JEE Main January 2024

Question Paper With Text Solution

29 January | Shift-1

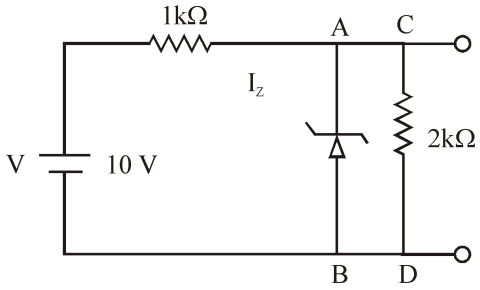
PHYSICS

MATRIX

JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

1. In the given circuit, the breakdown voltage of the Zener diode is 3.0 V. What is the value of Iz ?



(1) 7 mA (2) 5.5 mA (3) 10 mA (4) 3.3 mA

Question ID: 405859882

Ans. Official Answer NTA (2)

Sol.

2. A biconvex lens of refractive index 1.5 has a focal length of 20 cm in air. Its focal length when immersed in a liquid of refractive index 1.6 will be:

(1) + 160 cm (2) – 160 cm (3) + 16 cm (4) – 16 cm

Question ID: 405859879

Ans. Official Answer NTA (2)

Sol.

3. Match List I with List II

List I	List II
A. $\oint \vec{B}.\vec{dl} = \mu_0 i_c + \mu_0 \in_0 \frac{d\phi_E}{dt}$	I. Gauss' law for electricity
B. $\oint \vec{E}.\vec{dl} = \frac{d\phi_B}{dt}$	II. Gauss' law for magnetism
C. $\oint \vec{E}.\vec{dA} = \frac{Q}{\in_0}$	III. Faraday law
D. $\oint \vec{B}.\vec{dA} = 0$	IV. Ampere - Maxwell law

Choose the correct answer from the options given below:

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

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

Question ID: 405859878

Ans. Official Answer NTA (2)

Sol.

4. Two vessels A and B are of the same size and are at same temperature. A contains 1 g of hydrogen and B contains 1 g of oxygen. P_A and P_B are the pressures of the gases in A and B respectively, then $\frac{P_A}{P_B}$ is:

(1) 32 (2) 16 (3) 4 (4) 8

Question ID:405859873

Ans. Official Answer NTA (2)

Sol.

5. At what distance above and below the surface of the earth a body will have same weight. (take radius of earth as R)

(1) $\frac{R}{2}$ (2) $\sqrt{5}R - R$ (3) $\frac{\sqrt{5}R - R}{2}$ (4) $\frac{\sqrt{3}R - R}{2}$

Question ID:405859870

Ans. Official Answer NTA (3)

Sol.

6. If the radius of curvature of the path of two particles of same mass are in the ratio 3:4, then in order to have constant centripetal force, their velocities will be in the ratio of :

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

Question ID: 405859867

Ans. Official Answer NTA (4)

Sol.

7. A body starts moving from rest with constant acceleration covers displacement S_1 in first $(p-1)$ seconds and S_2 in first p seconds. The displacement $S_1 + S_2$ will be made in time:

(1) $\sqrt{(2p^2 - 2p + 1)}$s (2) $(2p - 1)$ s (3) $(2p + 1)$ s (4) $(2p^2 - 2p + 1)$ s

Question ID: 405859866

Ans. Official Answer NTA (1)

Sol.

38. A convex mirror of radius of curvature 30 cm forms an image that is half the size of the object. The object distance is:

(1) 15 cm (2) – 15 cm (3) – 45 cm (4) 45 cm

Question ID: 405859883

Ans. Official Answer NTA (2)

Sol.

9. A capacitor of capacitance 100 μF is charged to a potential of 12 V and connected to a 6.4 mH inductor to produce oscillations. The maximum current in the circuit would be:

(1) 1.2 A (2) 3.2 A (3) 1.5 A (4) 2.0 A

Question ID:405859877

Ans. Official Answer NTA (3)

Sol.

10. The electric current through a wire varies with time as $I = I_0 + \beta t$, where $I_0 = 20$ A and $\beta = 3$ A/s. The amount of electric charge crossed through a section of the wire in 20 s is:

(1) 800 C (2) 80 C (3) 1600 C (4) 1000 C

Question ID:405859875

Ans. Official Answer NTA (4)

Sol.

