JEE Main January 2024

Question Paper With Text Solution

30 January | Shift-1
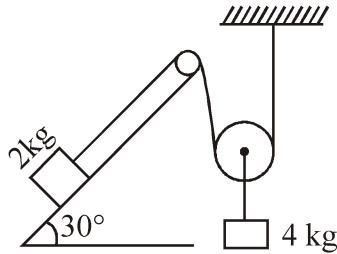
PHYSICS

1. All surfaces shown in figure are assumed to be frictionless and the pulleys and the string are light. The acceleration of the block of mass 2 kg is :

(1) $\dfrac{g}{2}$ (2) $\dfrac{g}{3}$ (3) $\dfrac{g}{4}$ (4) g

Question ID: 533543860

Ans. Official Answer NTA (2)

Sol.

2. The diffraction pattern of a light of wavelength 400 nM diffraction from a slit of width 0.2 mm is focused on the focal plane of a convex lens of focal lenght 100 cm. The width of the 1ˢᵗ secondary maxima will be :
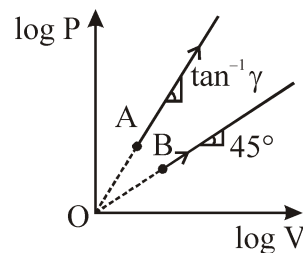
(1) 2 mm (2) 0.2 mm (3) 2 mm (4) 0.02 mm

Question ID: 533543871

Ans. Official Answer NTA (4)

Sol.

3. Two thermodynamical processes are shown in the figure. The molar heat capacity for process A and B are C_A and C_B. The molar heat capacity at constant pressure and constant volume are represented by C_P and C_V, respectively. Choose the correct statement.

(1) $C_A > C_P > C_V$

(2) $C_A > C_V > C_A = C_B$

(3) $C_A = 0$ and $CB = \infty$

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

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(4) CB = ∞, C$_A$ = 0

Question ID: 533543864

Ans.   Official Answer NTA (4)

Sol.

4.   The gravitational potential at a point above the surface of earth is -5.12×10^7 J/kg and the acceleration due to gravity at that point is 6.4 m/s^2. Assume that the mean radius of earth to be 6400 km. The height of this point above the earth's surface is :

(1) 1200 km   (2) 1600 km   (3) 540 km   (4) 1000 km

Question ID: 533543862

Ans.   Official Answer NTA (2)

Sol.

5.   A series LR circuit connected with an ac source E = (25 sin 1000 t) V has a power factor of $\frac{1}{\sqrt{2}}$. If the source of emf is changed to E = (20 sin 2000 t) V, the new power factor of the circuit will be :

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

Question ID: 533543869

Ans.   Official Answer NTA (3)

Sol.

6.   The work function of a substance is 3.0 eV. The longest wavelength of light that can cause the emission of photoelectrons from this substance is approximately ;

(1) 200 nm   (2) 400 nm   (3) 414 nm   (4) 215 nm

Question ID: 533543872

Ans.   Official Answer NTA (2)

Sol.

7.   The electrostatic potential due to an electric dipole at a distance 'r' varies as :

(1) $\frac{1}{r^2}$ (2) r   (3) $\frac{1}{3}$ (4) $\frac{1}{r}$

Question ID: 533543866

Ans.   Official Answer NTA (1)

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

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Sol.

8. The electric field of an electromagnetic wave in free space is represented as $\vec{E} = E_0 \cos(\omega t - kz)\hat{i}$. The corresponding magnetic induction vector will be :

(1) $\vec{B} = \dfrac{E_0}{C}\cos(\omega t - kz)\hat{j}$

(2) $\vec{B} = \dfrac{E_0}{C}\cos(\omega t + kz)\hat{j}$

(3) $\vec{B} = E_0 C \cos(\omega t - kz)\hat{j}$

(4) $\vec{B} = E_0 C \cos(\omega t + kz)\hat{j}$

Question ID: 533543870

Ans. Official Answer NTA (1)

Sol.

9. At which temperature the r.m.s velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C ?

(1) 20 K   (2) –73 K   (3) 4 K   (4) 80 K

Question ID: 533543865

Ans. Official Answer NTA (1)

Sol.

10. Match List - I with List - II

List -I   List - II

(A) Coefficient of viscosity   (I) $[ML^2T^{-2}]$

(B) Surface tension   (II) $[ML^2T^{-1}]$

(C) Angular momentum   (III) $[ML^{-1}T^{-1}]$

(D) Rotational kinetic energy   (IV) $[ML^0T^{-2}]$

Choose the correct answer from the options given below :

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

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

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

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

Question ID: 533543857

Ans. Official Answer NTA (3)

Sol.

