JEE Main January 2024

Question Paper With Text Solution

30 January | Shift-2

PHYSICS

1. Which a potential difference V is applied a wire of resistance R it dissipates energy at a rate W. If the wire is cut into two halves and these halves are connected mutually parallel across the same supply, the energy dissipation rate will become :

    (1) 1/4 W   (2) 2 W   (3) 1/2 W   (4) 4 W

Question ID: 4058591055

Ans.   Official Answer NTA (4)

Sol.

2. If three moles of monoatomic gas $\left(\gamma = \dfrac{5}{3} \right)$ is mixed with two moles of a diatomic gas $\left(\gamma = \dfrac{7}{5} \right)$, the value of adiabatic exponent γ for the mixture is

    (1) 1.52   (2) 1.35   (3) 1.40   (4) 1.75

Question ID: 4058591053

Ans.   Official Answer NTA (1)

Sol.

3. Projectiles A and B are thrown at angles of 45º and 60º with vertical respectively from top of a 400 m high tower. If their ranges and times of light are same, the ratio of their speeds of projection $v_A : v_B$ is :

    [Take g = 10 ms^{-2}]

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

Question ID: 4058591046

Ans.   Official Answer NTA (Bonus)

Sol.

4. If 50 Vernier divisions are equal to 49 main scale divisions of a traveling microscope and one smallest reading of main scale is 0.5 mm, the Vernier constant of traveling microscope is

    (1) 0.1 cm   (2) 0.01 cm   (3) 0.1 mm   (4) 0.01 mm

Question ID: 4058591064

Ans.   Official Answer NTA (4)

Sol.

5. Match List I with List II

    List I   *List II*

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A. Gauss's law of magnetostatics   I. $\oint \vec{E}.\vec{da} = \dfrac{1}{\varepsilon_0} \int \rho dV$

B. Faraday's law of electro magnetic induction   II. $\oint \vec{B}.\vec{da} = 0$

C. Ampere's law   III. $\oint \vec{E}.\vec{dl} = \dfrac{-d}{dt} \int \vec{B}.\vec{da}$

D. Gauss's law of electrostatics   IV. $\oint \vec{B}.\vec{da} = \mu_0 I$

Choose the correct answer from the options given below :

(1) A-III, B-IV, C-I, D-II   (2) A-I, B-III, C-IV, D-II
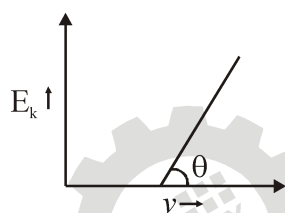
(3) A-IV, B-II, C-III, D-I   (4) A-II, B-III, C-IV, D-I

Question ID: 4058591056

Ans.   Official Answer NTA (4)

Sol.

6.   For the photoelectric effect, the maximum kinetic energy (E_k) of the photoelectrons is plotted against the frequency (v) of the incident photons as shown in figure. The slope of the graph gives

(1) Planck's constant   (2) Ration of Planck's constant to electric charge

(3) Work function of the metal   (4) Charge of electron

Question ID: 4058591060

Ans.   Official Answer NTA (1)

Sol.

7.   If the total energy transfereed to a surface in time t is $6.48 \times 10^5\, J$, then the magnitude of the total momentum delivered to this surface for complete absorption will be :

(1) $2.46 \times 10^{-3}\, kg\, m/s$ (2) $1.58 \times 10^{-3}\, kg\, m/s$ (3) $4.32 \times 10^{-3}\, kg\, m/s$ (4) $2.16 \times 10^{-3}\, kg\, m/s$

Question ID: 4058591058

Ans.   Official Answer NTA (4)

Sol.

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8. A block of mass m is placed on a surface having vertical crossection given by $y = x^2/4$. If coefficient of friction is 0.5, the maximum height above the ground at which block can be placed without slipping is :
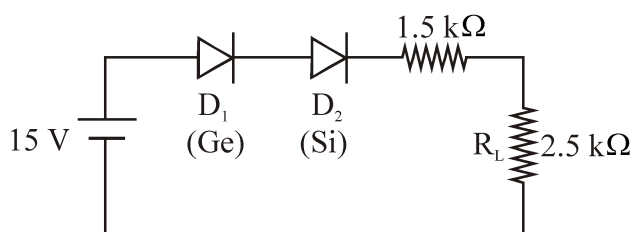
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(1) 1/3 m   (2) 1/4 m   (3) 1/2 m   (4) 1/6 m

Question ID : 4058591048

Ans.   Official Answer NTA (2)

Sol.

