

General Instructions

- (i) This question paper contains 50 questions. All questions are compulsory.
- (ii) It comprises 50 single-correct multiple-choice questions.
- (iii) These questions follow the CUET (UG) examination pattern.
- (iv) Each correct answer is awarded +5 marks, with -1 for an incorrect answer.
- (v) The time allotted for this paper is 60 minutes.
- (vi) Attempt every question; detailed solutions are provided in the companion solutions booklet.

1. An electric dipole is placed in an external uniform electric field. The net electric force on the dipole

- (A) is always zero
- (B) depends on the orientation of the dipole
- (C) can never be zero
- (D) depends on the dipole moment of the dipole

2. Identify the correct statements from the following :

- A. The charge on a body can have any value greater than the charge on an electron or proton.
- B. Gauss's theorem is valid for a closed surface of any shape and for any general charge distribution.
- C. The net flux through a closed surface due to a charge lying outside the closed surface is zero.
- D. Gauss's theorem is applicable to any field which obeys the inverse square law

Choose the *correct* answer from the options given below:

- (A) A, B and C only
- (B) A, B and D only
- (C) A, B, C and D
- (D) B, C and D only

3. Match the LIST-I with LIST-II

LIST-I

- A. E is independent of r
- B. E is inversely proportional to r
- C. E is inversely proportional to r^2
- D. E is inversely proportional to r^3

LIST-II

- I. For a point charge
- II. For a short dipole
- III. For a uniform line charge
- IV. For a uniformly charged infinite plane sheet

Choose the *correct* answer from the options given below:

- (A) A-I, B-II, C-III, D-IV
 - (B) A-IV, B-III, C-I, D-II
 - (C) A-IV, B-III, C-II, D-I
 - (D) A-III, B-IV, C-I, D-II
-

4. A charge q is placed at the center of a line joining two equal positive charges Q . The system of the three charges will be in equilibrium, if q is equal to

- (A) $-\frac{Q}{2}$
 - (B) $-\frac{Q}{4}$
 - (C) $+\frac{Q}{4}$
 - (D) $+\frac{Q}{2}$
-

5. A metal wire is bent in the shape of a circle of 10 cm radius. It is given a charge of $200 \mu\text{C}$ which spreads on it uniformly. The electric potential at its center is

- (A) $3 \times 10^6 \text{ V}$
 - (B) $6 \times 10^6 \text{ V}$
 - (C) $9 \times 10^6 \text{ V}$
 - (D) $18 \times 10^6 \text{ V}$
-

6. Three capacitors of equal capacitance, when connected in series have net capacitance C_1 and when connected in parallel have net capacitance C_2 . The ratio of C_1 and C_2 is

- (A) $\frac{1}{3}$
- (B) 3
- (C) $\frac{1}{9}$
- (D) 9



7. A 800 pF capacitor is charged by a 100 V battery. After some time, the battery is disconnected. The capacitor is then connected across another 800 pF capacitor. The electrostatic energy stored in the combination will be

- (A) $2 \times 10^{-6} \text{ J}$
- (B) $3.8 \times 10^{-6} \text{ J}$
- (C) $4.2 \times 10^{-6} \text{ J}$
- (D) $6 \times 10^{-6} \text{ J}$



8. Match the LIST-I with LIST-II

LIST-I (Quantity)

LIST-II (Formula)

- | | |
|------------------------|------------------------------------|
| A. Electromotive force | I. Drift velocity / Electric field |
| B. Electric field | II. Current / Area |
| C. Current density | III. Electric force / Charge |
| D. Charge mobility | IV. Work / Charge |

Choose the *correct* answer from the options given below:

- (A) A-I, B-II, C-III, D-IV
 - (B) A-IV, B-III, C-II, D-I
 - (C) A-IV, B-III, C-I, D-II
 - (D) A-III, B-IV, C-II, D-I
-

9. Arrange the following materials in the ascending order of their electrical conductivities.

- A. Rubber
- B. Iron
- C. Carbon
- D. Copper

Choose the correct answer from the options given below:

- (A) A, B, C, D
 - (B) D, B, C, A
 - (C) A, C, B, D
 - (D) C, A, B, D
-

10. Identify the correct statements among the following:

- A. A current carrying wire is electrically charged.
- B. The drift velocity of electrons in a metallic wire will decrease if the temperature of the wire is increased.
- C. The emf of a cell depends on the internal resistance of the cell.
- D. The internal resistance of dry cells is much higher than the common electrolytic cells.

