

Sample Question Paper 2021-22
Term 1
Subject: Physics (042)

Time: 90 Minutes

Max. Marks 35

General Instructions:

1. The Question Paper contains three sections.
2. Section A has 25 questions. Attempt any 20 questions.
3. Section B has 24 questions. Attempt any 20 questions.
4. Section C has 6 questions. Attempt any 5 questions.
5. All questions carry equal marks.
6. There is no negative marking.

SECTION A

This section consists of 25 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q1. Which of the following is NOT the property of equipotential surface?

- (i) They do not cross each other.
- (ii) The rate of change of potential with distance on them is zero.
- (iii) For a uniform electric field they are concentric spheres.
- (iv) They can be imaginary spheres.

Q2. Two point charges $+8q$ and $-2q$ are located at $x=0$ and $x=L$ respectively. The point on x axis at which net electric field is zero due to these charges is-

- (i) $8L$
- (ii) $4L$
- (iii) $2L$
- (iv) L

Q3. An electric dipole of moment p is placed parallel to the uniform electric field. The amount of work done in rotating the dipole by 90° is-

- (i) $2pE$
- (ii) pE
- (iii) $pE/2$
- (iv) Zero

Q4. Three capacitors $2\mu F$, $3\mu F$ and $6\mu F$ are joined in series with each other. The equivalent capacitance is-

- (i) $1/2\mu F$
- (ii) $1\mu F$
- (iii) $2\mu F$
- (iv) $11\mu F$

Q5. Two point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force ' F '. The electrostatic force between them in vacuum at the same distance r will be-

- (i) $5F$
- (ii) F
- (iii) $F/2$
- (iv) $F/5$

Q6. Which statement is true for Gauss law-

- (i) All the charges whether inside or outside the gaussian surface contribute to the electric flux.
- (ii) Electric flux depends upon the geometry of the gaussian surface.
- (iii) Gauss theorem can be applied to non-uniform electric field.
- (iv) The electric field over the gaussian surface remains continuous and uniform at every point.

Q7. A capacitor plates are charged by a battery with ' V ' volts. After charging battery is disconnected and a dielectric slab with dielectric constant ' K ' is inserted between its plates, the potential across the plates of a capacitor will become

- (i) Zero
- (ii) $V/2$
- (iii) V/K
- (iv) KV

Q8. The best instrument for accurate measurement of EMF of a cell is-

- (i) Potentiometer
- (ii) metre bridge
- (iii) Voltmeter
- (iv) ammeter and voltmeter

Q9. An electric current is passed through a circuit containing two wires of same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 3:2 and 2:3, then the ratio of the current passing through the wire will be

- (i) 2:3
- (ii) 3:2
- (iii) 8:27
- (iv) 27:8

Q10. By increasing the temperature, the specific resistance of a conductor and a semiconductor-

- (i) increases for both.
- (ii) decreases for both.
- (iii) increases for a conductor and decreases for a semiconductor.
- (iv) decreases for a conductor and increases for a semiconductor.

Q11. We use alloys for making standard resistors because they have

- (i) low temperature coefficient of resistivity and high specific resistance
- (ii) high temperature coefficient of resistivity and low specific resistance
- (iii) low temperature coefficient of resistivity and low specific resistance
- (iv) high temperature coefficient of resistivity and high specific resistance

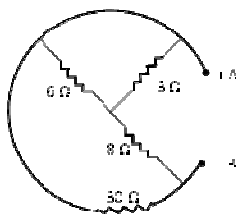
Q12. A constant voltage is applied between the two ends of a uniform metallic wire, heat 'H' is developed in it. If another wire of the same material, double the radius and twice the length as compared to original wire is used then the heat developed in it will be-

- (i) $H/2$
- (ii) H
- (iii) $2H$
- (iv) $4H$

Q13. If the potential difference V applied across a conductor is increased to $2V$ with its temperature kept constant, the drift velocity of the free electrons in a conductor will -

- (i) remain the same.
- (ii) become half of its previous value.
- (iii) be double of its initial value.
- (iv) become zero.

