Time : 2½ Hours   **PHYSICS (New Pattern)**

Subject Code

H	7	0	2

Total No. of Questions : 25   (Printed Pages : 8)   Maximum Marks : 55

INSTRUCTIONS :   i) Attempt **all** questions.

ii) Q. No. **1** to Q. No. **4** are multiple choice questions. Candidates are to choose and write the most suitable answer. **Each** carries **one** mark.

iii) Q. No. **5** to Q. No. **7** are very short answer type questions and **each** carries **one** mark.

iv) Q. No. **8** to Q. No. **15** are short answer type questions carrying **two** marks. **Each** with internal choice in **one** question **only**.

v) Q. No. **16** to Q. No. **23** are short answer type questions carrying **three** marks **each**, with internal choice in **one** question **only**.

vi) Q. No. **24** and **25** are long answer type questions carrying **four** marks **each,** with internal choice in **each** question.

vii) **Use** of calculators is **not** permitted. However, Log tables will be provided on **request**.

viii) You may use the following values of **physical** constants **wherever** necessary.

$c = 3 \times 10^8 \ ms^{-1}$

$e = 1.6 \times 10^{-19} \ C$

$h = 6.6 \times 10^{-34} \ Js$

$m_e = 9.1 \times 10^{-31} \ kg$

$\mu_0 = 4\pi \times 10^{-7} \ TmA^{-1}$

$\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9 Nm^2 c^{-2}$

1. When a charged particle enters a magnetic field at an angle of 60° with the field direction, it traces
    - a circular path
    - a parabolic path
    - a helical path
    - a hyperbolic path

2. n identical bulbs, each designed to draw a power P from a supply, are joined in series across the same supply. The total power which they draw is
    - $\dfrac{P}{n}$
    - $\dfrac{P}{n^2}$
    - nP
    - P

3. A beam of light passing from air into a transparent medium, suffers a deviation of 15° at the interface, when incident at an angle of 60°. The speed of light in the medium is
   - $\sqrt{3} \times 10^8$ m/s
   - $\sqrt{6} \times 10^8$ m/s
   - $\sqrt{2} \times 10^8$ m/s
   - $\sqrt{5} \times 10^8$ m/s

4. For a CE Common-Emitter amplifier, the audio signal voltage across the collector resistance of 2 KΩ is 2 V. The current amplification factor (β) of the transistor is 100. For the input resistance of 1KΩ, the input signal voltage will be
   - 0.02 V
   - 0.1 V
   - 0.01 V
   - 0.001 V

5. To reduce current in an ac circuit, an inductor coil is preferred to a resistor. Why ?

6.
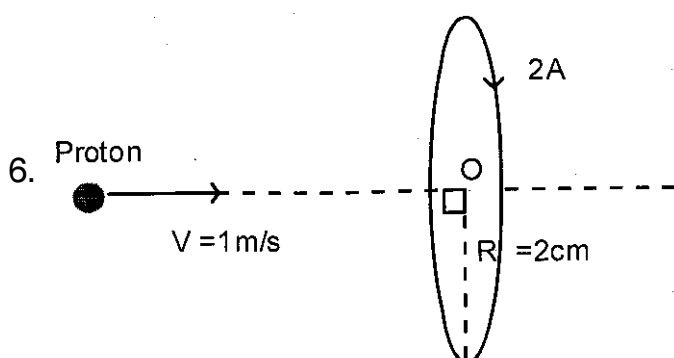
The velocity vector of a proton is directed perpendicular to the plane of a current loop at its centre O as shown in the figure. What will be the force acting on the proton at the centre of the loop ?

