SAMPLE Question Paper 1

Maximum Marks : 200 **Time : 45 Minutes**

General Instructions:

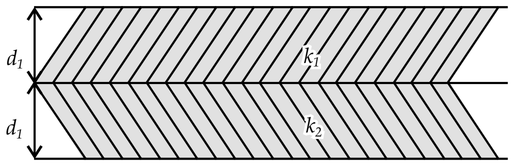
(i) This paper consists of 50 MCQs, attempt any 40 out of 50 .
(ii) Correct answer or the most appropriate answer: Five marks (+5) .
(iii) Any incorrect option marked will be given minus one mark (– 1) .
(iv) Unanswered/Marked for Review will be given no mark (0) .
(v) If more than one option is found to be correct then Five marks (+5) will be awarded to only those who have marked any of the correct options .
(vi) If all options are found to be correct then Five marks (+5) will be awarded to all those who have attempted the question .
(vii) If none of the options is found correct or a Question is found to be wrong or a Question is dropped then all candidates who have appeared will be given five marks (+5).
(viii) Calculator / any electronic gadgets are not permitted .

Section - II

PHYSICS

1. Electric potential inside a conducting sphere
(1) is zero.
(2) remains constant.
(3) decreases from centre to surface.
(4) increases from centre to surface.

2. A parallel plate capacitor is made of two dielectric blocks in series. One of the blocks has thickness d_1 and dielectric constant k_1 and the other has thickness d_2 and dielectric constant k_2 as shown in Figure. This arrangement can be thought as a dielectric slab of thickness $d\ (= d_1 + d_2)$ and effective dielectric constant k. The k is :



(1) $\dfrac{k_1d_1 + k_2d_2}{d_1 + d_2}$ **(2)** $\dfrac{k_1d_1 + k_2d_2}{k_1 + k_2}$

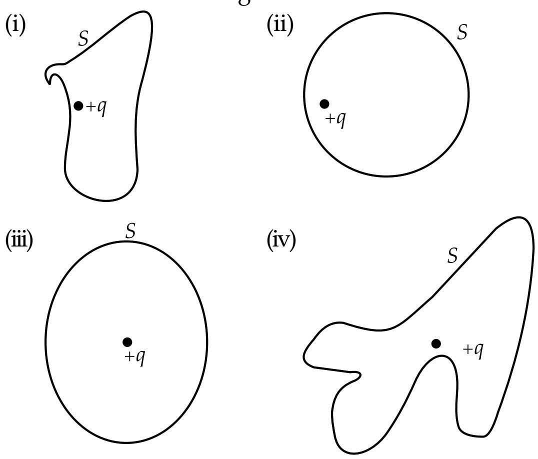
(3) $\dfrac{k_1k_2(d_1 + d_2)}{(k_1d_2 + k_2d_1)}$ **(4)** $\dfrac{2k_1k_2}{k_1 + k_2}$

3. The capacitance of a parallel plate capacitor is 10 μF. When a dielectric plate is introduced in between the plates, its potential becomes 1/4th of its original value. What is the value of the dielectric constant of the plate introduced?
(1) 4 **(2)** 40
(3) 2.5 **(4)** none of the above

4. Capacitance of a parallel plate capacitor can be increased by
(1) increasing the distance between the plates.
(2) decreasing the distance between the plates.
(3) decreasing the area of plates.
(4) increasing the thickness of the plates.

5. Equipotential at a great distance from a collection of charges whose total sum is not zero are approximately
(1) spheres. **(2)** planes.
(3) paraboloids. **(4)** ellipsoids.

6. The electric flux through the surface :



(1) in Figure (iv) is the largest.
(2) in Figure (iii) is the least.

(3) in Figure (ii) is same as Figure (iii) but is smaller than Figure (iv).
(4) is the same for all the figures.

7. Electric charge between two bodies can be produced by
(1) sticking (2) rubbing
(3) oiling (4) passing AC current

8. Photoelectrons emitted from a metal have
(1) different speeds starting from 0 to certain maximum.
(2) same kinetic energy.
(3) same frequency.
(4) Both (2) & (3)

9. Photons are
(1) electrically neutral and not deflected by electric or magnetic field.
(2) electrically neutral and deflected by magnetic field.
(3) electrically charged and not deflected by electric or magnetic field.
(4) electrically charged and not deflected by electric field.

