JEE Main January 2024

Question Paper With Text Solution

31 January | Shift-2

PHYSICS

1. Consider two physical quantities A and B related to eath other as $E = \dfrac{B - x^2}{At}$ where E, x and t have dimentions of energy, length and time respectively. The dimension of AB is
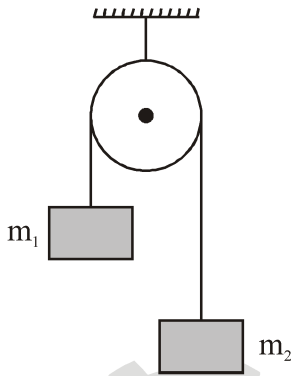
    (1) $L^{-2}M^1T^0$ (2) $L^2M^{-1}T^1$ (3) $L^0M^{-1}T^1$ (4) $L^{-2}M^{-1}T^1$

Question ID: 4058591225

Ans. Official Answer NTA (2)

Sol.

2. A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is g/8, the the ratio of masses is :

    (1) $\dfrac{9}{7}$ (2) $\dfrac{8}{1}$ (3) $\dfrac{4}{3}$ (4) $\dfrac{5}{3}$

Question ID: 4058591227

Ans. Official Answer NTA (1)

Sol.

3. A gas mixture consissts of 8 moles of argon and 6 moles of oxygen at temperature T. Neglecting all vibrational modes, the total internal energy of the system is :
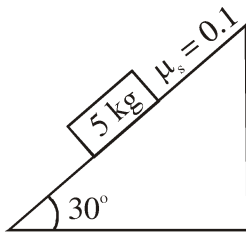
    (1) 29 RT   (2) 27 RT   (3) 21 RT   (4) 20 RT

Question ID: 4058591233

Ans. Official Answer NTA (3)

Sol.

4.

A block of mass 5 kg is placed on a rough inclined surfaced as shown in the figure. If $\vec{F}_1$ is the force required to just move the block up the inclined plane and $\vec{F}_2$ is the force required to just prevent the block from sliding down, then the value of $\left|\vec{F}_1\right| - \left|\vec{F}_2\right|$ is : [Use g = 10 m/s^2]
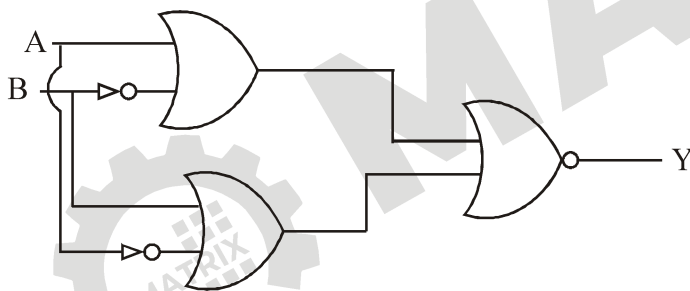
(1) 10 N

(2) $\dfrac{5\sqrt{3}}{2}$ N

(3) $25\sqrt{3}$N

(4) $50\sqrt{3}$N

Question ID: 4058591228

Ans.   Official Answer NTA (Bonus)

Sol.

5.

The output of the given circuit diagram is :

(1)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	0

(2)

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

(3)

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

(4)

A	B	Y
0	0	0
1	0	0
0	1	1
1	1	0

Question ID: 4058591242

Ans.   Official Answer NTA (1)

Sol.

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6. A uniform magnetic field of 2×10^{-3}T acts along positive Y - direction. A rectangular loop of sides 20 cm and 10 cm with current of 5 A is in Y-Z plane. The current is in anticlockwise sense with reference to negative X axis. magnitude and direction of the torque is :

    (1) 2×10^{-4} N-m along positive X - directoin   (2) 2×10^{-4} N-m along negative Z - directoin

    (3) 2×10^{-4} N-m along positive Y - directoin   (4) 2×10^{-4} N-m along positive Z - directoin

Question ID: 4058591236

Ans.   Official Answer NTA (2)

Sol.

7. By what percentage will the illumination of the lamp decrease if the current drops by 20% ?

    (1) 26%   (2) 46%   (3) 56%   (4) 36%

Question ID: 4058591235

Ans.   Official Answer NTA (4)

Sol.

8. In a photoelectric effect experiment a light of frequency 1.5 times that threshold frequency is made to fall on the surface of photosensitive material. Now if the frequency is halved and intensity is doubled, the number of photo electrons emitted will be :

    (1) quadrupled   (2) Zero   (3) halved   (4) doubled

Question ID: 4058591240

Ans.   Official Answer NTA (2)

Sol.

9. The speed of sound in oxgyen at S.T.P. will be approximaterly :

    (given, R = 8.3 JK^{-1}, γ =1.4)

    (1) 325 m/s   (2) 333 m/s   (3) 310 m/s   (4) 341 m/s

Question ID: 4058591232

Ans.   Official Answer NTA (3)

Sol.

