JEE Main January 2025

Question Paper With Text Solution

23 January | Shift-2

PHYSICS

SECTION – A

26. Two point charges $-4\mu C$ and $4\mu C$, constituting an electric dipole, are placed at (-9,0,0) cm and (9,0,0) cm in a uniform electric field of strength $10^4\ NC^{-1}$. The work done on the dipole in rotating it from the equilibrium through 180° is :

    (1) 14.4 mJ   (2) 16.4 mJ   (3) 18.4 mJ   (4) 15.4 mJ

Question ID : 656445411

Ans. Official answer NTA (1)

Sol.

27. A massless spring gets elongated by amount x_1 under a tension of 5N. Its elongatino is x_2 under the tension of 7 N. For the elongation of $(5x_1 - 2x_2)$,the tension in the spring will be,

    (1) 15 N   (2) 20 N   (3) 39 N   (4) 11 N

Question ID : 656445406

Ans. Official answer NTA (4)

Sol.

28. Water flows in a horizontal pipe whose one end is closed with a valve. The reading of the pressure gauge attached to the pipe is P_1. The reading of the pressure gauge falls to P_2 when the valve is opened. The speed of water flowing in the pipe is proportional to

    (1) $P_1 - P_2$ (2) $\sqrt{P_1 - P_2}$ (3) $\left(P_1 - P_2\right)^4$ (4) $\left(P_1 - P_2\right)^2$

Question ID : 656445407

Ans. Official answer NTA (2)

Sol.

29. Water of mass m gram is slowly heated to increase the temperature from T_1 to T_2. The change in entropy of the water, given specific heat of water is 1 $Jkg^{-1}K^{-1}$, is :

    (1) $m\left(T_2 - T_1\right)$ (2) $m\ln\left(\dfrac{T_1}{T_2}\right)$ (3) zero   (4) $m\ln\left(\dfrac{T_2}{T_1}\right)$

Question ID : 656445409

Ans. Official answer NTA (4)

Sol.

30. If a satellite orbiting the Earth is 9 times closer to the Earth than the Moon, what is the time period of rotation of the satellite? Given rotational time period of Moon =27 days and gravitational attraction between the satellite and the moon is neglected.
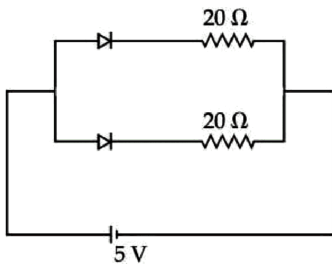
(1) 27 days   (2) 81 days   (3) 1day   (4) 3 days

Question ID : 656445405

Ans.   Official answer NTA (3)

Sol.

31. What is the current through the battery inthe circuit shown below ?

(1) 1.0 A   (2) 0.25 A   (3) 0.5 A   (4) 1.5 A

Question ID : 656445420

Ans.   Official answer NTA (3)

Sol.

32. A concave mirror of focal length f in air is dipped ina liquid of refractive index μ. Its focal length in the liquid will be:

(1) μf (2) $\dfrac{f}{\mu}$ (3) $\dfrac{f}{(\mu-1)}$ (4) f

Question ID : 656445417

Ans.   Official answer NTA (4)

Sol.

33. A ball having kinetic energy KE, is projected at an angle of 60° from the horizontal. What will be the kinetic energy of ball at the highest point of its flight ?

(1) $\dfrac{(KE)}{16}$ (2) $\dfrac{(KE)}{8}$ (3) $\dfrac{(KE)}{2}$ (4) $\dfrac{(KE)}{4}$

Question ID : 656445403

Ans.   Official answer NTA (4)

Sol.

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34. 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 found to be practically independent of the atomic number A, for nuclei with mass numbers between 30 and 170.

    Reason (R): Nuclear force is long range.

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

    (1) (A) is true but (R) is false

    (2) Both (A) and (R) are true and (R) is the correct explanation of (A)

    (3) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

    (4) (A) is false but (R) is true

Question ID : 656445419

Ans. Official answer NTA (1)

Sol.

35.   Match List - I with List - II.

List - I   List - II

(A) Permeability of free space   (I) $[ML^2T^{-2}]$

(B) Magnetic field   (II) $[MT^{-2}A^{-1}]$

(C) Magnetic moment   (III) $[L^2A]$

(D) Torsional constant &   (IV) $[L^2A]$

Choose the correct answer from the options given below :

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

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

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

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

Question ID 656445401

Ans.

Ans. Official answer NTA (1)

36. The energy of a system is given as $E(t) = \alpha^3 e^{-\beta t}$, where t is the time and $\beta = 0.3s^{-1}$. The errors in the measurement of α and t are 1.2% and 1.6 %, respectively. At t=5 s, maximum percentage error in the energy is :

(1) 4%   (2) 6%   (3) 8.4%   (4) 11.6%

Question ID 656445402

Ans. Official answer NTA (2)

Sol.

37. Two charges $7\mu c$ and $-4\mu c$ are placed at $(-7\,cm, 0, 0)$ and $(7\,cm, 0, 0)$ respectively. Given, $\epsilon_0 = 8.85 \times 10^{-12}\,C^2\,N^{-1}\,m^{-2}$, the electrostatic potential energy of the charge configuration is :

(1) -2.0 J   (2) -1.8 J   (3) -1.5 J   (4) -1.5

Question ID :

Ans. Official answer NTA (2)

Sol.