Q14. The equivalent resistance between A and B is-



- (i) 3 ohms
- (ii) 5.5 ohms
- (iii) 7.5 ohms
- (iv) 9.5 ohms

Q15. The SI unit of magnetic field intensity is

- (i) AmN^{-1}
- (ii) $\text{NA}^{-1}\text{m}^{-1}$
- (iii) $\text{NA}^{-2}\text{m}^{-2}$
- (iv) $\text{NA}^{-1}\text{m}^{-2}$

Q16. The coil of a moving coil galvanometer is wound over a metal frame in order to

- (i) reduce hysteresis
- (ii) increase sensitivity
- (iii) increase moment of inertia
- (iv) provide electromagnetic damping

Q17. Two wires of the same length are shaped into a square of side 'a' and a circle with radius 'r'. If they carry same current, the ratio of their magnetic moment is

- (i) $2 : \pi$
- (ii) $\pi : 2$
- (iii) $\pi : 4$
- (iv) $4 : \pi$

Q18. The horizontal component of earth's magnetic field at a place is $\sqrt{3}$ times the vertical component. The angle of dip at that place is

- (i) $\pi/6$
- (ii) $\pi/3$
- (iii) $\pi/4$
- (iv) 0

Q19. The small angle between magnetic axis and geographic axis at a place is-

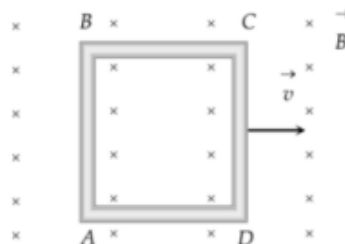
- (i) Magnetic meridian
- (ii) Geographic meridian
- (iii) Magnetic inclination
- (iv) Magnetic Declination

Q20. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon the

- (i) rate at which current change in the two coils
- (ii) relative position and orientation of the coils
- (iii) rate at which voltage induced across two coils
- (iv) currents in the two coils

Q21. A conducting square loop of side 'L' and resistance 'R' moves in its plane with the uniform velocity 'v' perpendicular to one of its sides. A magnetic induction 'B' constant in time and space pointing perpendicular and into the plane of the loop exists everywhere as shown in the figure. The current induced in the loop is

- (i) BLv/R Clockwise
- (ii) BLv/R Anticlockwise
- (iii) $2BLv/R$ Anticlockwise
- (iv) Zero



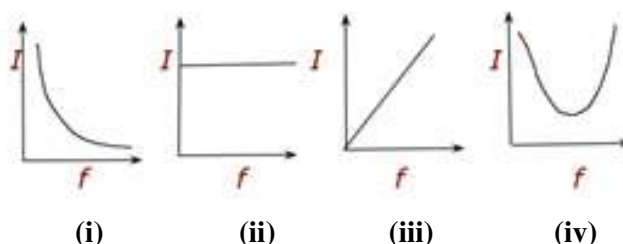
Q22. The magnetic flux linked with the coil (in Weber) is given by the equation –

$$\Phi = 5t^2 + 3t + 16$$

The induced EMF in the coil at time, $t=4$ will be-

- (i) -27 V
- (ii) -43 V
- (iii) -108 V
- (iv) 210 V

Q23. Which of the following graphs represent the variation of current(I) with frequency (f) in an AC circuit containing a pure capacitor?



Q24. A 20 volt AC is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is 12 volt, the voltage across the coil is-

- (i) 16 V
- (ii) 10 V
- (iii) 8 V
- (iv) 6 V

Q25. The instantaneous values of emf and the current in a series ac circuit are-

$E = E_0 \sin \omega t$ and $I = I_0 \sin(\omega t + \pi/3)$ respectively, then it is

- (i) Necessarily a RL circuit
- (ii) Necessarily a RC circuit
- (iii) Necessarily a LCR circuit
- (iv) Can be RC or LCR circuit

SECTION B

This section consists of 24 multiple choice questions with overall choice to attempt any 20 questions. In case more than desirable number of questions are attempted, ONLY first 20 will be considered for evaluation.

Q26. A cylinder of radius r and length l is placed in an uniform electric field parallel to the axis of the cylinder. The total flux for the surface of the cylinder is given by-

- (i) zero
- (ii) πr^2
- (iii) $E \pi r^2$
- (iv) $2 E \pi r^2$

Q27. Two parallel large thin metal sheets have equal surface densities

$26.4 \times 10^{-12} \text{ C/m}^2$ of opposite signs. The electric field between these sheets is-

- (i) 1.5 N/C
- (ii) $1.5 \times 10^{-16} \text{ N/C}$
- (iii) $3 \times 10^{-10} \text{ N/C}$
- (iv) 3 N/C

