FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Thursday 04th April, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

PHYSICS

TEST PAPER WITH ANSWER

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 $f_r = 2$

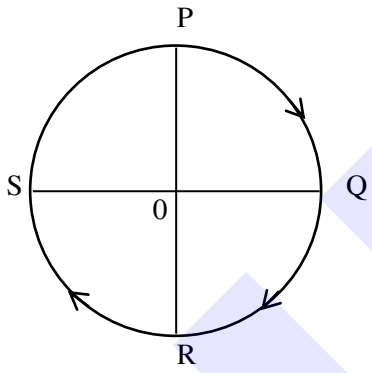
(2) $f_t = 3$ and $f_r = 3$

(3) $f_t = 3$ and $f_r = 2$

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

Ans. (2)

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

Ans. (2)

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

(1) 16×10^{-2} J

(2) 8×10^{-2} J

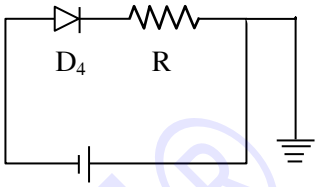
(3) 4×10^{-2} J

(4) Zero

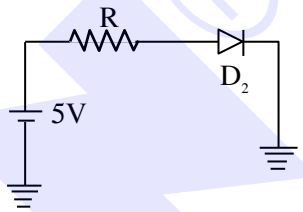
Ans. (2)

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

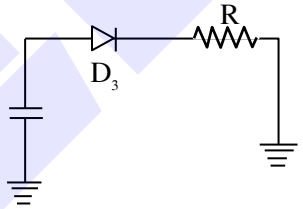
(1)



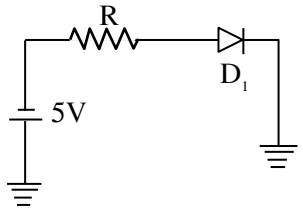
(2)



(3)



(4)



Ans. (2)

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)

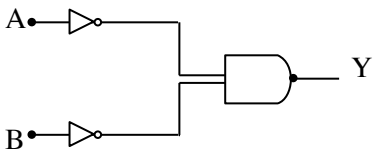
Choose the most appropriate answer from the options given below :

(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) $\lambda_2 < \lambda_1 < \lambda_4 < \lambda_3$

Ans. (3)

36. Identify the logic gate given in the circuit :



(1) NAND - gate

(2) OR - gate

(3) AND gate

(4) NOR gate

Ans. (2)

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

Ans. (1)

38. Correct formula for height of a satellite from earths surface is :

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

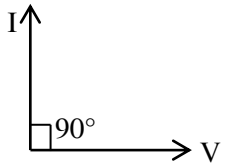
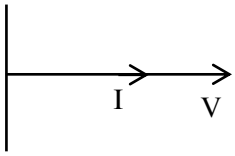
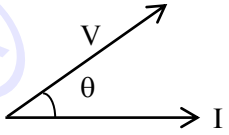
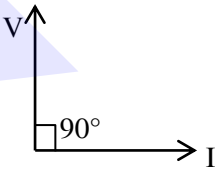
(2) $\left(\frac{T^2R^2g}{4\pi^2}\right)^{1/3} - R$

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

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

Ans. (2)

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

Ans. (4)

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

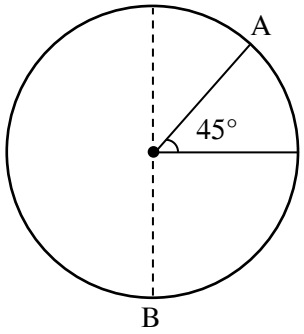
(2) Statement I is false but Statement II is true.

(3) Statement I is true but Statement II is false.

(4) Both Statement I and Statement II are true.

Ans. (3)

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 :



(Vertical Circle)

(given, R = 14 m, g = 10 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

Ans. (2)

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

Ans. (1)

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

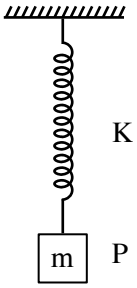
(2) $\frac{1}{\sqrt{3}}$

(3) 0.5

(4) 1.7

Ans. (1)

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

Ans. (2)

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.

Ans. (4)

46. According to Bohr's theory, the moment of momentum of an electron revolving in 4th orbit of hydrogen atom is :

(1) $8\frac{h}{\pi}$ (2) $\frac{h}{\pi}$

(3) $2\frac{h}{\pi}$ (4) $\frac{h}{2\pi}$

Ans. (3)

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 : (μ = 1 mole)

(1) $RT\left[\sqrt{2}-2\right]$

(2) $RT\left[1-2\sqrt{2}\right]$

(3) $RT\left[2\sqrt{2}-1\right]$

(4) $RT\left[2-\sqrt{2}\right]$

Ans. (4)

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) $\frac{q}{4\in_0}$ (2) $\frac{q}{2\in_0}$

(3) $\frac{q}{8\in_0}$ (4) Zero

Ans. (2)

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) $T^2=\frac{4\pi^2 r^2}{GM}$

Ans. (3)

50. A 90 kg body placed at 2R distance from surface of earth experiences gravitational pull of :
(R = Radius of earth, g = 10 ms^{-2})

(1) 300 N (2) 225 N

(3) 120 N (4) 100 N

Ans. (4)

SECTION-B

51. The displacement of a particle executing SHM is given by $x = 10\sin\left(\omega t+\frac{\pi}{3}\right)m$. The time period of motion is 3.14 s. The velocity of the particle at t = 0 is _____ m/s.

Ans. (10)

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.

Ans. (40)

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 ($\in_r$ = 6) is inserted between the plates. The change in its potential energy after inserting the dielectric slab is _____$\times 10^{-12}$ J.

Ans. (750)

54. In a system two particles of masses m_1 = 3kg and m_2 = 2kg 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.

Ans. (3)

55. The disintegration energy Q for the nuclear fission of $^{235}U \rightarrow {}^{140}Ce + {}^{94}Zr + n$ is ____MeV.
Given atomic masses of

$^{235}U : 235.0439u; {}^{140}Ce; 139.9054u$,

$^{94}Zr : 93.9063u; n : 1.0086u$,

Value of c^2 = 931 MeV/u.

Ans. (208)

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° = 0.25)

Ans. (2)

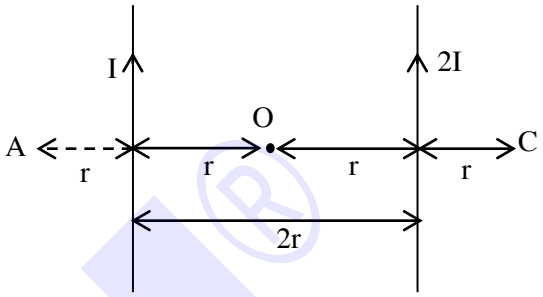
57. A rod of length 60 cm rotates with a uniform angular velocity 20 rad s^{-1} about its perpendicular bisector, in a uniform magnetic field 0.5 T. The direction of magnetic field is parallel to the axis of rotation. The potential difference between the two ends of the rod is ____V.

Ans. (0)

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.

Ans. (32)

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 ___.



Ans. (5)

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 = 1.36×10^4 kg m^{-3}, g = 10 ms^{-2}, $\pi = \frac{22}{7}$)

Ans. (177)