9.

15 V, D_1 (Ge), D_2 (Si), 1.5 kΩ, R_L 2.5 kΩ

In the given circuit, the voltage across load resistance (R_L) is :

(1) 14.00 V   (2) 9.00 V   (3) 8.75 V   (4) 8.50 V

Question ID : 4058591063

Ans.   Official Answer NTA (3)

Sol.

10. A beam of unpolarised light of intensity I_o is passed through a polarid B which is oriented so that its principal plane makes an angle of 45° relative to that of A. The intensity of emergent light is :
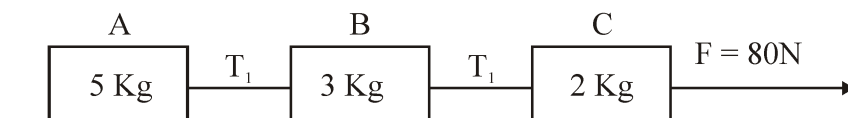
(1) I_o (2) $I_o/4$ (3) $I_o/2$ (4) $I_o/8$

Question ID : 4058591059

Ans.   Official Answer NTA (2)

Sol.

11. Three blocks A, B and C are pulled on a horizontal smooth surface by a force of 80N as shown in figure

A 5 Kg, T_1, B 3 Kg, T_1, C 2 Kg, F = 80N

The tnesions T_1 and T_2 in the string are respectively :

(1) 88N, 96N   (2) 40N, 64N   (3) 60N, 80N   (4) 80N, 100N

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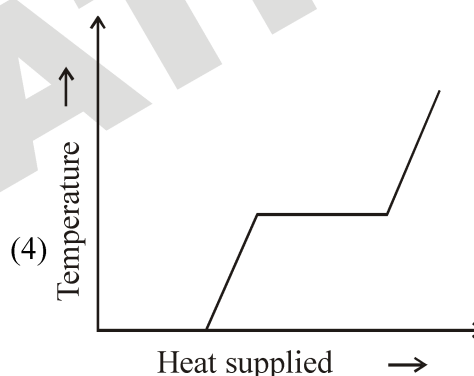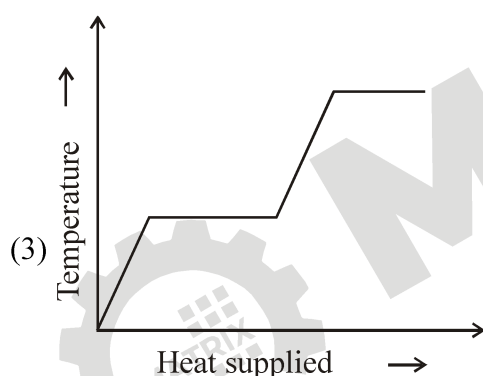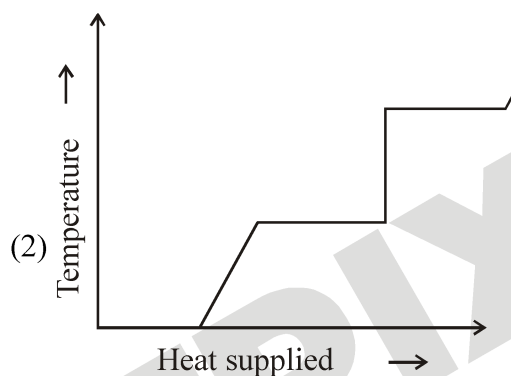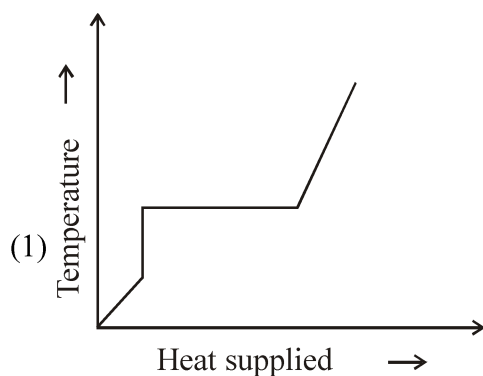
Ans.   Official Answer NTA (2)

Sol.