10. Tritium is an isotope of hydrogen whose nucleus Triton contains 2 neutrons and 1 proton. Free neutrons decay into $p + \bar{e} + \nu$. If one of the neutrons in Tritium decays, it would transform into ${}_2He^3$ nucleus. This does not happen. This is because
(1) tritium energy is less than that of a ${}_2He^3$ nucleus.
(2) the electron created in the beta decay process cannot remain in the nucleus.
(3) both the neutrons in triton have to decay simultaneously resulting in a nucleus with 3 protons, which is not a He^3 nucleus.
(4) because free neutrons decay due to external perturbations which is absent in a triton nucleus.

11. Which one of the following statements is correct?
(1) Potentiometer is used to measure the current in a circuit.
(2) Potentiometer is used to measure the internal resistance of a cell.
(3) Potentiometer is used to measure the resistance of a circuit.
(4) Potentiometer is used to measure the potential difference across a resistor.

12. Two cells of emf's approximately 5 V and 10 V are to be accurately compared using a potentiometer of length 400 cm :
(1) The battery that runs the potentiometer should have voltage of 8 V.
(2) The battery of potentiometer can have a voltage of 15 V and R adjusted so that the potential drop across the wire slightly exceeds 10 V.
(3) The first portion of 50 cm of wire itself should have a potential drop of 10 V.
(4) Potentiometer is usually used for comparing resistances and not voltages.

13. Which error of meter bridge is removed when the known and unknown resistances are interchanged?
(1) End error (2) Measurement error
(3) Percentage error (4) Parallax error

14. A circular current loop of magnetic moment M is in an arbitrary orientation in an external magnetic field B. The work done to rotate the loop by 30° about an axis perpendicular to its plane is
(1) MB (2) $\frac{\sqrt{3}MB}{2}$.
(3) $\frac{MB}{2}$. (4) zero.

15. At any point, empty space surrounded by a toroid, the magnetic field is B_1. At any point, outside the toroid, the magnetic field is B_2.
(1) $B_1 > B_2$ (2) $B_2 > B_1$
(3) $B_1 = B_2$ (4) $B_1 = B_2 = 0$

16. To convert a galvanometer to ammeter a shunt S is to be connected with the galvanometer. The effective resistance of the ammeter then is
(1) GS/(G+S) (2) (G+S)/GS
(3) G+S (4) None of the above

17. A galvanometer can be converted into a voltmeter by connecting a
(1) high resistance in series.
(2) high resistance in parallel.
(3) low resistance in parallel.
(4) low resistance in series.

18. When a charged particle moves through a magnetic field perpendicular to its direction. Then
(1) linear momentum changes
(2) kinetic energy remains constant
(3) both (1) and (2)
(4) both linear momentum and kinetic energy varies

19. Current sensitivity of a galvanometer is given by
(1) Cθ/nBA (2) nBA/C
(3) nBA/CG (4) CG/nBA

20. A coil of N turns and radius R carries a current I. It is unwound and rewound to make a square coil of side a having same number of turns (N). Keeping the current I same, the ratio of the magnetic moments of the circular coil and the square coil is
(1) $\pi\frac{R^2}{a^2}$ (2) $\pi\frac{a^2}{R^2}$
(3) $\frac{R^2}{a^2}$ (4) None of the above

21. A magnetic dipole moment is a vector quantity directed from:

(1) South to North (2) North to South
(3) East to West (4) West to East

22. A ferromagnetic substance is heated above its curie temperature. Which of the following statements is correct?
(1) Ferromagnetic domains get perfectly arranged.
(2) Ferromagnetic domains get randomly arranged.
(3) Ferromagnetic domains are not at all influenced.
(4) Ferromagnetic material transforms into diamagnetic substance.

23. Which of the following relation is correct?
(1) $B = B_V \times B_H$ (2) $B = B_V / B_H$
(3) $B = B_V + B_H$ (4) $B = \sqrt{B_V^2 + B_H^2}$

24. Three waves A, B and C of frequencies 1,600 kHz, 5 MHz and 60 MHz, respectively are to be transmitted from one place to another. Which of the following is the most appropriate mode of communication?
(1) A is transmitted via space wave while B and C are transmitted via sky wave.
(2) A is transmitted via ground wave, B via sky wave and C via space wave.
(3) B and C are transmitted via ground wave while A is transmitted via sky wave.
(4) B is transmitted via ground wave while A and C are transmitted via space wave.

25. A square of side L meters lies in the *x-y* plane in a region where the magnetic field is given by $\mathbf{B} = B_0(2\hat{i} + 3\hat{j} + 4\hat{k})$ Tesla, where B_0 is constant. The magnitude of flux passing through the square is
(1) $2B_0L^2$ Wb (2) $3B_0L^2$ Wb
(3) $4B_0L^2$ Wb (4) $\sqrt{29}B_0L^2$ Wb

26. The polarity of induced emf is defined by
(1) Ampere's circuital law.
(2) Biot-Savart law.
(3) Lenz's law.
(4) Fleming's right hand rule.