11. Given below are two statements:

Statement I: If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in hot water.

Statement II: If a capillary tube is immersed first in cold water and then in hot water, the height of capillary rise will be smaller in cold water.

In the light of the above statements, choose the most appropriate from the options given below:

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

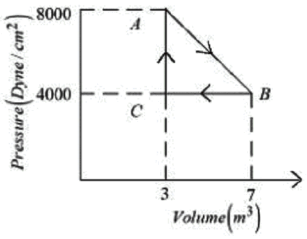
(3) Both Statement I and Statement II are true (4) Statement I is false but Statement II is true

Question ID:405859871

Ans. Official Answer NTA (1)

Sol.

12. A thermodynamic system is taken from an original state A to an intermediate state B by a linear process as shown in the figure. It's volume is then reduced to the original value from B to C by an isobaric process. The total work done by the gas from A to B to C would be:



(1) 2200 J (2) 600 J (3) 33800 J (4) 1200 J

Question ID:405859872

Ans. Answer by Matrix (800)

Sol.

13. A galvanometer having coil resistance 10 Ω shows a full scale deflection for a current of 3 mA. For it to measure a current of 8 A, the value of the shunt should be:

(1) 2.75×10^{-3} Ω (2) 3.75×10^{-3} Ω (3) 3×10^{-3} Ω (4) 4.85×10^{-3} Ω

Question ID:405859876

Ans. Official Answer NTA (2)

Sol.

14. The potential energy function (in J) of a particle in a region of space is given as $U = (2x^2 + 3y^2 + 2z)$. Here x, y and z are in meter. The magnitude of x-component of force (in N) acting on the particle at point P (1, 2, 3) m is:

(1) 2 (2) 6 (3) 4 (4) 8

Question ID:405859869

Ans. Official Answer NTA (3)

Sol.

15. The de-Broglie wavelength of an electron is the same as that of a photon. If velocity of electron is 25% of the velocity of light, then the ratio of K.E. of electron and K.E. of photon will be:

(1) 1/4 (2) 1/8 (3) 8/1 (4) 1/1

Question ID:405859880

Ans. Official Answer NTA (2)

Sol.

16. The deflection in moving coil galvanometer falls from 25 divisions to 5 division when a shunt of 24 Ω is applied. The resistance of galvanometer coil will be:

(1) 12 Ω (2) 48 Ω (3) 100 Ω (4) 96 Ω

Question ID:405859884

Ans. Official Answer NTA (4)

Sol.

17. A block of mass 100 kg slides over a distance of 10 m on a horizontal surface. If the co-efficient of friction between the surfaces is 0.4, then the work done against friction (in J) is:

(1) 4500 (2) 4000 (3) 4200 (4) 3900

Question ID:405859868

Ans. Official Answer NTA (2)

Sol.

18. Two charges of 5Q and –2Q are situated at the points (3a, 0) and (–5a, 0) respectively. The electric flux through a sphere of radius '4a' having center at origin is:

(1) $\frac{2Q}{\epsilon_0}$ (2) $\frac{3Q}{\epsilon_0}$ (3) $\frac{7Q}{\epsilon_0}$ (4) $\frac{5Q}{\epsilon_0}$

Question ID: 405859874

Ans. Official Answer NTA (4)

Sol.

19. The resistance $R = \frac{V}{I}$ where $V = (200 \pm 5)$ V and $I = (20 \pm 0.2)$ A, the percentage error in the measurement of R is:

(1) 7 % (2) 3 % (3) 3.5 % (4) 5.5 %

Question ID:405859865

Ans. Official Answer NTA (3)

Sol.

