

JEE MAINS 2023 Physics 13 APRIL Shift 2 Question Paper

Time Allowed :1 Hours

Maximum Marks :120

Total Questions :30

General Instructions

Read the following instructions very carefully and strictly follow them:

1. This question paper contains 30 questions. All questions are compulsory.
2. This question paper contains only one section - Mathematics
3. In all sections, Questions are multiple choice questions (MCQs) and questions carry 4 mark each.

31. Given below are two statements:

Statement I: An AC circuit undergoes electrical resonance if it contains either a capacitor or an inductor.

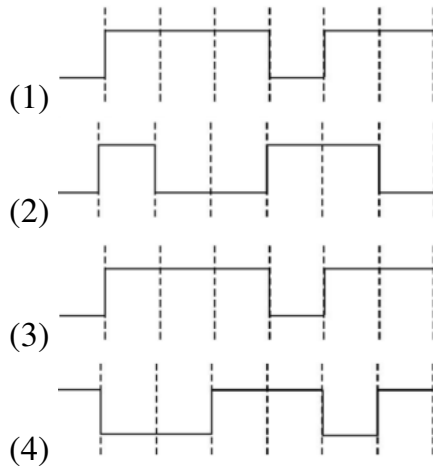
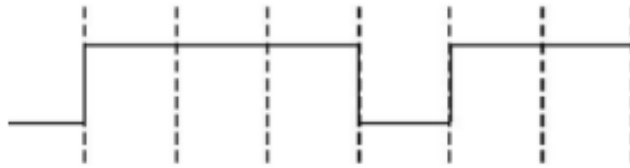
Statement II: An AC circuit containing a pure capacitor or a pure inductor consumes high power due to its non-zero power factor.

- (1) Statement I is false but Statement II is true
- (2) Statement I is true but Statement II is false
- (3) Both Statement I and Statement II are false
- (4) Both Statement I and Statement II are true

32. A passenger sitting in a train A moving at 90 km/h observes another train B moving in the opposite direction for 8 s. If the velocity of the train B is 54 km/h, then the length of train B is:

- (1) 120 m
- (2) 200 m
- (3) 320 m
- (4) 80 m

33. The output from a NAND gate having inputs A and B given below will be,



34. The distance travelled by an object in time t is given by $s = (2.5)t^2$. The instantaneous speed of the object at $t = 5$ sec will be:

- (1) 25 m/s
- (2) 12.5 m/s
- (3) 5 m/s
- (4) 62.5 m/s

35. In a Young's double slits experiment, the ratio of amplitude of light coming from slits is 2 : 1. The ratio of the maximum to minimum intensity in the interference pattern is:

- (1) 9 : 1
- (2) 9 : 4
- (3) 2 : 1
- (4) 25 : 9

36. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R. Assertion A: The binding energy per nucleon is practically independent of the atomic number for nuclei of mass number in the range 30 to 170.

Reason R: Nuclear force is short ranged.

- (1) Both A and R are true but R is NOT the correct explanation of A
 - (2) Both A and R are true and R is the correct explanation of A
 - (3) A is true but R is false
 - (4) A is false but R is true
-

37. Two planets A and B of radii R and $1.5R$ have densities ρ and $\rho/2$ respectively. The ratio of acceleration due to gravity at the surface of B to A is:

- (1) 2 : 3
 - (2) 2 : 1
 - (3) 4 : 3
 - (4) 3 : 4
-

38. The mean free path of molecules of a certain gas at STP is $1500d$, where d is the diameter of the gas molecules. While maintaining the standard pressure, the mean free path of the molecules at 373 K is approximately:

- (1) $750d$
 - (2) $1500d$
 - (3) $1098d$
 - (4) $2049d$
-

39. To radiate an EM signal of wavelength λ with high efficiency, the antennas should have a minimum size equal to:

- (1) λ
- (2) $\frac{\lambda}{2}$
- (3) 2λ

(4) $\frac{\lambda}{4}$

40. A particle executes SHM of amplitude A. The distance from the mean position when its kinetic energy is equal to its potential energy is:

- (1) $\sqrt{2}A$
 - (2) $\frac{1}{2}A$
 - (3) $\frac{1}{\sqrt{2}}A$
 - (4) $2A$
-

41. In an electromagnetic wave, at an instant and at a particular position, the electric field is along the negative z axis and magnetic field is along the positive x-axis. Then the direction of propagation of electromagnetic wave is:

- (1) negative y-axis
 - (2) at 45° angle from positive y-axis
 - (3) positive y-axis
 - (4) positive z-axis
-

42. Given below are two statements: Statement I: Out of microwaves, infrared rays and ultraviolet rays, ultraviolet rays are the most effective for the emission of electrons from a metallic surface. **Statement II:** Above the threshold frequency, the maximum kinetic energy of photoelectrons is inversely proportional to the frequency of the incident light.

- (1) Both Statement I and Statement II are true
 - (2) Both Statement I and Statement II are false
 - (3) Statement I is true but Statement II is false
 - (4) Statement I is false but Statement II is true
-

43. Given below are two statements: Statement I: For a planet, if the ratio of mass of the planet to its radius increases, the escape velocity from the planet also increases. **Statement II:** Escape velocity is independent of the radius of the planet.

