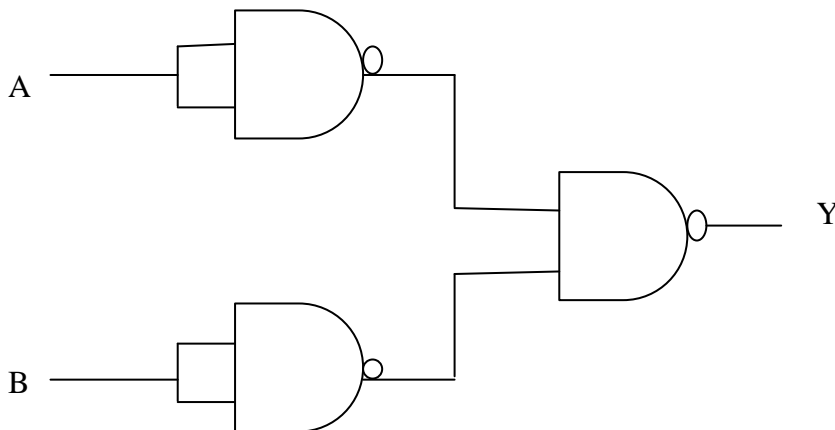
28.(a) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their separation. Mark the regions where the nuclear force is (i) attractive and (ii) repulsive.

(b) In the nuclear reaction



2+1

29.(a) Write the truth table for the combination of the gates shown in the figure.



(b) Explain briefly how a photo diode operates.

1+2

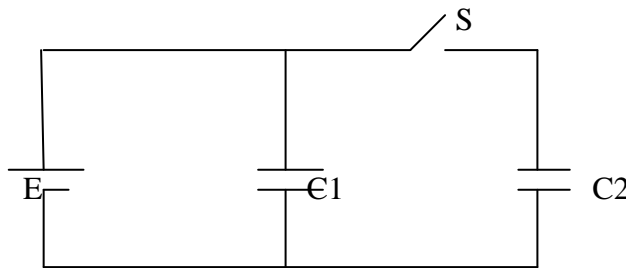
30.(a) State Biot – Savart law and express it in the vector form.

(b) Using Biot – Savart law, obtain the expression for the magnetic field due to a circular coil of radius  $r$ , carrying a current  $I$  at a point on its axis distant  $x$  from the centre of the coil. 1+2

31.i) Write two points to distinguish between interference and diffraction fringes.

ii) In a Young’s double slit experiment, fringes are obtained on a screen placed a certain distance away from the slits. If the screen is moved by 5 cm towards the slits, the fringe width changes by 30 micro-m. Given that the slits are 1 mm apart, calculate the wavelength of the light used. 1+2

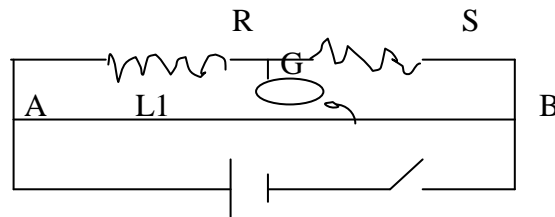
32. Two identical parallel plate capacitors A and B are connected to a battery of  $V$  volts with the switch  $S$  closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant  $K$ . Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



33. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

34.a) Write the principle of working of a metre bridge.

b) In a metre bridge, the balance point is found at a distance  $L_1$  with resistances  $R$  and  $S$  as shown in the figure. An unknown resistance  $X$  is now connected in parallel to the resistance  $S$  and the balance point is found at a distance  $L_2$ . Obtain a formula for  $X$  in terms of  $L_1$ ,  $L_2$  and  $S$ .



1+2

### SECTION D

35. Two point charges  $q$  and  $-q$  are located at points  $(0, 0, -a)$  and  $(0, 0, a)$  respectively.

(a) Find the electrostatic potential at  $(0, 0, z)$  and  $(x, y, 0)$

(b) 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 ?

(c) How would your answer change if the path of the test charge between the same points is not along the x-axis but along any other random path ?

(d) If the above point charges are now placed in the same positions in a uniform external electric field E. what would be the potential energy of the charge system in its orientation of unstable equilibrium ?

Justify your answer in each case.

(1+1)+1+1+1

36. a) Draw a ray diagram to show the image formation by a combination of two thin convex lenses in contact. Obtain the expression for the power of this combination in terms of the focal lengths of the lenses.

b) Draw Forward and Reverse bias Characteristic of a P-N Junction Diode.

(1+2)+2

37. a) Light of frequency  $\nu$  incident is on a photosensitive surface. Draw graph of the square of the maximum speed of the electrons ( $V_{MAX}^2$ ) vs.  $\nu$ .

Using Einstein's photoelectric equation, obtain expressions for (i) Planck's constant (ii) work function of the given photosensitive material in terms of parameters L(-y intersection), n(x intersection) and mass of the electron m.

b) Draw the circuit diagram of a full wave rectifier

(2+2)+1