FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Tuseday 09th April, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

PHYSICS

SECTION-A

31. A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio of 2:1. After disintegration they will move :-

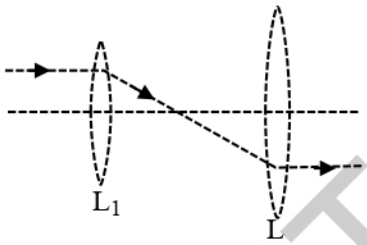
(1) In opposite directions with speed in the ratio of 1:2 respectively

(2) In opposite directions with speed in the ratio of 2:1 respectively

(3) In the same direction with same speed.

(4) In opposite directions with the same speed.

32. The following figure represents two biconvex lenses L_1 and L_2 having focal length 10 cm and 15 cm respectively. The distance between L_1 & L_2 is :



(1) 10 cm (2) 15 cm

(3) 25 cm (4) 35 cm

33. The temperature of a gas is –78° C and the average translational kinetic energy of its molecules is K. The temperature at which the average translational kinetic energy of the molecules of the same gas becomes 2K is :

(1) –39°C (2) 117°C

(3) 127°C (4) –78°C

34. A hydrogen atom in ground state is given an energy of 10.2 eV. How many spectral lines will be emitted due to transition of electrons ?

(1) 6 (2) 3

(3) 10 (4) 1

35. The magnetic field in a plane electromagnetic wave is $B_y = (3.5 \times 10^{-7}) \sin (1.5 \times 10^3 x + 0.5 \times 10^{11} t)T$. The corresponding electric field will be

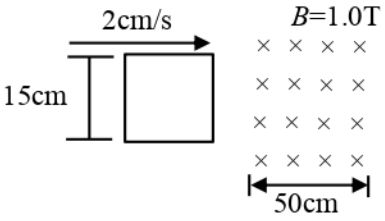
(1) $E_y = 1.17 \sin (1.5 \times 10^3 x + 0.5 \times 10^{11} t) Vm^{-1}$

(2) $E_z = 105 \sin (1.5 \times 10^3 x + 0.5 \times 10^{11} t) Vm^{-1}$

(3) $E_z = 1.17 \sin (1.5 \times 10^3 x + 0.5 \times 10^{11} t) Vm^{-1}$

(4) $E_y = 10.5 \sin (1.5 \times 10^3 x + 0.5 \times 10^{11} t) Vm^{-1}$

36. A square loop of side 15 cm being moved towards right at a constant speed of 2 cm/s as shown in figure. The front edge enters the 50 cm wide magnetic field at t = 0. The value of induced emf in the loop at t = 10 s will be :



(1) 0.3 *m*V (2) 4.5 *m*V

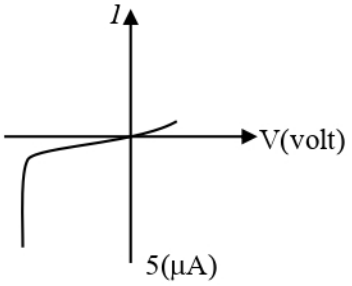
(3) zero (4) 3 *m*V

37. Two cars are travelling towards each other at speed of 20 m s^{-1} each. When the cars are 300 m apart, both the drivers apply brakes and the cars retard at the rate of 2 m s^{-2} . The distance between them when they come to rest is :

(1) 200 m (2) 50 m

(3) 100 m (4) 25 m

38. The *I-V* characteristics of an electronic device shown in the figure. The device is :



(1) a solar cell

(2) a transistor which can be used as an amplifier

(3) a zener diode which can be used as voltage regulator

(4) a diode which can be used as a rectifier

39. The excess pressure inside a soap bubble is thrice the excess pressure inside a second soap bubble. The ratio between the volume of the first and the second bubble is :

(1) 1 : 9 (2) 1 : 3

(3) 1 : 81 (4) 1 : 27

40. The de-Broglie wavelength associated with a particle of mass m and energy E is $h/\sqrt{2mE}$. The dimensional formula for Planck's constant is :