Choose the *correct* answer from the options given below:

- (A) A, B and D only
 - (B) A and D only
 - (C) B and D only
 - (D) A, C and D only
-

11. At what temperature the resistance of a conductor becomes 20% more than its resistance at 27° C? (The value of the temperature coefficient of resistance of the conductor is $2.0 \times 10^{-4}/\text{K}$.)

- (A) 900 K
 - (B) 1100 K
 - (C) 1300 K
 - (D) 1450 K
-

12. In a Wheatstone bridge arrangement (P, Q, R and S), the resistors P and Q are nearly equal. The bridge is balanced when $R = 500 \, \Omega$. On interchanging P and Q, the value of R for balancing is $505 \, \Omega$. The value of S will be:

- (A) $500 \, \Omega$
 - (B) $502.5 \, \Omega$
 - (C) $505 \, \Omega$
 - (D) $5 \, \Omega$
-

13. A positive charge enters a magnetic field and travels parallel to the magnetic field. The charge experiences

- (A) an upward force
 - (B) a downward force
 - (C) a force in the direction of magnetic field.
 - (D) no force
-

14. If a ferromagnetic material is inserted in a current carrying solenoid, the magnetic field inside the solenoid

- (A) increases
 - (B) decreases
 - (C) remains unchanged
 - (D) becomes zero
-

15. An electron of charge 'e' moves in a circular orbit of radius r around a nucleus with a frequency ν . The magnetic moment associated with the orbital motion of the electron is

- (A) $\pi\nu e r^2$
 - (B) $\frac{\pi\nu r^2}{e}$
 - (C) $\frac{\pi\nu e}{r}$
 - (D) $\frac{\pi e r^2}{\nu}$
-

16. Identify the correct statements among the following.

- A. The torque acting on a planar current loop in a magnetic field changes when its shape is changed without changing its area.
- B. Two parallel wires carrying currents in opposite directions attract each other.
- C. An ideal ammeter has zero resistance and an ideal voltmeter has infinite resistance.
- D. A galvanometer can be converted into a voltmeter by connecting a high resistance in series.

Choose the correct answer from the options given below:

- (A) A, B and C only
 - (B) B, C and D only
 - (C) C and D only
 - (D) A and C only
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17. A 0.5 m long solenoid has 500 turns and has a flux density of 2.52×10^{-3} T at its center. The current in the solenoid is (Given, $\mu_0 = 4\pi \times 10^{-7}$ H/m)

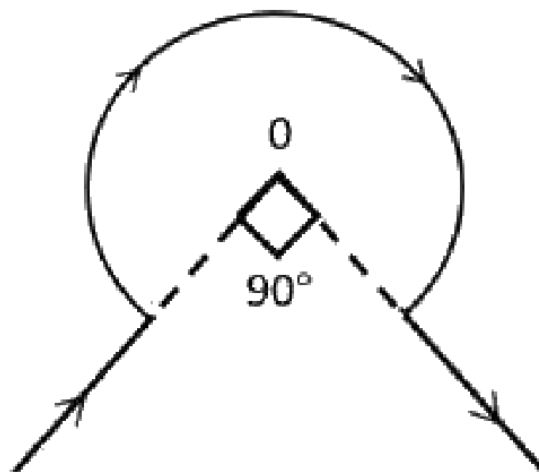
- (A) 1.2 A
 - (B) 2.0 A
 - (C) 2.8 A
 - (D) 3.4 A
-

18. A bar magnet of dipole moment 3 Am^2 rests with its centre on a frictionless point. A force F is applied at right angles to the axis of the magnet, 10 cm from the point. It is observed that an external magnetic field of 0.25 T is required to hold the magnet in equilibrium at an angle of 30° with the field. The value of F is:

- (A) 2.75 N
- (B) 2.93 N
- (C) 3.75 N
- (D) 4.08 N



19. A wire shown in figure carries a current of 10 A. The magnitude of the magnetic field at the centre O is: (Given: radius of the bent coil is 3 cm.)