Q28. Consider an uncharged conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,

- (i) negative and uniformly distributed over the surface of sphere
- (ii) positive and uniformly distributed over the surface of sphere
- (iii) negative and appears at a point the surface of sphere closest to point charge.
- (iv) Zero

Q29. Three Charges $2q$, $-q$ and $-q$ lie at vertices of a triangle. The value of E and V at centroid of triangle will be-

- (i) $E \neq 0$ and $V \neq 0$
- (ii) $E = 0$ and $V = 0$
- (iii) $E \neq 0$ and $V = 0$
- (iv) $E = 0$ and $V \neq 0$

Q30. Two parallel plate capacitors X and Y, have the same area of plates and same separation between plates. X has air and Y with dielectric of constant 2, between its plates. They are connected in series to a battery of 12 V. The ratio of electrostatic energy stored in X and Y is-

- (i) 4:1
- (ii) 1:4
- (iii) 2:1
- (iv) 1:2

Q31. Which among the following, is not a cause for power loss in a transformer-

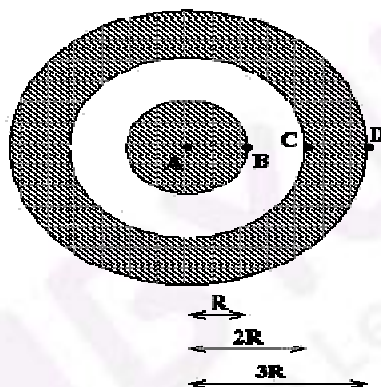
- (i) Eddy currents are produced in the soft iron core of a transformer.
- (ii) Electric Flux sharing is not properly done in primary and secondary coils.

- (iii) Humming sound produced in the transformers due to magnetostriction.
- (iv) Primary coil is made up of a very thick copper wire.

Q32. An alternating voltage source of variable angular frequency ' ω ' and fixed amplitude ' V ' is connected in series with a capacitance C and electric bulb of resistance R (inductance zero). When ' ω ' is increased-

- (i) The bulb glows dimmer.
- (ii) The bulb glows brighter.
- (iii) Net impedance of the circuit remains unchanged.
- (iv) Total impedance of the circuit increases.

Q33. A solid spherical conductor has charge $+Q$ and radius R . It is surrounded by a solid spherical shell with charge $-Q$, inner radius $2R$, and outer radius $3R$. Which of the following statements is true?



- (i) The electric potential has a maximum magnitude at C and the electric field has a maximum magnitude at A
- (ii) The electric potential has a maximum magnitude at D and the electric field has a maximum magnitude at B.
- (iii) The electric potential at A is zero and the electric field has a maximum magnitude at D.
- (iv). Both the electric potential and electric field achieve a maximum magnitude at B.

Q34. A battery is connected to the conductor of non-uniform cross section area. The quantities or quantity which remains constant is-

- (i) electric field only
- (ii) drift speed and electric field
- (iii) electric field and current

(iv) current only

Q35. Three resistors having values R_1 , R_2 , and R_3 are connected in series to a battery. Suppose R_1 carries a current of 2.0 A, R_2 has a resistance of 3.0 ohms, and R_3 dissipates 6.0 watts of power. Then the voltage across R_3 is-

(i) 1V

(ii) 2V

(iii) 3V

(iv) 4V

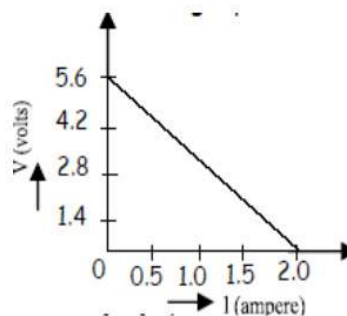
Q36. A straight line plot showing the terminal potential difference (V) of a cell as a function of current (I) drawn from it, is shown in the figure. The internal resistance of the cell would be then-