(1) $[ML^{-1}T^{-2}]$ (2) $[ML^{2}T^{-1}]$

(3) $[MLT^{-2}]$ (4) $[M^{2}L^{2}T^{-2}]$

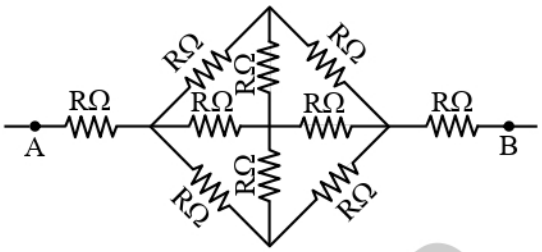
41. A satellite of 10^3 kg mass is revolving in circular orbit of radius 2R. If $\frac{10^4 R}{6} J$ energy is supplied to the satellite, it would revolve in a new circular orbit of radius :

(use g = 10m/s^2, R = radius of earth)

(1) 2.5 R (2) 3 R

(3) 4 R (4) 6 R

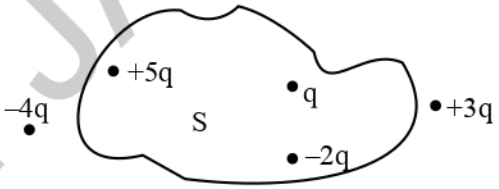
42. The effective resistance between A and B, if resistance of each resistor is R, will be



(1) $\frac{2}{3}R$ (2) $\frac{8R}{3}$

(3) $\frac{5R}{3}$ (4) $\frac{4R}{3}$

43. Five charges +q, +5q, –2q, +3q and –4q are situated as shown in the figure. The electric flux due to this configuration through the surface S is :



(1) $\frac{5q}{\epsilon_0}$ (2) $\frac{4q}{\epsilon_0}$

(3) $\frac{3q}{\epsilon_0}$ (4) $\frac{q}{\epsilon_0}$

44. A proton and a deutron (q= +e, m = 2.0u) having same kinetic energies enter a region of uniform magnetic field $\vec{B}$, moving perpendicular to $\vec{B}$. The ratio of the radius r_d of deutron path to the radius r_p of the proton path is :

(1) 1 : 1 (2) $1:\sqrt{2}$

(3) $\sqrt{2}:1$ (4) 1 : 2

45. UV light of 4.13 eV is incident on a photosensitive metal surface having work function 3.13 eV. The maximum kinetic energy of ejected photoelectrons will be :

(1) 4.13 eV (2) 1 eV

(3) 3.13 eV (4) 7.26 eV

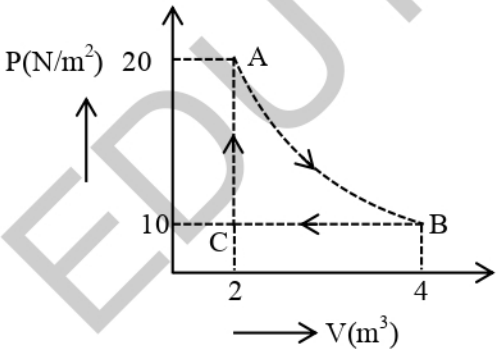
46. The energy released in the fusion of 2 kg of hydrogen deep in the sun is E_H and the energy released in the fission of 2 kg of ^{235}U is E_U. The ratio $\frac{E_H}{E_U}$ is approximately :

(Consider the fusion reaction as $4_1^1H + 2e^- \rightarrow {}_2^4He + 2v + 6\gamma + 26.7\,MeV$, energy released in the fission reaction of ^{235}U is 200 *MeV* per fission nucleus and $N_A = 6.023\times10^{23}$)

(1) 9.13 (2) 15.04

(3) 7.62 (4) 25.6

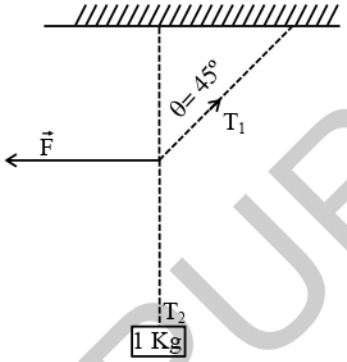
47. A real gas within a closed chamber at 27°C undergoes the cyclic process as shown in figure. The gas obeys $PV^3 = RT$ equation for the path *A* to *B* . The net work done in the complete cycle is (assuming *R* = 8J/molK):



(1) 225 *J* (2) 205 *J*

(3) 20 *J* (4) –20 *J*

48. A 1 kg mass is suspended from the ceiling by a rope of length 4m. A horizontal force 'F' is applied at the mid point of the rope so that the rope makes an angle of 45° with respect to the vertical axis as shown in figure. The magnitude of F is :