7.
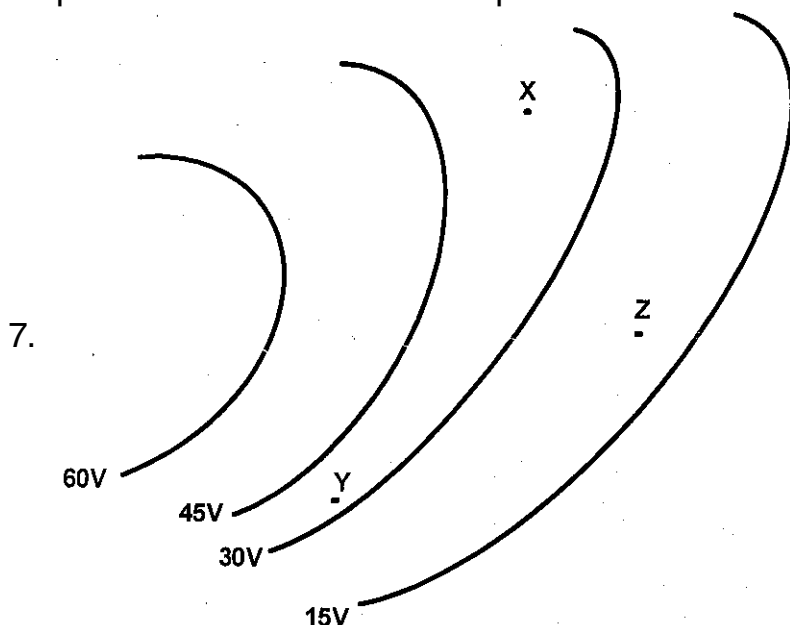
The above figure shows equipotential surfaces in an electric field. At which of the points X, Y and Z is the magnitude of the electric field the highest ? Why ?

8. Identify the part of the electromagnetic spectrum represented by the following wavelengths and arrange them in the descending order of their wavelengths.

l_1 – produced by bombarding a metal target with high energy electrons.

l_2 – produced by klystron and magnetron valves

l_3 – produced by vibrations of atoms and molecules.

9. A metal wire of resistance 'R' and length 'l' is bent to form a circular loop. L and M are two diametrically opposite points of the loop.

   i) What is the equivalent resistance across the points L and M ?

   ii) How will the resistance across the points L and M change, if the temperature of the loop is increased ?

10. A metal rod AB of length 20 cm is kept in contact with a conductor PQRS of negligible resistance to form a loop as shown in the figure. A magnetic field of 0.2 T is acting perpendicular to the plane of the loop. The resistance of the rod AB is 2 Ω. Determine the force required to move the rod at a constant speed of 3 m/s.


11. a)
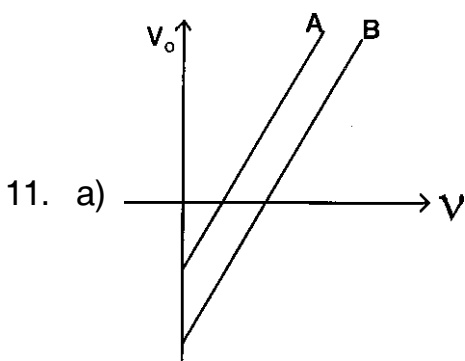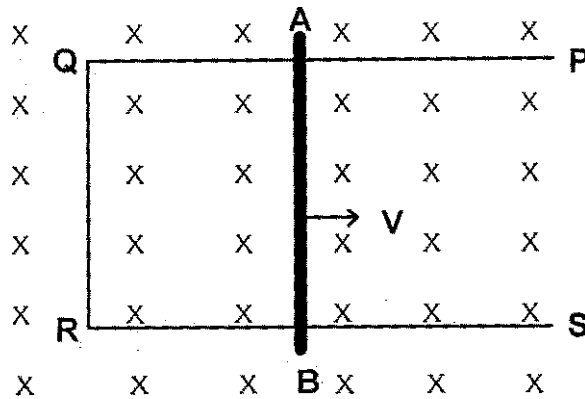
A graph of stopping potential against incident frequency for two photo sensitive metals A and B is shown in the figure.

Which of the two metals A and B has the higher threshold wavelength ?

b) Write the expression for the maximum velocity of a photo electron, in terms of its cut off voltage V_0.