- (A) $1 \times 10^{-4} \text{ T}$
- (B) $1.57 \times 10^{-3} \text{ T}$
- (C) $1.57 \times 10^{-4} \text{ T}$
- (D) $2.41 \times 10^{-5} \text{ T}$



20. The mutual inductance of a pair of coils placed close to each other depends upon

- (A) The rate at which currents are changing in the two coils.
 - (B) Relative position and orientation of the two coils
 - (C) The materials of the wires of the coils
 - (D) The current in the two coils
-

21. If the number of turns in a coil is tripled, the value of the magnetic flux linked with the coil:

- (A) remains unchanged
 - (B) becomes $\frac{1}{3}$ times
 - (C) is tripled
 - (D) becomes $\frac{2}{3}$ times
-

22. Identify the correct statement(s) among the following.

- A. In a d.c. circuit, a capacitor can conduct but not an inductor.
- B. In a d.c. circuit, an inductor can conduct but not a capacitor.
- C. In a d.c. circuit, both the inductor and capacitor cannot conduct.
- D. An inductor has infinite resistance in a d.c. circuit.

Choose the correct answer from the options given below:

- (A) A and C only
 - (B) B and D only
 - (C) B only
 - (D) A, C and D only
-

23. An a.c. voltage is applied to a pure inductor. The current in the inductor would be

- (A) leading the voltage by $\frac{\pi}{2}$
 - (B) lagging the voltage by $\frac{\pi}{2}$
 - (C) leading the voltage by $\frac{\pi}{4}$
 - (D) in phase with the voltage.
-

24. A pure inductor of 0.25 H is connected to a source of 220 V. If the frequency of the source is 50 Hz, then the rms current in the circuit will be.

- (A) 1.6 A
 - (B) 4.0 A
 - (C) 2.8 A
 - (D) 28 A
-

25. A coil with an average diameter of 0.02 m is placed with its plane perpendicular to a magnetic field of 6000 T. The induced emf in the coil is 11 V, when the magnetic field is changed to 1000 T in 4 s. The number of turns in the coil is

- (A) 16
 - (B) 18
 - (C) 24
 - (D) 28
-

26. Arrange the following electromagnetic waves in the ascending order of their energies.

- A. X-rays
- B. UV-rays
- C. Infrared rays
- D. Microwaves

Choose the correct answer from the options given below:

- (A) A, B, C, D
 - (B) B, C, D, A
 - (C) D, B, A, C
 - (D) D, C, B, A
-

27. The conduction current is same as displacement current in a circuit when the source is

- (A) a.c. only
 - (B) d.c. only
 - (C) either a.c. or d.c.
 - (D) neither d.c nor a.c.
-

28. Identify the correct statements among the following.

- A. All electromagnetic waves, irrespective of their frequencies, travel at the same speed through vacuum.
- B. A capacitor is fully charged by a d.c. source. When it is fully charged, the displacement current is zero.
- C. Ultraviolet radiation can be used for viewing objects through haze and fog.
- D. A moving charge in a circular orbit cannot produce electromagnetic waves.

