

JEE-MAIN EXAMINATION – APRIL, 2024

(Held On Thursday 04th April, 2024)

TIME : 3 : 00 PM to 6 : 00 PM

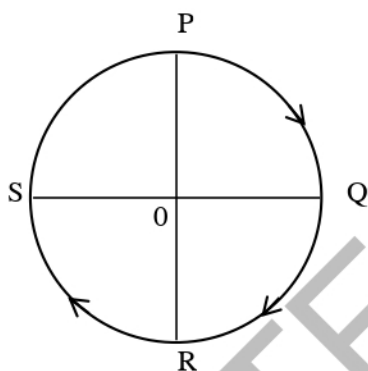
PHYSICS

SECTION-A

31. The translational degrees of freedom (f_t) and rotational degrees of freedom (f_r) of CH_4 molecule are :

- (1) $f_t = 2$ and $f_r = 2$
- (2) $f_t = 3$ and $f_r = 3$
- (3) $f_t = 3$ and $f_r = 2$
- (4) $f_t = 2$ and $f_r = 3$

32. A cyclist starts from the point P of a circular ground of radius 2 km and travels along its circumference to the point S. The displacement of a cyclist is :

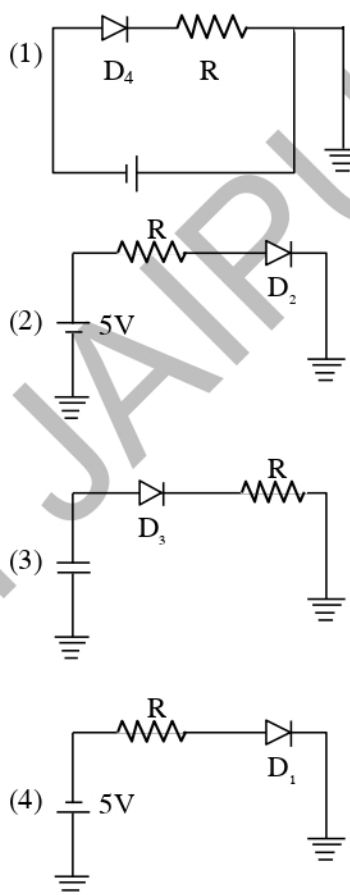


- (1) 6 km
- (2) $\sqrt{8}$ km
- (3) 4 km
- (4) 8 km

33. The magnetic moment of a bar magnet is 0.5 Am^2 . It is suspended in a uniform magnetic field of $8 \times 10^{-2} \text{ T}$. The work done in rotating it from its most stable to most unstable position is :

- (1) $16 \times 10^{-2} \text{ J}$
- (2) $8 \times 10^{-2} \text{ J}$
- (3) $4 \times 10^{-2} \text{ J}$
- (4) Zero

34. Which of the diode circuit shows correct biasing used for the measurement of dynamic resistance of p-n junction diode :



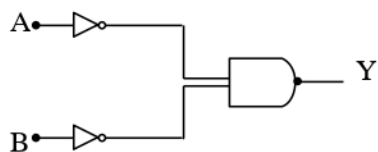
35. Arrange the following in the ascending order of wavelength :

- (A) Gamma rays (λ_1) (B) x-ray (λ_2)
- (C) Infrared waves (λ_3) (D) Microwaves (λ_4)

Choose the most appropriate answer from the options given below :

- (1) $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$ (2) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$
- (3) $\lambda_1 < \lambda_2 < \lambda_3 < \lambda_4$ (4) $\lambda_2 < \lambda_1 < \lambda_4 < \lambda_3$

36. Identify the logic gate given in the circuit :



- (1) NAND - gate
- (2) OR - gate
- (3) AND gate
- (4) NOR gate

37. The width of one of the two slits in a Young's double slit experiment is 4 times that of the other slit. The ratio of the maximum of the minimum intensity in the interference pattern is :

- (1) 9 : 1
- (2) 16 : 1
- (3) 1 : 1
- (4) 4 : 1

38. Correct formula for height of a satellite from earth's surface is :

- (1) $\left(\frac{T^2 R^2 g}{4\pi}\right)^{1/2} - R$
- (2) $\left(\frac{T^2 R^2 g}{4\pi^2}\right)^{1/3} - R$
- (3) $\left(\frac{T^2 R^2}{4\pi^2 g}\right)^{1/3} - R$
- (4) $\left(\frac{T^2 R^2}{4\pi^2}\right)^{-1/3} + R$

39. Match List I with List II

	List-I		List-II
A.	Purely capacitive circuit	I.	
B.	Purely inductive circuit	II.	
C.	LCR series at resonance	III.	
D.	LCR series circuit	IV.	