12. The following figure shows the input waveforms A, B and the output waveform Y of a gate. Identify the gate and draw its logic symbol.
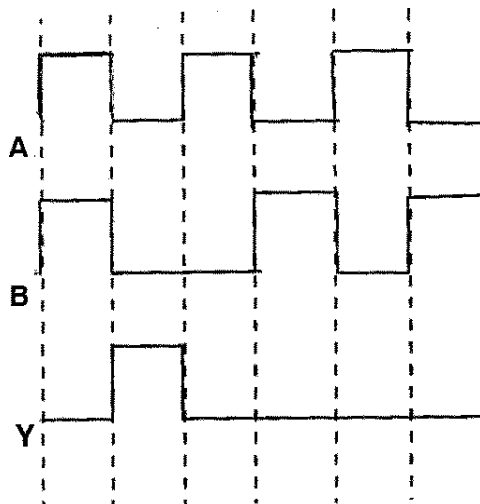
13. In a communication system
    a) Why are radio waves used in sky wave propagation ?
    b) How is the mixing up of signals from different transmitters prevented ?

14. a) Two nucleic have atomic mass numbers A_1 and A_2, such that $A_1 > A_2$. Which of the two will have a higher nuclear density ?

    b) Identify the decay processes represented by the following nuclear reactions.

       i) $^{32}_{15}P \rightarrow \, ^{32}_{16}S + \bar{e} + \bar{v}$ ii) $^{238}_{92}U \rightarrow \, ^{234}_{90}Th + \, ^4_2He$
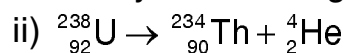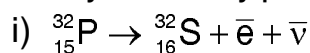
15. A point source O is placed at a distance of 12.5 cm from a converging lens of focal length 10 cm, on its principal axis as shown in the figure. Find the distance at which a diverging mirror of focal length 20 cm should be placed, so that a real image is formed on the source itself.


OR
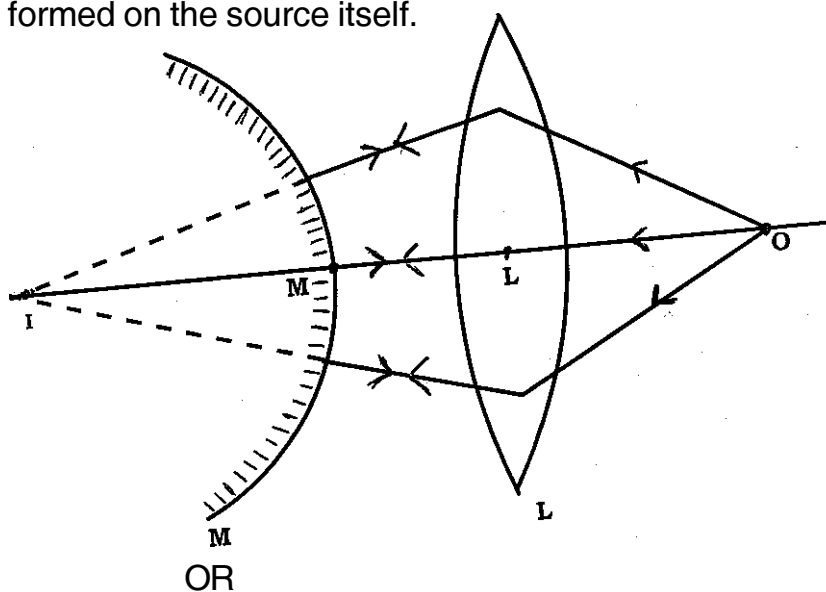
A screen is placed at a distance of 90 cm from an object. A convex lens forms the image of this object on the screen, when placed at two different locations separated by 30 cm as shown in the figure. Determine the focal length of the lens.
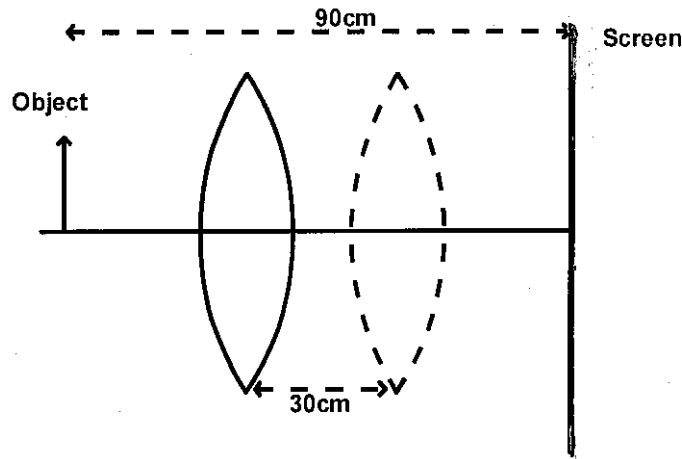
16. In a potentiometer experiment, PS is the balancing length obtained for a cell of emf E_1 and internal resistance r_1 as shown in the figure below.
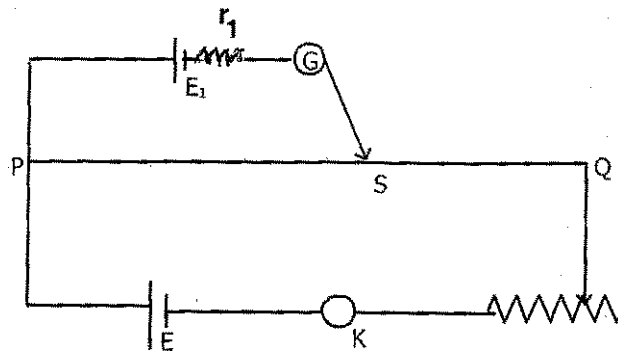

