Amity, Saket.

First Term Exam – 2017-2018

Class – XII

Subject – PHYSICS

Time : 3 Hours **Max. Marks. 70**

General Instructions:

(i) *All questions are compulsory*

(ii) *There are 26 questions in total. Questions 1 to 5 carry one mark each; questions 6 to 10 carry 2 marks each, questions 11 to 22 carry 3 marks each & question 23 carry 4 marks & questions 24 to 26 carry 5 marks each.*

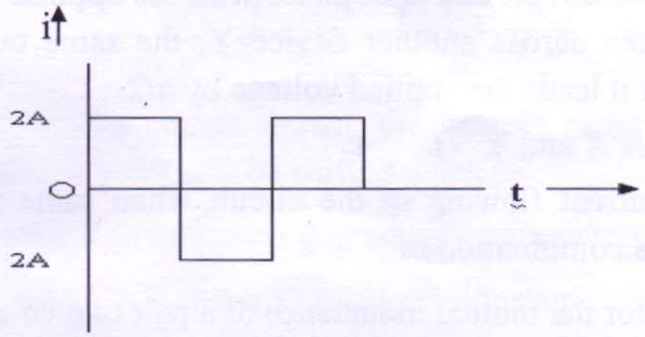
(iii) *There is no overall choice, however, an internal choice has been provided in one question of two marks one question of three marks and all three question of five marks each. You have to attempt only one of the given* choices in such questions.

(iv) *Use of calculators is not permitted.*

Q1. Why an electric dipole placed in a uniform electric field does not undergoes acceleration?

Q2. Two different wires X and Y of same diameter but of different materials are joined in series and connected across a battery. If the number density of electrons in X is twice that of Y, find the ratio of drift velocity of electrons in the two wires.

Q3. Find the RMS value of A.C. shown in the figure.



Q4. Sun glasses are made up of curved surfaces. But the power of the sun glass is zero. Why?

Q5. Using the mirror formula show that a virtual image is obtained when an object is placed in between the principal focus and pole of the concave mirror.

Q6. For the same angle of incidence, the angles of refraction in three different media A, B, and C are 15°, 20° and 30° respectively. In which medium will the velocity of light be minimum?

Q7. An electric lamp connected in series with a capacitor and an AC source is glowing with certain brightness. How does the brightness of the lamp be affected when a dielectric slab of constant k is introduced in between the plates of capacitor?

Q8. The susceptibility of a magnetic material is 0.9853. Identify the type of the magnetic material. Draw the modification of the field pattern on keeping a piece of this material in a uniform magnetic field.

Q9. Two cells each of emf E and internal resistances r_1 and r_2 are connected in series to an external resistance R. Can a value of R be selected such that the potential difference across the first cell is 0.

Q10. Two parallel plate capacitors X and Y have the same area of plates and the same separation between them. X has air between the plates and Y contains a dielectric medium of K=4.

Calculate

(i) Capacitance of X and Y if equivalent capacitance of combination is 4 μF.

(ii) Potential Difference between the plates of X and Y

Q11. A converging lens has a focal length of 20cm in air. It is made of a material of refractive index 1.6. If the lens is immersed in a liquid of refractive index 1.3. What will be the new focal length of the lens?

Q12. When an alternating voltage of 220 V is applied across a device X, a current of 0.5 A flows through the circuit and is in phase with the applied voltage. When the same voltage is applied across another device Y, the same current again flows through the circuit but it leads the applied voltage by $\pi/2$.

(i) name the devices X and Y

(ii) calculate the current flowing in the circuit when same voltage is applied across the series combination of X and Y

Q13. Derive an expression for the mutual inductance of a pair two co-axial solenoids.

Q14. A long straight conductor PQ, carrying a current of 60 A, is fixed horizontally. Another long conductor XY is kept parallel to PQ at a distance of 4 mm, in air. Conductor XY is free to move and carries a current 'I'. Calculate the magnitude and direction of current 'I' for which the magnetic repulsion just balances the weight of the conductor XY.

Q15. State Bio-Savart law. Using it derive an expression for the Magnetic field due to a current carrying circular loop at its center.

Q16. Two similar bars, made from two different materials P and Q are placed one by one in a non-uniform magnetic field. It is observed that

(a) the bar P tends to move from the weak to the strong field region.

(b) the bar Q tends to move from the strong to the weak field region.