(1) $\frac{10}{\sqrt{2}}$ N (2) 1 N

(3) $\frac{1}{10\times\sqrt{2}}$ N (4) 10 N

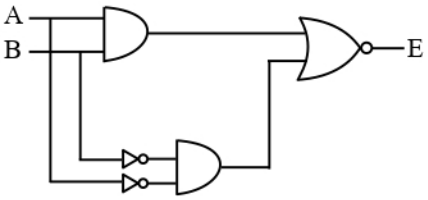
49. A spherical ball of radius 1×10^{-4} m and density 10^5 kg/m^3 falls freely under gravity through a distance *h* before entering a tank of water, If after entering in water the velocity of the ball does not change, then the value of *h* is approximately :

(The coefficient of viscosity of water is 9.8×10^{-6} N s/m^2**)**

(1) 2296 m (2) 2249 m

(3) 2518 m (4) 2396 m

50.



A	B	E
0	0	0
0	1	X
1	0	Y
1	1	0

In the truth table of the above circuit the value of X and Y are :

(1) 1, 1 (2) 1, 0

(3) 0, 1 (4) 0, 0

SECTION-B

51. A straight magnetic strip has a magnetic moment of 44 Am^2. If the strip is bent in a semicircular shape, its magnetic moment will be ……. Am^2.

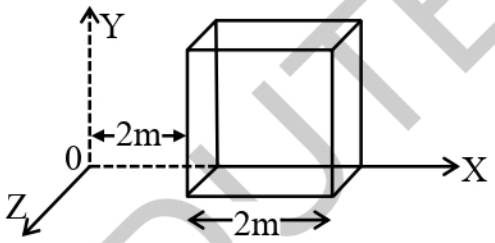
(Given $\pi = \frac{22}{7}$)

52. A particle of mass 0.50 kg executes simple harmonic motion under force $F = -50(Nm^{-1})x$. The time period of oscillation is $\frac{x}{35}s$. The value of x is ……..

(Given $\pi = \frac{22}{7}$)

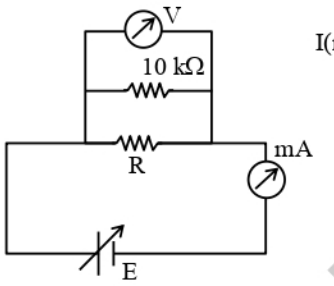
53. A capacitor of reactance $4\sqrt{3}\Omega$ and a resistor of resistance 4Ω are connected in series with an ac source of peak value $8\sqrt{2}V$. The power dissipation in the circuit is ……..W.

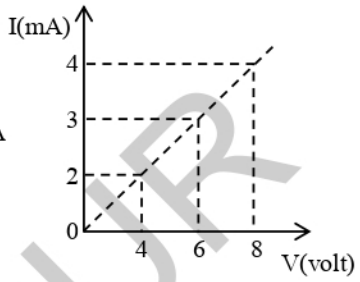
54. An electric field $\vec{E} = (2x\hat{i})NC^{-1}$ exists in space. A cube of side 2m is placed in the space as per figure given below. The electric flux through the cube is …… Nm^2/C.



55. A circular disc reaches from top to bottom of an inclined plane of length *l*. When it slips down the plane, if takes t s. When it rolls down the plane then it takes $\left(\frac{\alpha}{2}\right)^{1/2}$ t s, where α is …….

56. To determine the resistance (R) of a wire, a circuit is designed below, The V-I characteristic curve for this circuit is plotted for the voltmeter and the ammeter readings as shown in figure. The value of R is …… Ω.





57. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is ……

58. Monochromatic light of wavelength 500 nm is used in Young's double slit experiment. An interference pattern is obtained on a screen When one of the slits is covered with a very thin glass plate (refractive index = 1.5), the central maximum is shifted to a position previously occupied by the 4^{th} bright fringe. The thickness of the glass-plate is ……μm.

59. A force $(3x^2 + 2x - 5)$ N displaces a body from x = 2 m to x = 4m. Work done by this force is ……J.

60. At room temperature (27ºC), the resistance of a heating element is 50Ω. The temperature coefficient of the material is 2.4×10^{-4} $ºC^{-1}$. The temperature of the element, when its resistance is 62 Ω, is …… ºC.