How does the balancing length change, if

i) The length of the potentiometer wire is doubled ?

ii) An external resistance R of finite value is connected in series with the potentiometer wire ?

iii) Another identical cell is connected in parallel with E_1 with their positive terminals together.

17. a) What is the phase difference between the input and the output voltage in a transistor oscillator circuit ?

b) Doping level in the base region of a function transistor amplifier is increased. What will be the effect on

   i) base current   ii) collector current

c)
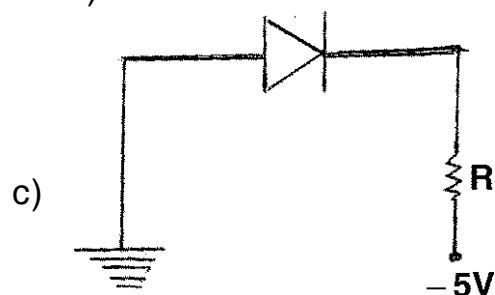
    i) State the type of biasing of the diode shown in the figure given above.

    ii) What is the effect of this type of biasing on the potential barrier height of the diode ?

18. For a purely inductive ac circuit, show that the current lags the voltage by a phase angle of $\dfrac{\pi}{2}$ radians. Hence show that the power dissipated across the inductor is zero. Draw the phasor diagram.

OR

LCR series circuit is connected to an ac source of voltage $V = V_0$ sinwt.

Using phasor diagrams, obtain an expression for the impedance and the phase angle between the voltage and the current.

19.
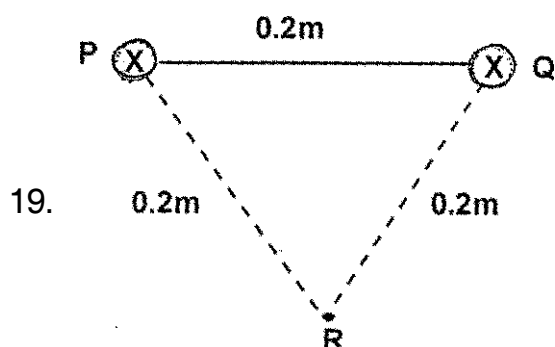
The figure shows two infinitely long and this parallel wires P and Q placed 0.2 m apart perpendicular to the plane of the paper, carrying equal currents of 20 A each. Find the magnetic field at a point R, at a distance of 0.2 m from both the wires. The symbol ⊗ indicates that the current is directed inward.