(i) 2.8 ohms

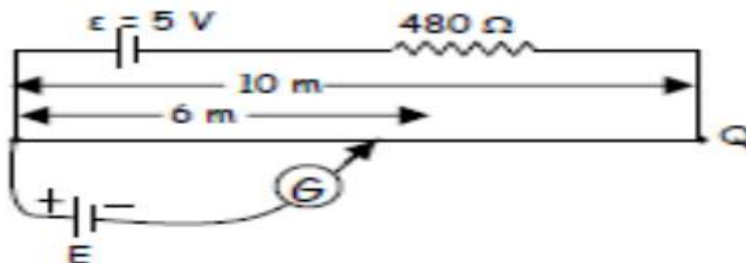
(ii) 1.4 ohms

(iii) 1.2 ohms

(iv) zero



Q37. A 10 m long wire of uniform cross-section and $20\ \Omega$ resistance is used in a potentiometer. The wire is connected in series with a battery of 5 V along with an external resistance of $480\ \Omega$. If an unknown emf E is balanced at 6.0 m length of the wire, then the value of unknown emf is-



(i) 1.2 V

(ii) 1.02 V

(iii) 0.2 V

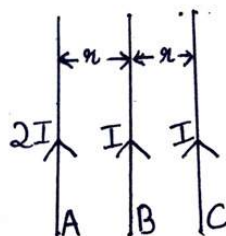
(iv) 0.12 V

Q38. The current sensitivity of a galvanometer increases by 20%. If its resistance also increases by 25%, the voltage sensitivity will

- (i) decrease by 1%
- (ii) increased by 5%
- (iii) increased by 10%
- (iv) decrease by 4%

Q39. Three infinitely long parallel straight current carrying wires A, B and C are kept at equal distance from each other as shown in the figure. The wire C experiences net force F . The net force on wire C, when the current in wire A is reversed will be

- (i) Zero
- (ii) $F/2$
- (iii) F
- (iv) $2F$



Q40. In a hydrogen atom the electron moves in an orbit of radius 0.5 \AA making 10 revolutions per second, the magnetic moment associated with the orbital motion of the electron will be

- (i) $2.512 \times 10^{-38} \text{ Am}^2$
- (ii) $1.256 \times 10^{-38} \text{ Am}^2$
- (iii) $0.628 \times 10^{-38} \text{ Am}^2$
- (iv) zero

Q41. An air-cored solenoid with length 30 cm, area of cross-section 25 cm^2 and number of turns 800, carries a current of 2.5 A. The current is suddenly switched off in a brief time of 10^{-3} s . Ignoring the variation in magnetic field near the ends of the solenoid, the average back emf induced across the ends of the open switch in the circuit would be

- (i) zero
- (ii) 3.125 volts

- (iii) 6.54 volts
- (iv) 16.74 volts

Q42. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which $R = 3 \Omega$, $L = 25.48 \text{ mH}$, and $C = 796 \mu\text{F}$, then the power dissipated at the resonant condition will be-

- (i) 39.70 kW
- (ii) 26.70 kW
- (iii) 13.35 kW
- (iv) Zero

Q43. A circular loop of radius 0.3 cm lies parallel to much bigger circular of radius 20 cm. The centre of the small loop is on the axis of the bigger loop. The distance between their centres is 15 cm. If a current of 2.0 A flows through the smaller loop, then the flux linked with the bigger loop is

- (i) $3.3 \times 10^{-11} \text{ weber}$
- (ii) $6 \times 10^{-11} \text{ weber}$
- (iii) $6.6 \times 10^{-9} \text{ weber}$
- (iv) $9.1 \times 10^{-11} \text{ weber}$

Q44. If both the number of turns and core length of an inductor is doubled keeping other factors constant, then its self-inductance will be-

- (i) Unaffected
- (ii) doubled
- (iii) halved
- (iv) quadrupled

45. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): To increase the range of an ammeter, we must connect a suitable high resistance in series to it.

Reason (R): The ammeter with increased range should have high resistance.

Select the most appropriate answer from the options given below:

- (i) Both A and R are true and R is the correct explanation of A
- (ii) Both A and R are true but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A is false and R is also false.

46. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): An electron has a high potential energy when it is at a location associated with a more negative value of potential, and a low potential energy when at a location associated with a more positive potential.

Reason (R): Electrons move from a region of higher potential to region of lower potential.

Select the most appropriate answer from the options given below:

- (i) Both A and R are true and R is the correct explanation of A
- (ii) Both A and R are true but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A is false and R is also false.

47. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion(A): A magnetic needle free to rotate in a vertical plane, orients itself (with its axis) vertical at the poles of the earth.

Reason (R): At the poles of the earth the horizontal component of earth's magnetic field will be zero.

Select the most appropriate answer from the options given below:

- (i) Both A and R are true and R is the correct explanation of A
- (ii) Both A and R are true but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A is false and R is also false.

48. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion(A): A proton and an electron, with same momenta, enter in a magnetic field in a direction at right angles to the lines of the force. The radius of the paths followed by them will be same.

Reason(R): Electron has less mass than the proton.

Select the most appropriate answer from the options given below:

- (i) Both A and R are true and R is the correct explanation of A
- (ii) Both A and R are true but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A is false and R is also false.

49. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): On Increasing the current sensitivity of a galvanometer by increasing the number of turns, may not necessarily increase its voltage sensitivity.

Reason(R): The resistance of the coil of the galvanometer increases on increasing the number of turns.

Select the most appropriate answer from the options given below:

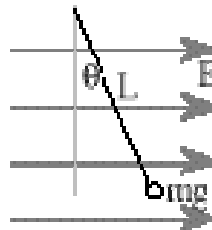
- (i) Both A and R are true and R is the correct explanation of A
- (ii) Both A and R are true but R is not the correct explanation of A.
- (iii) A is true but R is false.
- (iv) A is false and R is also false.

SECTION C

This section consists of 6 multiple choice questions with an overall choice to attempt any 5. In case more than desirable number of questions are attempted, ONLY first 5 will be considered for evaluation.

Q50. A small object with charge q and weight mg is attached to one end of a string of length ' L ' attached to a stationary support. The system is placed in a uniform horizontal electric field ' E ', as shown in the accompanying figure. In the presence of the field, the string makes a constant angle θ with the vertical. The sign and magnitude of q -

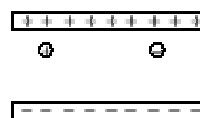
- (i) positive with magnitude mg/E
- (ii) positive with magnitude $(mg/E)\tan\theta$



(iii) negative with magnitude $mg/E \tan\theta$

(iv) positive with magnitude $E \tan\theta/mg$

Q51. A free electron and a free proton are placed between two oppositely charged parallel plates. Both are closer to the positive plate than the negative plate.



Which of the following statements is true?

- I. The force on the proton is greater than the force on the electron.
- II. The potential energy of the proton is greater than that of the electron.
- III. The potential energy of the proton and the electron is the same.

- (i) I only
- (ii) II only
- (iii) III and I only
- (iv) II and I only

Case study :

Read the following paragraph and answers the questions:

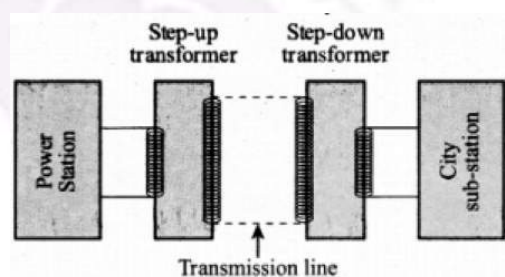


Figure: Long distance power transmissions

The large-scale transmission and distribution of electrical energy over long distances is done with the use of transformers. The voltage output of the generator is stepped-up. It is then transmitted over long distances to an area sub-station near the consumers. There the voltage is stepped down. It is further stepped down at distributing sub-stations and utility poles before a power supply of 240 V reaches our homes.

Q52. Which of the following statement is true?

- (i) Energy is created when a transformer steps up the voltage
- (ii) A transformer is designed to convert an AC voltage to DC voltage
- (iii) Step-up transformer increases the power for transmission
- (iv) Step-down transformer decreases the AC voltage

Q53. If the secondary coil has a greater number of turns than the primary,

- (i) the voltage is stepped-up ($V_s > V_p$) and arrangement is called a step-up transformer
- (ii) the voltage is stepped-down ($V_s < V_p$) and arrangement is called a step-down transformer
- (iii) the current is stepped-up ($I_s > I_p$) and arrangement is called a step-up transformer
- (iv) the current is stepped-down ($I_s < I_p$) and arrangement is called a step-down transformer

Q54. We need to step-up the voltage for power transmission, so that

- (i) the current is reduced and consequently, the I^2R loss is cut down
- (ii) the voltage is increased, the power losses are also increased
- (iii) the power is increased before transmission is done
- (iv) the voltage is decreased so V^2/R losses are reduced

Q55. A power transmission line feeds input power at 2300 V to a step down transformer with its primary windings having 4000 turns. The number of turns in the secondary in order to get output power at 230 V are

- (i) 4
- (ii) 40
- (iii) 400
- (iv) 4000