12.   A block of ice at - 10°C is slowly heated and converted to steam at 100°C. Which of the following curves represent the phenomenon qualitatively :

Question ID: 4058591051

Ans.   Official Answer NTA (3)

Sol.

13.   An alternating voltage V(t) = 220 sin 100 π t volt is applied to a purely resistive load of 50 Ω. The time taken for the current to rise from half of the peak value to the peak value is :

(1) 2.2 ns   (2) 7.2 ms   (3) 3.3 ms   (4) 5 ms

Question ID: 4058591057

Ans.   Official Answer NTA (3)

Sol.

14.   If mass is written as $m = k \, c^P G^{-1/2} h^{1/2}$ then the value of P wll be : (Constant have their usual meaning with k a dimensionless constant)

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(1) 1/3 　　　　 (2) –1/3 　　　　 (3) 2 　　　　 (4) 1/2

Question ID: 4058591045

Ans. 　 Official Answer NTA (4)

Sol.

15. A particle of charge '–q' and mass 'm' moves in a circle of radius 'r' around an infinitely long line charge of linear charge density '+ λ '. Then time period will be given as :

(Consider k as Coulomb's constant)

(1) $T = \dfrac{1}{2\pi}\sqrt{\dfrac{2k\lambda q}{m}}$ 　　 (2) $T = 2\pi r\sqrt{\dfrac{m}{2k\lambda q}}$ 　　 (3) $T^2 = \dfrac{4\pi^2 m}{2k\lambda q}r^3$ 　　 (4) $T = \dfrac{1}{2\pi r}\sqrt{\dfrac{m}{2k\lambda q}}$

Question ID: 4058591054

Ans. 　 Official Answer NTA (2)

Sol.

16. An electron revolving in n^{th} Bohar has magnetic moment $\mu_n \alpha\, n^x$, the value of x is
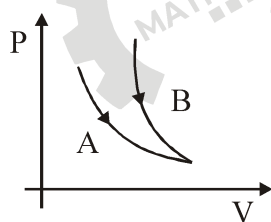
(1) 3 　　　　 (2) 1 　　　　 (3) 2 　　　　 (4) 0

Question ID: 4058591062

Ans. 　 Official Answer NTA (2)

Sol.

17. Choose the correct statement for processes A & B shown in figure.

(1) $\dfrac{P^{\gamma-1}}{T^{\gamma}} = k$ for process B and T = k for process A.

(2) PV = k for process B and A.

(3) $\dfrac{T^{\gamma}}{P^{\gamma-1}} = k$ for process A and PV = k for process B.

(4) $PV^{\gamma} = k$ for process B and PV = k for process A.

Question ID: 4058591052

Ans.   Official Answer NTA (1,4)

Sol.

18.   In a nuclear fission reaction of an isotope of mass M, three similar daughter nuclei of same mass are formed. The speed of a daughter nuclei in terms of mass defect ΔM will be :
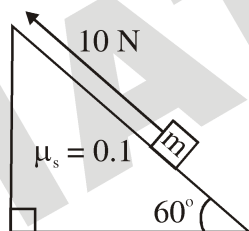
(1) $\sqrt{\dfrac{2c\Delta M}{M}}$ (2) $c\sqrt{\dfrac{3\Delta M}{M}}$ (3) $c\sqrt{\dfrac{2\Delta M}{M}}$ (4) $\dfrac{\Delta Mc^2}{3}$

Question ID: 4058591061

Ans.   Official Answer NTA (3)

Sol.

19.   A block of mass 1 kg is pushed up a surface inclined to horizontal at an angle of 60° by a force of 10 N parallel to the inclined surface as shown in figure. When the block is pushed up by 10 m along inclined suraface, the work done against frictional force is : [g = 10 m/s²]

(1) 5 J   (2) $5\sqrt{3}$ J   (3) 10 J   (4) 5×10^3 J

Question ID: 4058591049

Ans.   Official Answer NTA (1)

Sol.

20.   Escape velocity of a body from earth is 11.2 km/s. If the radius of a planet be one - third the radius of earth and mass be one - sixth that of earth, the escape velocity from the planet is :

(1) 11.2 km/s   (2) 7.9 km/s   (3) 8.4 km/s   (4) 4.2 km/s

Question ID: 4058591050

Ans.   Official Answer NTA (2)

Sol.