Choose the correct answer from the options given below :

- (1) A-I, B-IV, C-III, D-II
- (2) A-IV, B-I, C-III, D-II
- (3) A-IV, B-I, C-II, D-III
- (4) A-I, B-IV, C-II, D-III

40. Given below are two statements :

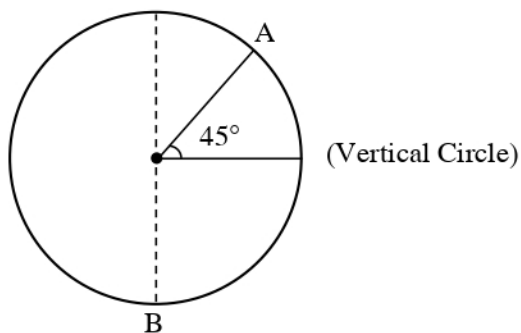
Statement I : The contact angle between a solid and a liquid is a property of the material of the solid and liquid as well.

Statement II : The rise of a liquid in a capillary tube does not depend on the inner radius of the tube.

In the light of the above statements, choose the correct answer from the options given below :

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

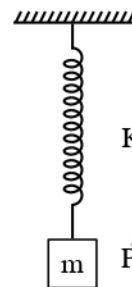
41. A body of m kg slides from rest along the curve of vertical circle from point A to B in friction less path. The velocity of the body at B is :



(given, $R = 14$ m, $g = 10 \text{ m/s}^2$ and $\sqrt{2} = 1.4$)

- (1) 19.8 m/s
(2) 21.9 m/s
(3) 16.7 m/s
(4) 10.6 m/s
42. An electric bulb rated 50 W – 200 V is connected across a 100 V supply. The power dissipation of the bulb is :
- (1) 12.5 W
(2) 25 W
(3) 50 W
(4) 100 W
43. A 2 kg brick begins to slide over a surface which is inclined at an angle of 45° with respect to horizontal axis. The co-efficient of static friction between their surfaces is :
- (1) 1
(2) $\frac{1}{\sqrt{3}}$
(3) 0.5
(4) 1.7

44. In simple harmonic motion, the total mechanical energy of given system is E . If mass of oscillating particle P is doubled then the new energy of the system for same amplitude is :



- (1) $\frac{E}{\sqrt{2}}$ (2) E
(3) $E\sqrt{2}$ (4) $2E$
45. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A : Number of photons increases with increase in frequency of light.
Reason R : Maximum kinetic energy of emitted electrons increases with the frequency of incident radiation.
- In the light of the above statements, choose the **most appropriate** answer from the options given below :
- (1) Both **A** and **R** are correct and **R** is **NOT** the correct explanation of **A**.
(2) **A** is correct but **R** is not correct.
(3) Both **A** and **R** are correct and **R** is the correct explanation of **A**.
(4) **A** is not correct but **R** is correct.
46. According to Bohr's theory, the moment of momentum of an electron revolving in 4^{th} orbit of hydrogen atom is :
- (1) $8\frac{h}{\pi}$ (2) $\frac{h}{\pi}$
(3) $2\frac{h}{\pi}$ (4) $\frac{h}{2\pi}$