Choose the correct answer from the options given below:

- (A) A, B and C only
 - (B) B and C only
 - (C) A and B only
 - (D) C and D only
-

29. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

- (A) $\frac{2E}{c}$
 - (B) $\frac{2E}{c^2}$
 - (C) $\frac{E}{c^2}$
 - (D) $\frac{E}{c}$
-

30. The intensity of a laser beam is $2.5 \times 10^{14} \text{ W/m}^2$. The amplitude of the magnetic field in the beam is

(Given, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$)

- (A) $\sim 1.15 \text{ T}$
 - (B) $\sim 1.45 \text{ T}$
 - (C) $\sim 2.0 \text{ T}$
 - (D) $\sim 3.25 \text{ T}$
-

31. A real image is formed by a convex lens on the screen. If half of the lens is covered by an opaque object, then

- (A) half image is not seen
 - (B) full image of same intensity is seen
 - (C) half image of same intensity is seen
 - (D) full image of decreased intensity is seen
-

32. Arrange the following substances/media in the increasing order of their refractive indices.

- A. Crown glass
- B. Water
- C. Diamond
- D. CO_2

Choose the **correct** answer from the options given below:

- (A) A, B, C, D
 - (B) D, C, B, A
 - (C) D, B, A, C
 - (D) D, B, C, A
-

33. Match the **LIST-I** with **LIST-II** (In the context of Young's double slit experiment)

LIST-I

A. The width of one slit is slightly increased.

B. One slit is closed.

C. The width of the source slit is increased.

D. Light of smaller frequency is used.

LIST-II

I. The fringe width increases.

II. Interference pattern becomes less sharp.

III. Maximum intensity increases

IV. Interference pattern disappears

Choose the **correct** answer from the options given below:

(A) A-I, B-II, C-III, D-IV

(B) A-IV, B-III, C-II, D-I

(C) A-III, B-IV, C-II, D-I

(D) A-III, B-IV, C-I, D-II

34. In a Young's double slit experiment, the intensity at the center of the screen is I. If one of the slits is closed, the intensity at the center of the screen now will be:

(A) $\frac{1}{2}$

(B) 1

(C) $\frac{1}{4}$

(D) $\frac{1}{3}$

35. A ray of light of frequency 5×10^{14} Hz is passed through a liquid. The wavelength of light measured inside the liquid is found to be 450×10^{-9} m. The refractive index of the liquid is

- (A) 1.25
- (B) 1.33
- (C) 1.45
- (D) 1.51

36. If the two slits in a Young's double slit experiment have their widths in the ratio 4:1, then the ratio of intensities at maxima and minima in the interference pattern will be

- (A) 16 : 3
- (B) 16 : 1
- (C) 25 : 9
- (D) 9 : 1

37. A concave mirror forms a real image of an object kept at a distance of 9 cm from it. If the object is taken away further from the mirror by 6 cm, the image size is reduced to $(1/4)^{th}$ of its previous size. The focal length of the mirror is:

- (A) -5 cm
- (B) -7 cm
- (C) 15 cm
- (D) 18 cm

38. Arrange the following photosensitive metals (work function given in brackets) according to their threshold wavelengths in decreasing order of their values.

- A. K ($\Phi = 2.3$ eV)
- B. Na ($\Phi = 2.75$ eV)
- C. Cs ($\Phi = 2.14$ eV)
- D. Ca ($\Phi = 3.2$ eV)

Choose the *correct* answer from the options given below:

- (A) A, B, C, D
 - (B) D, C, B, A
 - (C) C, A, D, B
 - (D) C, A, B, D
-

39. An electron and a photon each have the same de-Broglie wavelength of 1.0 nm. The ratio of their linear momenta is

- (A) 1:1
 - (B) 1:2
 - (C) 2:1
 - (D) 4:9
-

40. A monochromatic source emitting light of 600 nm, has a power output of 66 W. The number of photons emitted by the source per second is (Given, Plank's constant $h = 6.6 \times 10^{-34}$ Js)

- (A) 2×10^{18}
 (B) 2×10^{19}
 (C) 2×10^{20}
 (D) 8×10^{22}

41. Match the **LIST-I** with **LIST-II** (Symbols have their usual meaning)

LIST-I	LIST-II
Spectral series of Hydrogen	Wave Number
A. Lyman series	I. $\bar{\nu} = R \left[\frac{1}{1^2} - \frac{1}{n_2^2} \right]$
B. Paschen series	II. $\bar{\nu} = R \left[\frac{1}{2^2} - \frac{1}{n_2^2} \right]$
C. Balmer series	III. $\bar{\nu} = R \left[\frac{1}{3^2} - \frac{1}{n_2^2} \right]$
D. Brackett series	IV. $\bar{\nu} = R \left[\frac{1}{4^2} - \frac{1}{n_2^2} \right]$