- (1) Both Statement I and Statement II are correct
 - (2) Statement I is correct but Statement II is incorrect
 - (3) Statement I is incorrect but Statement II is correct
 - (4) Both Statement I and Statement II are incorrect
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44. A vehicle of mass 200 kg is moving along a levelled curved road of radius 70 m with angular velocity of 0.2 rad/s. The centripetal force acting on the vehicle is: (1) 2800 N
(2) 560 N
(3) 2240 N
(4) 14 N

45. A $10 \mu\text{C}$ charge is divided into two parts and placed at 1 cm distance so that the repulsive force between them is maximum. The charges of the two parts are:
(1) $7 \mu\text{C}$, $3 \mu\text{C}$
(2) $8 \mu\text{C}$, $2 \mu\text{C}$
(3) $9 \mu\text{C}$, $1 \mu\text{C}$
(4) $5 \mu\text{C}$, $5 \mu\text{C}$

46. In the equation $[x + \frac{a}{y}][Y - b] = RT$, where X is pressure, Y is volume, R is universal gas constant and T is temperature. The physical quantity equivalent to the ratio $\frac{a}{b}$ is:
(1) Coefficient of viscosity
(2) Energy
(3) Impulse
(4) Pressure gradient

47. An electron is moving along the positive x-axis. If the uniform magnetic field is applied parallel to the negative z-axis, then
(1) B and E only
(2) A and E only

- (3) B and D only
 - (4) C and D only
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48. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: A spherical body of radius (5 ± 0.1) mm having a particular density is falling through a liquid of constant density. The percentage error in the calculation of its terminal velocity is 4%.

Reason R: The terminal velocity of the spherical body falling through the liquid is inversely proportional to its radius.

- (1) Both A and R are true but R is NOT the correct explanation of A
 - (2) Both A and R are true and R is the correct explanation of A
 - (3) A is false but R is true
 - (4) A is true but R is false
-

49. The initial pressure and volume of an ideal gas are P_1 and V_1 . The final pressure of the gas when the gas is suddenly compressed to volume $\frac{V_1}{4}$ will be:

- (1) $P_1 \left(\frac{V_1}{4}\right)^\gamma$
 - (2) $4P_1$
 - (3) P_0
 - (4) $P_1 \left(\frac{V_1}{4}\right)^{\gamma-1}$
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50. In the network shown below, the charge accumulated in the capacitor in steady state will be:

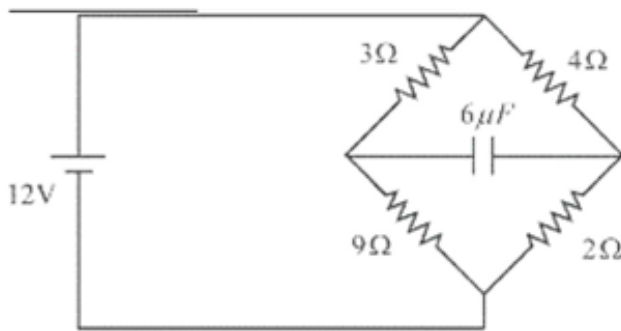
- (1) $4.8 \mu C$
 - (2) $12 \mu C$
 - (3) $7.2 \mu C$
 - (4) $10.3 \mu C$
-

Section - B

51. In an experiment with sonometer when a mass of 180 g is attached to the string, it vibrates with fundamental frequency of 30 Hz. When a mass m is attached, the string vibrates with fundamental frequency of 50 Hz. The value of m is _____ g

52. Two plates A and B have thermal conductivities $84 \text{ W/m}\cdot\text{K}$ and $126 \text{ W/m}\cdot\text{K}$ respectively. They have the same surface area and same thickness. They are placed in contact along their surfaces. If the temperatures of the outer surfaces of A and B are kept at 100°C and 0°C respectively, then the temperature of the surface of contact in steady state is _____ $^\circ\text{C}$.

53. In the circuit shown below, the energy stored in the capacitor is $3 \mu\text{J}$. The value of n is _____.



54. A light rope is wound around a hollow cylinder of mass 5 kg and radius 70 cm. The rope is pulled with a force of 52.5 N. The angular acceleration of the cylinder will be _____ rad/s^2

55. A straight wire AB of mass 40 g and length 50 cm is suspended by a pair of flexible leads in uniform magnetic field of magnitude 0.40 T. The magnitude of the current required in the wire to remove the tension in the supporting leads is _____ A. (Take $g = 10 \text{ m/s}^2$)

56. An insulated copper wire of 100 turns is wrapped around a wooden cylindrical core of the cross-sectional area 24 cm^2 . The two ends of the wire are connected to a resistor. The total resistance in the circuit is 12Ω . If an externally applied uniform magnetic field

is directed in the core along its axis changes from 1.5 T in the opposite direction to 1.5 T in the same direction, the charge flowing through a point in the circuit during the change of magnetic field is _____ mC.

57. A bi convex lens of focal length 10 cm is cut in two identical parts along a plane perpendicular to the principal axis. The power of each lens after cut is _____ D.

58. Three point charges $q = -2q$ and $2q$ are placed on x-axis at a distance $x = 0$, $x = \frac{2}{3}R$ and $x = R$ respectively from origin as shown. If $q = 2 \times 10^{-4} C$ and $R = 2$ cm, the magnitude of net force experienced by the charge $-2q$ is _____ N.

59. An atom absorbs a photon of wavelength 500 nm and emits another photon of wavelength 600 nm. The net energy absorbed by the atom in this process is 3×10^{-4} eV. The value of h is _____.

60. A car accelerates from rest to 2 m/s. The energy spent in this process is E_1 . The energy required to accelerate the car from 1 m/s to 2 m/s is E_2 . The value of E_1 is _____.