21.   The current of 5A flows in a square loop of sides 1 m is placed in air. The magnetic field at the centre of the loop is $X\sqrt{2}\times10^{-7}\,\text{T}$. The value of X is _____ .

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Question ID: 4058591071

Ans.   Official Answer NTA (40)

Sol.

22.   A point source is emitting sound waves of intensity $16 \times 10^{-8}\,\mathrm{Wm^{-2}}$ at the origin. The difference in intensity (magnitude only) at two points located at a distance of 2m and 4m from the origin respectively will be _____ $\times 10^{-8}\,\mathrm{Wm^{-2}}$.

Question ID: 4058591068

Ans.   Official Answer NTA (0.24)

Sol.

23.   A big drop is formed by coalescing 1000 small identical drops of water. If E_1 be the total surface energy of 1000 small drops of water and E_2 be the surface energy of single big drop of water, then $E_1 : E_2$ is x : 1 where x = _____ .

Question ID: 4058591067

Ans.   Official Answer NTA (10)

Sol.

24.   Two identical charged spheres are suspended by string of equal lengths. The strings make an angle of 37° with each otehr. When suspended in a liquid of density 0.7 g/cm³, the angle remains same. If density of material of the sphere is 1.4 g/cm³, the dielectric constant of the liquid is _____ $\left(\tan 37^\circ = \dfrac{3}{4} \right)$

Question ID: 4058591069

Ans.   Official Answer NTA (2)

Sol.

25.   A vector has magnitude same as that of $\vec{A} = 3\hat{j} + 4\hat{j}$ and is parallel to $\vec{B} = 4\hat{i} + 3\hat{j}$. The x and y components of this vector in first quadrant are x and 3 respectively where x =

Question ID: 4058591065

Ans.   Official Answer NTA (4)

Sol.

26.   Two discs of moment of inertia $I_1 = 4\,\mathrm{kg\,m^2}$ and $I_2 = 2\,\mathrm{kg\,m^2}$, about their central axes & normal to their planes, rotating with angular speed 10 rad/s & 4 rad/s respectively are brough into contact face to face with

their axes of rotation coincident. The loss in kinetic energy of the system in the process is _____ J.

Question ID: 4058591066

Ans.   Official Answer NTA (24)

Sol.

27.   A simple pendulum is placed at a place where its distance from the earth's surface is equal to the radius of the earth. If the length of the string is 4m, then the time period of small oscillations will be : s. $\left[\text{Take g} = \pi^2 \text{ms}^{-2} \right]$

Question ID: 4058591074

Ans.   Official Answer NTA (8)

Sol.

28.   A power transmission line feeds input power at 2.3 kV to a step down transformed with its primary windings having 3000 turns. The outpout power is delivered at 230 V by the transormer. The current in the primary of the transformer is 5A and its efficiency is 90% . The winding of transformer is made of copper. The output current of transformer is _____ A.

Question ID: 4058591072
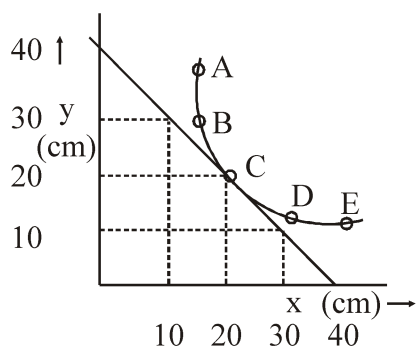
Ans.   Official Answer NTA (45)

Sol.

29.   Ttwo resistance of $100\,\Omega$ and $200\,\Omega$ are connected in series with a battery of 4V and negligible internal resitance. A voltmeter is used to measure voltage across $100\,\Omega$ resistance, which gives reading as 1 V. The resitance of voltmeter must be Ω .

Question ID: 4058591070

Ans.   Official Answer NTA (200)

Sol.

30.   In an experiment to measure the focal length (f) of a convex lens, the magnitude of object distance (x) and the image distance (y) are measured with reference to the focal point of the lends. The y-x plot is shown in figure. The focal length of the lens is _____ cm.

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Question ID: 4058591073

Ans.   Official Answer NTA (20)

Sol.