20. The explosive in a Hydrogen bomb is a mixture of ${}_1H^2$, ${}_1H^3$ and ${}_3Li^6$ in some condensed form. The chain reaction is given by

$${}_3Li^6 + {}_0n^1 \longrightarrow {}_3He^4 + {}_1H^3$$
$${}_1H^2 + {}_1H^3 \longrightarrow {}_2He^4 + {}_0n^1$$

During the explosion the energy released is approximately

[Given: M(Li) = 6.01690 amu, M(${}_1H^2$) = 2.01471 amu, M(${}_2He^4$) = 4.00388 amu, and 1 amu = 931.5 MeV]

(1) 16.48 MeV (2) 28.12 MeV (3) 22.22 MeV (4) 12.64 MeV

Question ID:405859881

Ans. Official Answer NTA (3)

Sol.

21. When a hydrogen atom going from n = 2 to n = 1 emits a photon, its recoil speed is $\frac{x}{5}$ m / s.

Where x = _____. (Use, mass of hydrogen atom = 1.6×10^{-27} kg)

Question ID:405859894

Ans. Official Answer NTA (17)

Sol.

22. A square loop of side 10 cm and resistance 0.7 Ω is placed vertically in east-west plane. A uniform magnetic field of 0.20 T is set up across the plane in north east direction. The magnetic field is decreased to zero in 1 s at a steady rate. Then, magnitude of induced emf is $\sqrt{x} \times 10^{-3}$ V. The value of x is _____.

Question ID:405859892

Ans. Official Answer NTA (2)

Sol.

23. An electron is moving under the influence of the electric field of a uniformly charged infinite plane sheet S having surface charge density +σ. The electron at t = 0 is at a distance of 1 m from S and has a speed of 1 m/s. The maximum value of σ if the electron strikes S at t = 1 s is $\alpha\left[\frac{m\epsilon_0}{e}\right]\frac{C}{m^2}$, the value of α is _____.

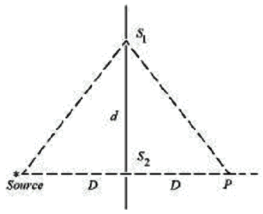
Question ID:405859889

Ans. Official Answer NTA (8)

Sol.

24. In a double slit experiment shown in figure, when light of wavelength 400 nm is used, dark fringe is observed at

P. If D = 0.2 m, the minimum distance between the slits S_1 and S_2 is _____ mm.



Question ID:405859893

Ans. Answer by Matrix (0.2 mm)

Sol.

25. A ball rolls off the top of a stairway with horizontal velocity *u*. The steps are 0.1 m high and 0.1 m wide. The minimum velocity *u* with which that ball just hits the step 5 of the stairway will be $\sqrt{x}$ ms^{-1} where x = _____ [use g = 10 m/s^2].

Question ID:405859885

Ans. Official Answer NTA (2)

Sol.

26. A 16Ω wire is bend to form a square loop. A 9 V battery with internal resistance 1 Ω is connected across one of its sides. If a 4μF capacitor is connected across one of its diagonals, the energy stored by the capacitor will be $\frac{x}{2}\mu J$, where *x* =

Question ID:405859890

Ans. Official Answer NTA (81)

Sol.

27. The magnetic potential due to a magnetic dipole at a point on its axis situated at a distance of 20 cm from its center is 1.5×10^{-5} T m. The magnetic moment of dipole is _____ $A\,m^2$.

(Given : $\frac{\mu_0}{4\pi} = 10^{-7}\ T\ m\ A^{-1}$)

Question ID: 405859891

Ans. Official Answer NTA (6)

Sol.

28. In a test experiment on a model aeroplane in wind tunnel, the flow speeds on the upper and lower surfaces of the wings are 70 ms^{-1} and 65 ms^{-1} respectively. If the wing area is 2 m^2, the lift of the wing is _____ N.

(Given density of air = 1.2 kg m^{-3})

Question ID:405859887

Ans. Official Answer NTA (810)

Sol.

29. When the displacement of a simple harmonic oscillator is one third of its amplitude, the ratio of total energy to the kinetic energy is $\frac{x}{8}$, where x = _____.

Question ID: 405859888

Ans. Official Answer NTA (9)

Sol.

30. A cylinder is rolling down on an inclined plane of inclination 60°. It's acceleration during rolling down will be $\frac{x}{\sqrt{3}} m/s^2$, (use g = 10 m/s^2).

Question ID:405859886

Ans. Official Answer NTA (10)

Sol.