10. Force between two points charges q_1 and q_2 placed in vaccuum at 'r' cm apart is F. Force between them when placed in a medium having dielectric constant K = 5 at 'r / 5' cm apart will be :

    (1) 5 F   (2) 25 F   (3) F/25   (4) F/5

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Question ID: 4058591234

Ans.   Official Answer NTA (1)

Sol.

11.   When unpolarized light is incident at an angle of 60° on a transparent medium from air, the reflected ray is completely polarized. The angle of refraction in the medium is :

(1) 45°   (2) 60°   (3) 90°   (4) 30°

Question ID: 4058591239

Ans.   Official Answer NTA (4)

Sol.

12.   A small spherical ball of radius r, falling through a viscous medium of negligible density has terminal velocity 'v'. Another ball of the same mass but the radius 2r, falling through the same viscous medium will have terminal velocity :

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

Question ID: 4058591231

Ans.   Official Answer NTA (3)

Sol.

13.   A body of mass 2 kg begins to move under the action of a time dependent force given by $\vec{F} = \left(6t\hat{i} + 6t^2\hat{j}\right) N$. The poweer developed by the force at the time t is given by :

(1) $(6t^4 + 9t^5)W$ (2) $(9t^5 + 6t^3)W$ (3) $(3t^3 + 6t^5)W$ (4) $(9t^3 + 6t^5)W$

Question ID: 4058591229

Ans.   Official Answer NTA (4)

Sol.

14.   Given below are two statements :

Statement I : Electromagnetic waves carry energy as they travel through space and this energy is equally shared by the electric and magnetic fields.

Statement II : When electromagnetic waves strike a surface, a pressure is exerted on the surface.

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

(1) Both Statement I and Statement II are incorrect.

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(2) Statement I correct but Statement II is incorrect.

(3) Statement I is incorrect but Statement II is correct.

(4) Both Statement I and Statement II are correct.

Question ID: 4058591238

Ans.   Official Answer NTA (4)

Sol.

15.   The mass number of nucleus having radius equal to half of the radius of nucleus with mass number 192 is :

   (1) 2   (2) 40   (3) 32   (4) 24

Question ID: 4058591241

Ans.   Official Answer NTA (4)

Sol.

16.   The resistance per centimeter of a meter bridge wire is r, with X Ω resistance in left gap. Balancing length from left end is at 40 cm with 25 Ω resistance in right gap. Now the wire is replaced by another wire of 2r resistance per centimeter. The new balancing length for same setting will be at :

   (1) 40 cm   (2) 20 cm   (3) 10 cm   (4) 80 cm

Question ID: 4058591243

Ans.   Official Answer NTA (1)

Sol.

17.   The mass of the moon is $\dfrac{1}{144}$ times the mass of a planet and its diameter is $\dfrac{1}{16}$ times the diameter of a planet. If the escape velocity on the plaet is v, the escape velocity on the moon will be :

   (1) $\dfrac{v}{4}$ (2) $\dfrac{v}{12}$ (3) $\dfrac{v}{3}$ (4) $\dfrac{v}{6}$

Question ID: 4058591230

Ans.   Official Answer NTA (3)

Sol.

18.   An AC voltage V = 20 sin 200 π t is aplied to a series LCR circuit which drives a current I = 10 sin $\left(200\pi t + \dfrac{\pi}{3}\right)$. The average power dissipated is :

   (1) 50 W   (2) 200 W   (3) 173.2 W   (4) 21.6 W

Question ID: 4058591237

Ans.   Official Answer NTA (1)

Sol.

19.   If two vectors $\vec{A}$ and $\vec{B}$ having equal magnitude R are inclined at an angle θ, then

(1) $\left|\vec{A}+\vec{B}\right| = 2R\cos\left(\dfrac{\theta}{2}\right)$

(2) $\left|\vec{A}-\vec{B}\right| = \sqrt{2}R\cos\left(\dfrac{\theta}{2}\right)$

(3) $\left|\vec{A}+\vec{B}\right| = 2R\sin\left(\dfrac{\theta}{2}\right)$

(4) $\left|\vec{A}-\vec{B}\right| = 2R\cos\left(\dfrac{\theta}{2}\right)$

Question ID: 4058591226

Ans.   Official Answer NTA (1)

Sol.

20.   The measured value of the length of a simple pendulum is 20 cm with 2 mm accuracy. The time for 50 oscillations was measured to be 40 seconds with 1 second resolution. From these measurements, the accuracy in the measurement of acceleration due to gravity is N%. The value of N is :

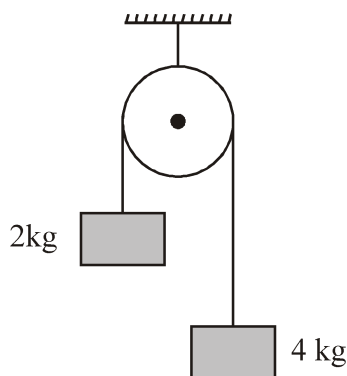(1) 6   (2) 4   (3) 5   (4) 8

Question ID: 4058591244

Ans.   Official Answer NTA (1)

Sol.