27. Which of these sets of logic gates are designated as universal gates?
(1) NAND (2) NOX
(3) EX-OR (4) EX-NOR

28. Magnetic field energy stored in a coil is
(1) Li^2 (2) ½ Li
(3) Li (4) ½ Li^2

29. If two coils of self inductance L_1 and L_2 are coupled together, their mutual inductance becomes
(1) $M = k\sqrt{L_1L_2}$ (2) $M = k\sqrt{\frac{L_1}{L_2}}$
(3) $M = k\sqrt{L_1 + L_2}$ (4) None of the above

30. In which of the following application, eddy current has no role to play?
(1) Electric power meters
(2) Induction furnace
(3) LED lights
(4) Magnetic brakes in trains

31. If the rms current in a 50 Hz AC circuit is 5 *A*, the value of the current $\frac{1}{300}$ s is:
(1) $5\sqrt{2}$ A (2) $5\sqrt{\frac{3}{2}}$A
(3) $\frac{5}{6}$A (4) $\frac{5}{\sqrt{2}}$A

32. When a voltage measuring device is connected to AC mains, the meter shows the steady input voltage of 220 V. this means
(1) input voltage cannot be AC voltage, but a DC voltage.
(2) maximum input voltage is 220 V.
(3) The meter reads not v but (v^2) and is calibrated to read $\sqrt{(v^2)}$.
(4) The pointer of the meter is stuck by some mechanical defect.

33. Which of the following combinations should be selected for better tuning of an ***L-C-R*** circuit used for communication?
(1) $R = 20\ \Omega, L = 1.5\ H, C = 35\ \mu F$
(2) $R = 25\ \Omega, L = 2.5\ H, C = 45\ \mu F$
(3) $R = 15\ \Omega, L = 3.5\ H, C = 30\ \mu F$
(4) $R = 25\ \Omega, L = 1.5\ H, C = 45\ \mu F$

34. The sharpness of tuning of a series LCR circuit at resonance is measured by Q factor of the circuit which is given by
(1) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ (2) $Q = \frac{1}{R}\sqrt{\frac{C}{L}}$
(3) $Q = \frac{1}{L}\sqrt{\frac{R}{C}}$ (4) $Q = \frac{1}{C}\sqrt{\frac{R}{L}}$

35. The underlying principle of transformer is
(1) resonance. (2) mutual induction.
(3) self induction. (4) none of the above.

36. The power factor of series LCR circuit at resonance is
(1) 0.707 (2) 1
(3) 0.5 (4) 0

37. A linearly polarized electromagnetic wave given as $\mathbf{E} = E_0\,\hat{i}\cos(kz - \omega t)$ is incident normally on a perfectly reflecting infinite wall at $z = a$. Assuming that the material of the wall is optically inactive, the reflected wave will be given as
(1) $E_r = -E_0\,\hat{i}\cos(kz - \omega t)$
(2) $E_r = E_0\,\hat{i}\cos(kz + \omega t)$
(3) $E_r = -E_0\,\hat{i}\cos(kz + \omega t)$
(4) $E_r = E_0\,\hat{i}\sin(kz - \omega t)$

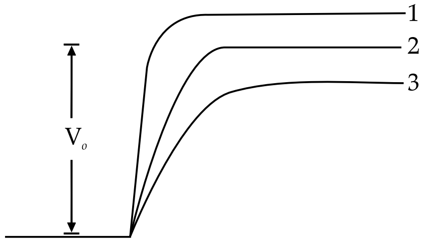
38. In vacuum, the wavelength of the electromagnetic wave of frequency 5×10^{19} Hz is
(1) 6×10^{-12} m (2) 3×10^{-8} m
(3) 1.6×10^{11} m (4) 15×10^{27} m

39. Semiconductors behave like insulators at ______

(1) 0°C **(2)** 0 K

(3) 273 K **(4)** None of the above

40. In Figure, V_o is the potential barrier across a *p-n* junction, when no battery is connected across the junction



(1) 1 and 3 both correspond to forward bias of junction

(2) 3 corresponds to forward bias of junction and 1 corresponds to reverse bias of junction

(3) 1 corresponds to forward bias and 3 corresponds to reverse bias of junction.

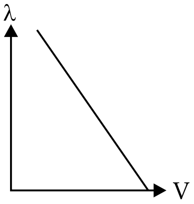
(4) 3 and 1 both correspond to reverse bias of junction.