11.   An electric toaster has resistance of 60 Ω at room temperature (27° C). The toaster is connected to a 220 V supply. If the current flowing through it reaches 2.75 A, the temperature attained gby toaster is around :

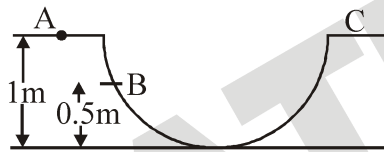(if α = 2 ×10⁻⁴/°C)

(1) 1235 °C   (2) 694 °C   (3) 1694 °C   (4) 1667 °C

Question ID: 533543867

Ans.   Official Answer NTA (3)

Sol.

12.   A particle is placed at the point A of a frictionless track ABC as shown in figure. It is gently pushed towards right. The speed of the particle when it reaches the point B is : (Take g = 10 m/s²)
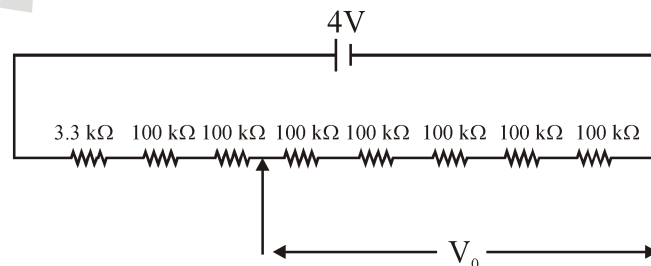

(1) $\sqrt{10}$ m/s   (2) 20 m/s   (3) $2\sqrt{10}$ m/s   (4) 10 m/s

Question ID: 533543861

Ans.   Official Answer NTA (1)

Sol.

13.   A potential divider circuit is shown in figure. The output voltage V_0 is :

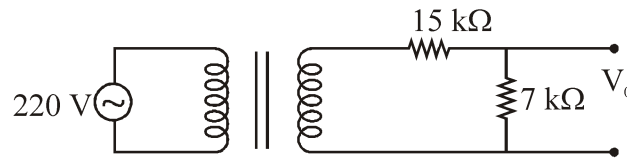(1) 2 mV   (2) 0.5 V   (3) 12 mV   (4) 4 V

Question ID: 533543875

Ans.   Official Answer NTA (2)

Sol.

14.   Primary coil of a transformer is connected to 220 V ac. Primary and secondary turns of the transforms are 100

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

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and 10 respectively. Secondary coil of transformer is connected to two series resistances shown in figure. The output voltatge (V_0) is :

(1) 7 V   (2) 44 V   (3) 22 V   (4) 15 V

Question ID: 533543876

Ans.   Official Answer NTA (1)

Sol.

15.   The ratio of the magnitude of the kinetic energy to the potential energy of an electron in the 5th excited state of a hydrogen atom is :

(1) $\dfrac{1}{4}$ (2) $\dfrac{1}{2}$ (3) 4   (4) 1

Question ID: 533543873

Ans.   Official Answer NTA (2)

Sol.

46.   Young's modules of material of a wire of length 'L' and cross- sectional area A is Y. If the length of the wire is doubled and cros- sectional area is halved then Young's modules will be :

(1) $\dfrac{Y}{4}$ (2) 2Y   (3) Y   (4) 4Y

Question ID: 533543863

Ans.   Official Answer NTA (3)

Sol.

17.   A spherical body of mass 100 g is dropped from a height of 10 m from the ground. After hitting the ground, the body rebounds to a height of 5 m. The impulse of force imparted by the ground to the body is given by : (given, g = 9.8 m/s^2)

(1) 4.32 kg ms^{-1} (2) 23.9 kg ms^{-1} (3) 43.2 kg ms^{-1} (4) 2.39 kg ms^{-1}
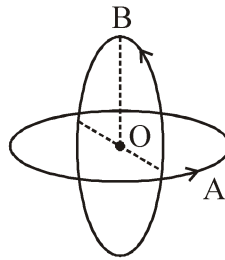
Question ID: 533543859

Ans.   Official Answer NTA (4)

Sol.

18. Two insulated circular loop A and B of radius 'a' carrying a current of 'I' in the anti clockwise direction as shown in the figure. The magnitude of the magnetic induction at the centre will be :

(1) $\dfrac{\sqrt{2}\mu_0 I}{a}$ (2) $\dfrac{\mu_0 I}{\sqrt{2}a}$ (3) $\dfrac{\mu_0 I}{2a}$ (4) $\dfrac{2\mu_0 I}{a}$

Question ID : 533543868

Ans. Official Answer NTA (2)

Sol.

19. A particle of mass m is projected with a velocity 'u' making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is :
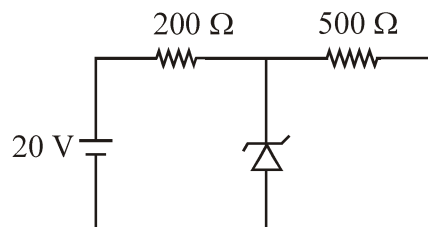
(1) zero   (2) $\dfrac{\sqrt{3}}{16}\dfrac{mu^3}{g}$ (3) $\dfrac{mu^3}{\sqrt{2}\,g}$ (4) $\dfrac{\sqrt{3}}{2}\dfrac{mu^2}{g}$

Question ID : 533543858

Ans. Official Answer NTA (2)

Sol.