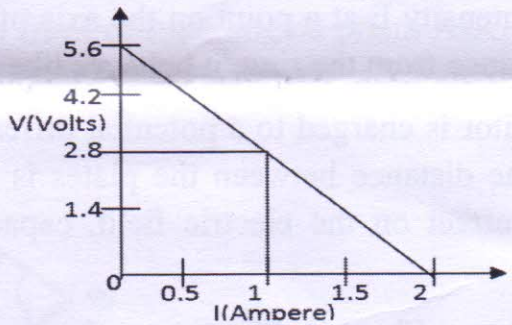
What is the nature of the magnetic materials used for making these two bars? Also Sketch the graphical variation of magnetic susceptibility with temperature for both materials P & Q.

Q17. 4 cells of identical emf E, internal resistance r are connected in series to a variable resistor. The following graph shows the variation of terminal voltage of the combination with the current output.

(i) What is the emf of each cell used?

(ii) For what current from the cells, does maximum power dissipation occur in the circuit?

(iii) Calculate the internal resistance of each cell

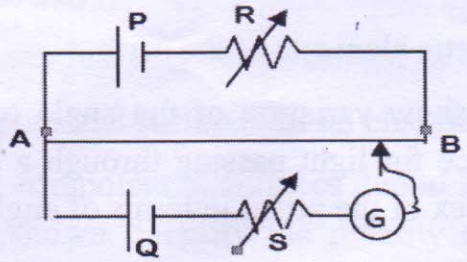


Q18. In the potentiometer circuit shown, the balance point is at X. State with reason where the balance point will be shifted when

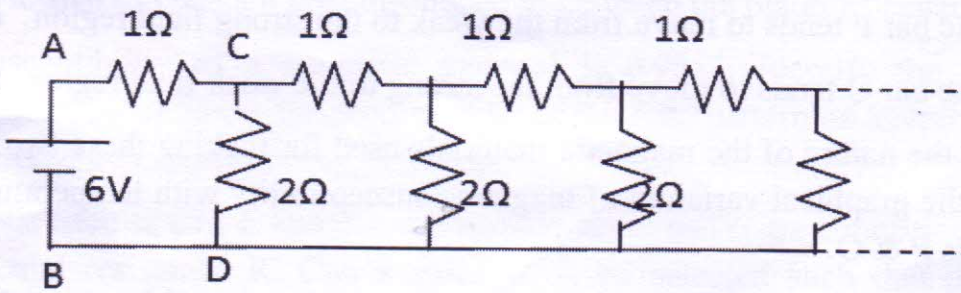
(i) Resistance R is increased, keeping all parameters unchanged.

(ii) Resistance S is increased keeping R constant.

(iii) Cell P is replaced by another cell whose emf is lower than that of that cell Q.



Q19. An infinite ladder network of resistances is constructed with 1Ω and 2Ω resistance shown in figure. Find the current drawn from the cell.



Q20. Are the path of electrons straight lines between two successive collisions in a conductor (with positive ions of the metal)

(i) in the absence of electric field and

(ii) in the presence of electric field?

Write an expression relating current density and drift velocity.

Q21. A charge is distributed uniformly over a ring of radius '*a*'. Obtain an expression for the electric field intensity E at a point on the axis of the ring. Hence show that for points at large distance from the ring, it behaves like a point charge.

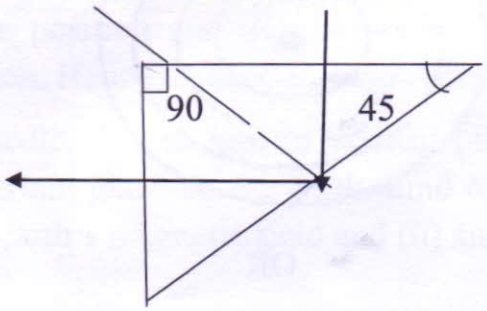
Q22. A parallel plate capacitor is charged to a potential difference V by d.c. source and then disconnected. The distance between the plates is then halved. Explain with reason what will be effect on the electric field, capacitance and energy of the capacitor.

Q23. While watching Discovery Channel. Sheena was impressed that certain organisms have the ability to sense the field lines of earth's magnetic field. They use this ability to travel from one location to another. Sheena wanted to find the angle of dip at her place. She got a magnetic compass, using which she found the magnetic meridian. She then mounted the compass on a cardboard and placed it vertically along the magnetic meridian. She was able to measure the angle of dip.