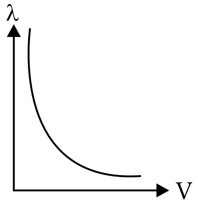
41. The relationship between angle of incidence *i*, prism of angle A and angle of minimum deviation for a triangular prism is

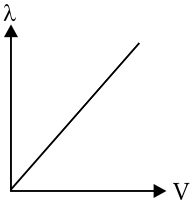
(1) $A + \delta_m = i$ **(2)** $A + \delta_m = 2i$

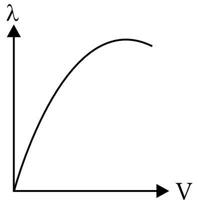
(3) $A + \delta_m/2 = i$ **(4)** $2A + \delta_m = i$

42. Which of the following graphs shows the variation of de-Broglie wavelength with potential through which a particle of charge *q* and mass *m* is accelerated?

(1)


(2)


(3)


(4)


43. Taking the Bohr radius as $a_0 = 53$ pm, the radius of Li^{++} ion in its ground state, on the basis of Bohr's model, will be about

(1) 53 pm. **(2)** 27 pm.

(3) 18 pm. **(4)** 13 pm.

44. Convex mirrors are preferred over plane mirrors as rear view mirror in automobile since

(1) the image formed is magnified.

(2) the image formed is real.

(3) the field of view is large.

(4) it is light weight.

45. **Assertion (A):** Density of all the nuclei is same.

Reason (R): Radius of nucleus is directly proportional to the cube root of mass number.

(1) Both A and R are true and R is the correct explanation of A

(2) Both A and R are true but R is NOT the correct explanation of A

(3) A is true but R is false

(4) A is false and R is true

II. Read the following text and answer the following questions on the basis of the same:

Diffraction in a hall:

A and B went to purchase a ticket of a music programme. But unfortunately only one ticket was left. They purchased the single ticket and decided that A would be in the hall during the 1st half and B during the 2nd half.

Both of them reached the hall together. A entered the hall and found that the seat was behind a pillar which creates an obstacle. He was disappointed. He thought that he would not be able to hear the programme properly.

B was waiting outside the closed door. The door was not fully closed. There was a little opening. But surprisingly, A could hear the music programme.

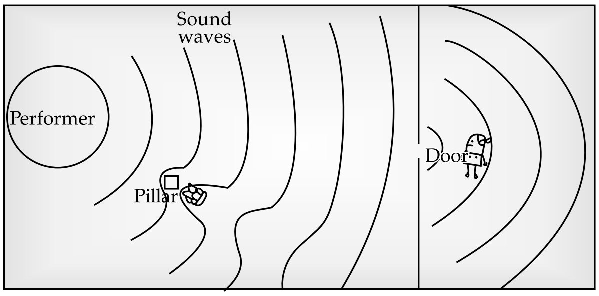
This happened due to diffraction of sound.

The fact we hear sounds around corners and around barriers involves both diffraction and reflection of sound.

Diffraction in such cases helps the sound to "bend around" the obstacles.

In fact, diffraction is more pronounced with longer wavelengths implies that we can hear low frequencies around obstacles better than high frequencies.

B was outside the door. He could also hear the programme. But he noticed that when the door opening is comparatively less he could hear the programme even being little away from the door. This is because when the width of the opening is larger than the wavelength of the wave passing through the gap then it does not spread out much on the other side. But when the opening is smaller than the wavelength more diffraction occurs and the waves spread out greatly – with semicircular wavefront. The opening in this case functions as a localized source of sound.



46. A and B could hear the music programme due to phenomenon named

(1) interference. **(2)** scattering.

(3) diffraction. **(4)** dispersion.

47. Diffraction is more pronounced with ______ wavelengths.

(1) Longer **(2)** Shorter

(3) fluctuating **(4)** all

48. The minimum and maximum frequencies in the musical programme were 550 Hz and 10 kHz. Which frequency was better audible around the pillar obstacle?

(1) 10 kHz

(2) 550 kHz

(3) Mid frequency

(4) The complete frequency range

49. Diffraction of sound takes place more when :

(1) sound is diffracted through an opening having width equal to the wavelength of the sound.

(2) sound is diffracted through an opening having width more than the wavelength of the sound.

(3) sound is diffracted through an opening having width less than the wavelength of the sound.

(4) diffraction of sound does not depend on the width of the opening.

50. How the waveform will look like outside the door of the hall?

(1) Sound repeater

(2) Sound reflector

(3) Localized sound source

(4) None of the above

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