50. A Zener diode of breakdown voltage 10 V is used as a voltage regulator as shown in the figure. The current through the Zener diode is :

(1) 30 mA   (2) 0   (3) 50 mA   (4) 20 mA

Question ID : 533543874

Ans.   Official Answer NTA (1)

Sol.

21.   The displacement and the increase in the velocity of a moving particle in the time interval of t to (t + 1) s are 125 m and 50 m/s, respectively. The distance travelled by the particle in $(t + 2)^{th}$ s is _____ m.

Question ID: 533543877

Ans.   Official Answer NTA (175)

Sol.

22.   A ceiling fan having 3 blades of length 80 cm each is rotating with an angular velocity of 1200 rpm. The magnetic field of earth in that region is 0.5 G and angle of dip is 30°. The emf induced across the blades is $N\pi \times 10^{-5} V$. The value of N is _____ .

Question ID: 533543884

Ans.   Official Answer NTA (32)

Sol.

23.   A capacitor of capacitance C and potential V has energy E. It is connected to another capacitor of capacitance 2 C nad potential 2V. Then the loss of energy is $\frac{x}{3}E$, where x is _____ .

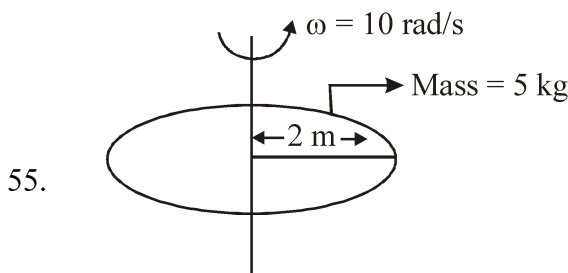Question ID: 533543881

Ans.   Official Answer NTA (2)

Sol.

24.   A electron of hydrogen atom on an excited state is having energy $E_n = -0.85$ eV. The maximum number of allowed transitions to lower energy level is _____ .

Question ID: 533543886

Ans.   Official Answer NTA (3)

Sol.

55.

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

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Consider a Disc of mass 5 kg, radius 2 m, rotating with angular velocity of 10 rad/s about an axis perpendicular to the plane of rotation. An identical disc is kept gently over the rotating disc along the same axis. The energy dissipated so that both the discs continue to rotate together without slipping is _____ J.

Question ID: 533543878

Ans. Official Answer NTA (250)

Sol.

26. In a closed organ pipe, the frequency of fundamental note is 30 Hz. A certain amount of water is now poured in the organ pipe so that tha fundamental frequency is increased to 110 Hz. If the organ pipe has a cross-sectional area of 2 cm^2, the amount of water poured in the organ tube is _____ g. (Take speed of sound in air is 330 m/s)

Question ID: 533543880
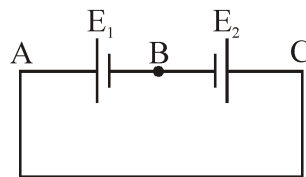
Ans. Official Answer NTA (400)

Sol.

27. The horizontal component of earth's magnetic field at a place is 3.5×10^{-5} T. A very long straight conductor carrying current of $\sqrt{2}A$ in the direction from South east to North West is placed. The force per unit length experienced by the conductor is _____ $\times 10^{-6}$ N/m.

Question ID: 533543883

Ans. Official Answer NTA (35)

Sol.

28. Two cells are connected in opposition as shown. Cell E_1 is of 8 V emf and 2 Ω internal resistance; the cell E_2 is of 2 V emf and 4 Ω internal resistance. The terminal potential difference of cell E_2 is _____ V.
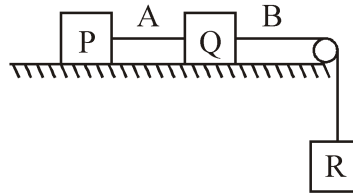

Question ID: 533543882

Ans. Official Answer NTA (6)

Sol.

29. Each of three blocks P, Q and R shown in figure has a mass of 3 kg. Each of the wires A and B has cross-sectional area 0.005 cm^2 and Young's modulus 2×10^{11} N/m^{-2}. Neglecting friction, the longitudinal strain on

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

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wire B is _____ $\times 10^{-4}$. (Take g = 10 m/s^2)

Question ID: 533543879

Ans.   Official Answer NTA (2)

Sol.

30.   The distance between object and its two times magnified real image as produced by a convex lens is 45 cm.

The focal length of the lens used is _____ cm.

Question ID: 533543885

Ans.   Official Answer NTA (10)

Sol.

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Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

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