47. A sample of gas at temperature T is adiabatically expanded to double its volume. Adiabatic constant for the gas is $\gamma = 3/2$. The work done by the gas in the process is : ($\mu = 1$ mole)
- (1) $RT[\sqrt{2} - 2]$
 - (2) $RT[1 - 2\sqrt{2}]$
 - (3) $RT[2\sqrt{2} - 1]$
 - (4) $RT[2 - \sqrt{2}]$
48. A charge q is placed at the center of one of the surface of a cube. The flux linked with the cube is :-
- (1) $\frac{q}{4\epsilon_0}$
 - (2) $\frac{q}{2\epsilon_0}$
 - (3) $\frac{q}{8\epsilon_0}$
 - (4) Zero
49. Applying the principle of homogeneity of dimensions, determine which one is correct. where T is time period, G is gravitational constant, M is mass, r is radius of orbit.
- (1) $T^2 = \frac{4\pi^2 r}{GM^2}$
 - (2) $T^2 = 4\pi^2 r^3$
 - (3) $T^2 = \frac{4\pi^2 r^3}{GM}$
 - (4) $T^2 = \frac{4\pi^2 r^2}{GM}$
50. A 90 kg body placed at $2R$ distance from surface of earth experiences gravitational pull of : (R = Radius of earth, $g = 10 \text{ ms}^{-2}$)
- (1) 300 N
 - (2) 225 N
 - (3) 120 N
 - (4) 100 N
51. The displacement of a particle executing SHM is given by $x = 10 \sin\left(\omega t + \frac{\pi}{3}\right) \text{ m}$. The time period of motion is 3.14 s. The velocity of the particle at $t = 0$ is _____ m/s.
52. A bus moving along a straight highway with speed of 72 km/h is brought to halt within 4s after applying the brakes. The distance travelled by the bus during this time (Assume the retardation is uniform) is _____ m.
53. A parallel plate capacitor of capacitance 12.5 pF is charged by a battery connected between its plates to potential difference of 12.0 V. The battery is now disconnected and a dielectric slab ($\epsilon_r = 6$) is inserted between the plates. The change in its potential energy after inserting the dielectric slab is _____ $\times 10^{-12} \text{ J}$.
54. In a system two particles of masses $m_1 = 3\text{kg}$ and $m_2 = 2\text{kg}$ are placed at certain distance from each other. The particle of mass m_1 is moved towards the center of mass of the system through a distance 2cm. In order to keep the center of mass of the system at the original position, the particle of mass m_2 should move towards the center of mass by the distance ____ cm.
55. The disintegration energy Q for the nuclear fission of $^{235}\text{U} \rightarrow ^{140}\text{Ce} + ^{94}\text{Zr} + n$ is ____ MeV. Given atomic masses of $^{235}\text{U} : 235.0439\text{u}$, $^{140}\text{Ce} : 139.9054\text{u}$, $^{94}\text{Zr} : 93.9063\text{u}$; $n : 1.0086\text{u}$, Value of $c^2 = 931 \text{ MeV/u}$.

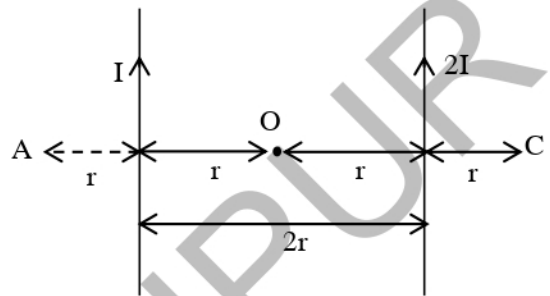
56. A light ray is incident on a glass slab of thickness $4\sqrt{3}$ cm and refractive index $\sqrt{2}$. The angle of incidence is equal to the critical angle for the glass slab with air. The lateral displacement of ray after passing through glass slab is ____ cm.

(Given $\sin 15^\circ = 0.25$)

57. A rod of length 60 cm rotates with a uniform angular velocity 20 rad s^{-1} about its perpendicular bisector, in a uniform magnetic field 0.5 T. The direction of magnetic field is parallel to the axis of rotation. The potential difference between the two ends of the rod is ____ V.

58. Two wires A and B are made up of the same material and have the same mass. Wire A has radius of 2.0 mm and wire B has radius of 4.0 mm. The resistance of wire B is 2Ω . The resistance of wire A is ____ Ω .

59. Two parallel long current carrying wire separated by a distance $2r$ are shown in the figure. The ratio of magnetic field at A to the magnetic field produced at C is $\frac{x}{7}$. The value of x is ____.



60. Mercury is filled in a tube of radius 2 cm up to a height of 30 cm. The force exerted by mercury on the bottom of the tube is ____ N.

(Given, atmospheric pressure = 10^5 Nm^{-2} , density of mercury = $1.36 \times 10^4 \text{ kg m}^{-3}$, $g = 10 \text{ ms}^{-2}$, $\pi = \frac{22}{7}$)