Choose the **correct** answer from the options given below:

- (A) A-I, B-II, C-III, D-IV
 (B) A-IV, B-III, C-II, D-I
 (C) A-I, B-III, C-IV, D-II
 (D) A-I, B-III, C-II, D-IV

42. In Bohr's model of hydrogen atom, which of the following is an integral multiple of $\frac{h}{2\pi}$?

- (A) Kinetic energy of electron
 - (B) Radius of an atom
 - (C) Potential energy of electron
 - (D) Angular momentum of electron
-

43. Arrange the following elements in the increasing order of their binding energies per nucleon.

- A. ${}^4\text{He}$
- B. ${}^6\text{Li}$
- C. ${}^{14}\text{N}$
- D. ${}^{12}\text{C}$

Choose the *correct* answer from the options given below:

- (A) A, B, C, D
 - (B) A, B, D, C
 - (C) B, A, C, D
 - (D) B, A, D, C
-

44. If r_1 and r_2 are the radii of the atomic nuclei of mass number 4 and 32, respectively, then the ratio $\left(\frac{r_1}{r_2}\right)$ is

- (A) 1:2
 - (B) 1:3
 - (C) 1:4
 - (D) 1:5
-

45. The maximum wavelength of electromagnetic radiation which can create a hole-electron pair in the semiconductor Ge is: (Given, the band gap of Ge is 0.72 eV)

- (A) $\sim 1.1 \times 10^{-5} \text{ m}$
 - (B) $\sim 1.4 \times 10^{-5} \text{ m}$
 - (C) $\sim 1.7 \times 10^{-6} \text{ m}$
 - (D) $\sim 2.6 \times 10^{-6} \text{ m}$
-

46. If the forward bias voltage in a diode is increased, the width of the depletion region

- (A) increases
 - (B) decreases
 - (C) fluctuates
 - (D) does not change
-

47. For a heavily doped n-type semi-conductor, donor level lies

- (A) a little below the conduction band
 - (B) a little above the valance band
 - (C) a little inside the valence band
 - (D) at the center of the band gap
-

48. Match List-I with List-II. Assume that the Si intrinsic semiconductor has 5×10^{28} atoms/m³. (Given: the intrinsic concentration of electrons in the semiconductor is 10^{16} m⁻³).

	LIST-I	LIST-II
A	When it is doped with 2 ppm concentration of a pentavalent atom, n_e is	I 4.0×10^8 m ⁻³
B	When it is doped with 2 ppm concentration of a pentavalent atom, n_h is	II 2.5×10^{23} m ⁻³
C	When it is doped with 5 ppm concentration of a pentavalent atom, n_e is	III 10^9 m ⁻³
D	When it is doped with 5 ppm concentration of a pentavalent atom, n_h is	IV 10^{23} m ⁻³

Choose the *correct* answer from the options given below:

- (A) A-I, B-II, C-III, D-IV
- (B) A-II, B-III, C-IV, D-I
- (C) A-IV, B-III, C-II, D-I
- (D) A-IV, B-II, C-III, D-I

49. If 200 MeV energy is released in the fission of a single nucleus of ${}_{92}^{235}\text{U}$, how many fissions per second must occur to produce a power of 1 kW?

- (A) 6.250×10^{15}
- (B) 3.125×10^{13}
- (C) 4.251×10^{13}
- (D) 2.155×10^{14}

50. An alpha particle of energy $\frac{1}{2} mv^2$ bombards a heavy target nucleus of charge Ze . Then, the distance of closet approach for the alpha particle will be proportional to

- (A) v^{-1}
- (B) v^{-2}
- (C) v^{-4}
- (D) $(Ze)^{-1}$