38. n photoelectric effect an em-wave is incident on a metal surface and electrons are ejected from the surface. If the work function of the metal is 2.14 eV and stopping potential is 2 V , what is the wavelength of the em-wave ?

(Given hc =1242 eVnm where h is the Planck's constant and c is the speed of light in vaccum.)

(1) 200 nm   (2) 300 nm   (3) 600 nm   (4) 400 nm

Question ID :656445418

Ans. Official answer NTA (2)

Sol.

39. A galvanometer having a coil of resistance 30Ω need 20 mA of current for full-scale deflection. If a maximum current of 3 A is to be measured using this galvanometer, the resistance of the shunt to be added to the galvanometer should be $\frac{30}{X}\Omega$, where X is

(1) 149   (2) 447   (3) 596   (4) 298

Question ID 656445412

Ans. Official answer NTA (1)

Sol.

40. The equation of a transverse wave travelling along a string is $y(x, t) = 4.0\sin\left[20 \times 10^{-3} x + 600t\right] mm$, where x is in mm and t is in second. The velocity of the wave is :

(1) $+60$ m/s   (2) -60 m/s   (3) -30 m/s   (4) $+30$ m/s

Question ID 656445410

Ans. Official answer NTA (3)

Sol.

41. A plane electromagnetic wave of frequency 20 MHz travels in free space along the + x direction. At a particular point in space and time, the electric field vector of the wave is $E_y = 9.3 \, Vm^{-1}$. Then, the magnetic field vector of the wave at that point is

    (1) $B_z = 1.55 \times 10^{-8} \, T$ (2) $B_z = 3.1 \times 10^{-8} \, T$ (3) $B_z = 6.2 \times 10^{-8} \, T$ (4) $B_z = 9.3 \times 10^{-8} \, T$

Question ID : 656445414

Ans. Official answer NTA (2)

Sol.

42. A circular disk of radius R meter and mass M kg is rotating around the axis perpendicular to the disk. An external torque is applied to the disk such that $\theta(t) = 5t^2 - 8t$, where $\theta(t)$ is the angular position of the rotating disc as a function of time t.

    How much power is delivered by the applied torque, when $t = 2s$?

    (1) $8 \, MR^2$ (2) $60 \, MR^2$ (3) $108 \, MR^2$ (4) $72 \, MR^2$

Question ID 656445404

Ans. Official answer NTA (2)

Sol.

43. The refractive index of the material of a glass prism is $\sqrt{3}$. The angle of minimum deviation is equal to he angle of the prism. What is the angle of them prism?
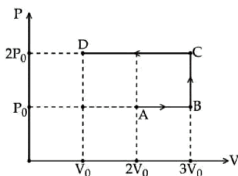
    (1) 58°   (2) 50°   (3) 48°   (4) 60°

Question ID 656445415

Ans. Official answer NTA (4)

Sol.

44.

    Using the given P-V diagram, the work done by an ideal gas along the path ABCD is:

    (1) $4P_0V_0$ (2) $-4 \, P_0V_0$ (3) $3 \, P_0V_0$ (4) $-3 \, P_0V_0$

Question ID : 656445408

Ans. Official answer NTA (4)

Sol.

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45. The width of one of the two slits in Young's double slit experiment is d while that of the other slit is xd. If the ratio of the maximum to the minimum intensity in the interference pattern on the screen is 9: 4 then what is the value of x ?

(Assume that the field strength varies according to the slit width.)
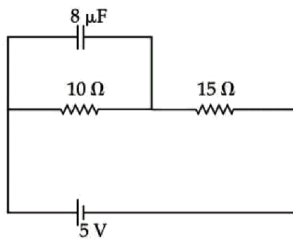
(1) 4   (2) 2   (3) 5   (4) 3

Question ID 656445416

Ans. Official answer NTA (3)

Sol.

SECTION – B

46. At steady state the charge on the capacitor, as shown in the circuit below, is ___ μC .

Question ID 656445425

Ans. Official answer NTA (16)

Sol.

47. In a series LCR circuit, a resistor of 300Ω , a capacitor of 25 nF and an inductor of 100 mH are used. For maximum current in the circuit, the angular frequency of the ac source is___ 10^4 radians s^{-1}.

Question ID 656445424

Ans. Official answer NTA (2)

Sol.

48. An air bubble of radius 1.0 mm is observed at a depth of 20 cm below the free surface of a liquid having surface tension $0.095\,J/m^2$ and density $10^3\,kg/m^3$. The difference between pressure inside the bubble and atmospheric pressure is N/m^2 .(Take g = 10 m/s²)

Question ID :656445422

Ans. Official answer NTA (2190)

Sol.

49. A satellite of mass $\dfrac{M}{2}$ is revolving around earth in a circular orbit at a height of $\dfrac{R}{3}$ from earth surface.

The angular momentum of the satellite is $M\sqrt{\dfrac{GMR}{x}}$. The value of x is _____, where M and R are

the mass and radius of earth, respectively. (G is the gravitational constant)

Question ID 656445421

Ans. Official answer NTA (3)

Sol.

50. A time varying potential difference is applied between the plates of a parallel plate capacitor of capacitance $2.5\mu F$. The dielectric constant of the medium between the capacitor plates is 1. It produces an instantaneous displacement current of 0.25 mA in the intervening space between the capacitor plates, the magnitude of the rate of change of the potential difference will be____ Vs^{-1}.

Question ID 656445423

Ans. Official answer NTA (100)

Sol.