20. Assuming the expression for the path difference between two waves meeting at a point on the screen, obtain an expression for the fringe width in Young's double slit experiment.

When are two sources of light said to be coherent ?

21. a) The electron in a hydrogen atom passes from n = 4 energy level to n = 1 energy level. What is the maximum number of photons that can be emitted ?

b) The figure shows the standing particle wave on a circular orbit of an electron in a hydrogen atom.
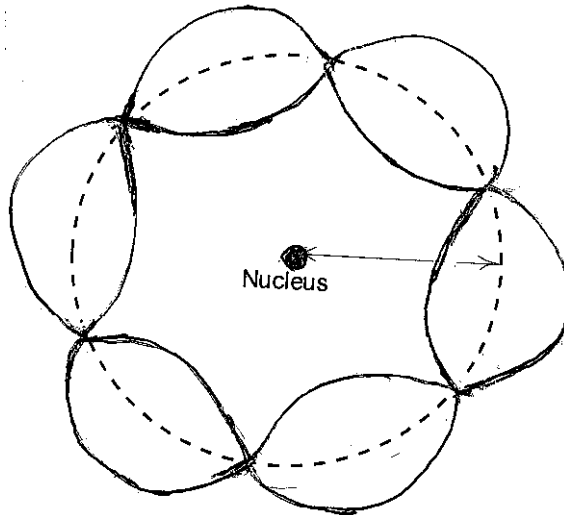
i) To which principal quantum number does the given orbit correspond to ?

ii) What is the angular momentum of the electron in this orbit ?

22.
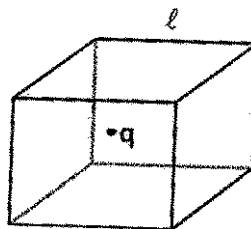
A cube of side length '*l*', encloses a charge 'q' placed at its centre as shown in the figure. What is the flux linked with one face of the cube ?

The plane of a square of side 10 cm makes an angle of 30° with the direction of an electric field, whose magnitude is 4×10^3 N/C. Determine the flux through the square.

23. A bar magnet of magnetic moment 'm' is allowed to oscillate freely in an external uniform magnetic field of strength B.

a) If the strength of the magnetic field is doubled, keeping it uniform, what will be the effect on
 i) The time period of oscillations of the magnet ?
 ii) The torque acting on the magnet ?

b) An external torque is applied to rotate the bar magnet from a position in which the magnetic dipole moment is parallel to the magnetic field to a position in which it is perpendicular to the field.
What will be the change in potential energy of the magnet ?

24. Derive an expression for the electric potential due to a point charge.

A positive charge of magnitude $6 \mu c$ is placed in a dielectric medium of dielectric constant 2. What is the electric potential at a point in the dielectric medium at a distance of 10 cm from the charge ?

OR

Derive an expression for the energy stored in a parallel plate capacitor and express it in two more forms.

A ————|⊢———|⊢——— B
          $2 \mu F$ $2 \mu F$
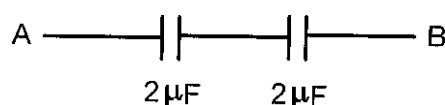
The figure shows two air filled capacitors of capacitance $2 \mu F$ each connected in series. What will be the equivalent capacitance across AB if dielectric slabs of dielectric constant 3 are introduced between the plates of both the capacitors filling the space between the plates completely ?

25. With the help of a neat ray diagram, derive the relationship between the focal length, the object distance and the image distance for a concave mirror. A concave mirror is first kept in a medium of refractive index 1.33 and then in another medium of refractive index 1.4. What will be the change in its focal length ?

OR

A spherical surface of radius of curvature R separates a rarer and a denser medium. With the help of a neat ray diagram obtain the relationship between the object distance 'u', the image distance 'v', the radius of curvature 'R' and the refractive indices n_1 and n_2 of the two media, when the object is kept in the rarer medium.

How does the scattering of light vary with the wavelength of different colours of light ?

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