- What values did Sheena have?
- Define the magnetic elements of the earth.

Q24. (i) Plot a graph to show variation of the angle of deviation as a function of angle of incidence for light passing through a prism. Derive an expression for refractive index of the prism in terms of angle of minimum deviation and angle of prism.

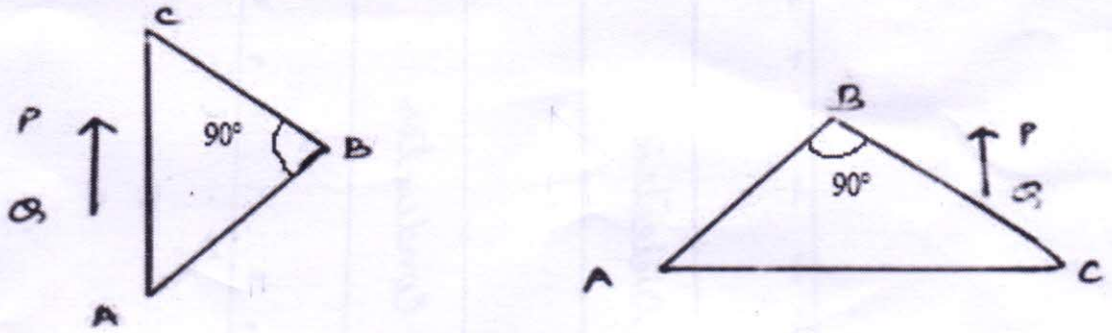
(ii) A ray of light incident normally on one face of a right isosceles prism is totally reflected as shown. What must be the minimum value of refractive index of glass? Give relevant calculations.



OR

(a) Draw a ray diagram to show the formation of the real image of a point object due to a convex spherical refracting surface, when a ray of light is traveling from a rarer medium of refractive index μ_1 to a denser medium of refractive index μ_2. Hence derive the relation between object distance, image distance and radius of curvature of the spherical surface.

(b) An object is placed in front of right angled prism ABC in two positions as shown. The prism is made of crown glass with critical angle of 41°. Trace the path of the two rays from P & Q.



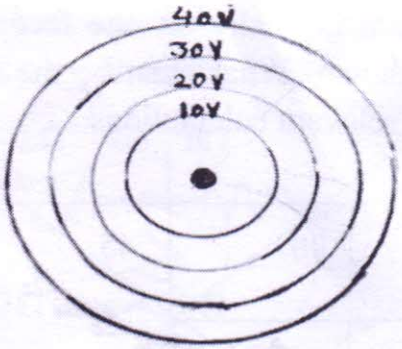
Q25. (a) Two isolated metal spheres A and B have radii R and 2R respectively, and same charge q. Find which of the two spheres have greater.

(i) Capacitance and

(ii) energy density just outside the surface of the spheres.

(b) (i) Draw equipotential surfaces for an electric dipole.

(ii) Concentric equipotential surfaces due to a charged body placed at the centre are shown. Identify the polarity of the charge and draw the electric field lines due to it.



OR

Compare the individual dipole moment and the specimen dipole moment for H_2O molecule and O_2 molecule when placed in

(i) Absence of external electric field (ii) Presence of external electric field. Justify your answer. (b) Given two parallel conducting plates of area A and charge densities + σ & -σ. A dielectric slab of constant K and a conducting slab of thickness d each are inserted in between them as shown. (i) Find the potential difference between the plates.

(ii) Plot E versus x graph, taking x=0 at positive plate and x=5d at negative plate.

Q26. (a) Derive the expression for the torque on a rectangular current carrying loop suspended in a uniform magnetic field.

(b) A proton and a deuteron having equal momenta enter in a region of a uniform magnetic field at right angle to the direction of a the field. Depict their trajectories in the field.

OR

(a) A small compass needle of magnetic moment 'm is free to turn about an axis perpendicular to the direction of uniform magnetic field 'B'. The moment of inertia of the needle about the axis is 'I'. The needle is slightly disturbed from its stable position and then released. Prove that it executes simple harmonic motion. Hence deduce the expression for its time period.

(b) A compass needle, free to turn in vertical plane orient itself with its axis vertical at a certain place on the earth. Find out the values of (i) horizontal component of earth's magnetic field and (ii) angle of dip at that place.