21.   Two blocks of mass 2kg and 4kg are connected by a metal wire going over a smooth pulley as shown in figure. The radius of wire is 4.0×10^{-5} m and oung's modulus of the metal is 2.0×10^{11} N/m^2. The longitudinal strain developed in the wire is $\dfrac{1}{\alpha\pi}$. The value of α is _____ . [Use g = 10 m/s^2]

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Question ID: 4058591247

Ans.   Official Answer NTA (12)

Sol.

22.   Two circualr coils P and Q of 100 turns each have same radius of π cm. The currents in P and R are 1A and 2A respectively. P and Q are placed with their planes mutually perpendicular with their centres coincide. The resulant magnetic field induction at the center of the coils is $\sqrt{x}\,\text{mT}$, where x = _____ .

$$\left[\text{Use } \mu_0 = 4\pi \times 10^{-7}\,\text{Tm}^{A^{-1}} \right]$$
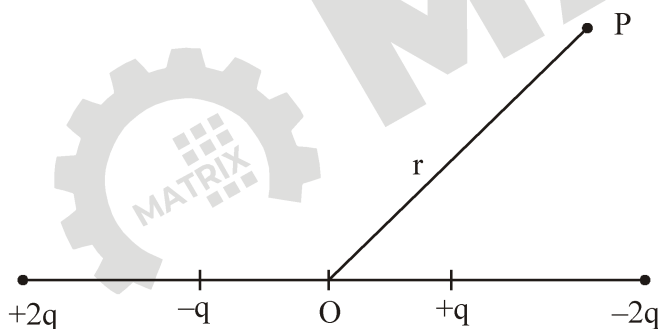
Question ID: 4058591251

Ans.   Official Answer NTA (20)

Sol.

23.   The distance between charges +q and –q is 2l and between +2q and –2q is 4l. The electrostatic potential at point P at a distance r from centre O is $-\alpha\left[\dfrac{q_1}{r^2}\right]\times 10^9\,\text{V}$, where the value of α is _____ .

(Use $\dfrac{1}{4\pi\varepsilon_0} = 9\times 10^9\,\text{Nm}^2\text{C}^{-3}$)

Question ID: 4058591249

Ans.   Official Answer NTA (27)

Sol.

24.   Two identical spheres each of mass 2 kg and radius 50 cm are fixed at the ends of a light rod so that the separation ebtween the centres is 150 cm. Then, moment of inertia of the system about an axis perpendicular to the rod and passing through its middle point is $\dfrac{x}{20}\,\text{kg m}^2$, where the value of x is _____ .

Question ID: 4058591246

Ans.   Official Answer NTA (53)

Sol.

25.   The magnetic flux ϕ (in water) linked with a closed circuit of resistance $8\,\Omega$ varies with time (in seconds) as $\phi = 5t^2 - 36t + 1$. The induced current in the circuit at t = 2 is _____ A.

Question ID: 4058591252

Ans.   Official Answer NTA (2)

Sol.

26.   Light from a point source in air falls on a convex curved surface of raiuds 20 cm and refractive index 1.5. If the source is located at 1000 cm from the convex surface, the image will be formed at _____ cm from the object.

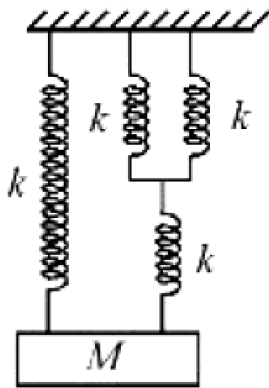Question ID: 4058591253

Ans.   Official Answer NTA (200)

Sol.

27.   A nucleus has mass umber A_1 and volume V_1, Another nucleus has mass number A_2 and Volume V_2. If relation between mass number is $A_2 = 4A_1$, then $\dfrac{V_2}{V_1} =$ _____ .

Question ID: 4058591254

Ans.   Official Answer NTA (4)

Sol.

28.   The time period of simple harmonic motion of mass M in the given figure is $\pi\sqrt{\dfrac{\alpha M}{5k}}$, where the value of α is _____ .

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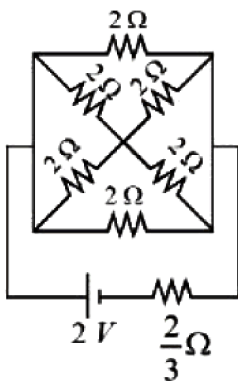Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

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Question ID: 4058591248

Ans.   Official Answer NTA (12)

Sol.

29.   In the following circuit, the battery has an emf of 2V and an internal resistance of $\frac{2}{3}\Omega$. The power consumption in the entire circuit is _____ W.

Question ID: 4058591250

Ans.   Official Answer NTA (3)

Sol.

30.   A body of mass 'm' is project with a speed 'u' making an angle of 45° with the ground. The angular momentum of the body about the point of projection, at the highest point is expressed as $\frac{\sqrt{2}mu^3}{Xg}$. The value of 'x' is _____ .

Question ID: 4058591245

Ans.   Official Answer NTA (8)

Sol.

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