JEE Main January 2024

Question Paper With Text Solution

29 January | Shift-2

PHYSICS

1. Two particles X and Y having equal charges are being accelerated through the same potential difference. Thereafter they enter normally in a region of uniform magnetic field and describes circular paths of radii R_1 and R_2 respectively. The mass ratio of X and Y is:

   (1) $\left(\dfrac{R_1}{R_2}\right)$ 　　　 (2) $\left(\dfrac{R_2}{R_1}\right)^2$ 　　　 (3) $\left(\dfrac{R_2}{R_1}\right)$ 　　　 (4) $\left(\dfrac{R_1}{R_2}\right)^2$

   Question ID:405859786

   Ans.　Official Answer NTA (4)

   Sol.

2. Given below are two statements:

   Statement I: Most of the mass of the atom and all its positive charge are concentrated in a tiny nucleus and the electrons revolve around it, is Rutherford's model.

   Statement II: An atom is a spherical cloud of positive charges with electrons embedded in it, is a special case of Rutherford's model.

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

   (1) Statement I is false but Statement II is true

   (2) Both statement I and statement II are false

   (3) Both statement I and statement II are true

   (4) Statement I is true but Statement II are false

   Question ID:405859791

   Ans.　Official Answer NTA (4)

   Sol.

3. A physical quantity Q is found to depend on quantities a, b, c by the relation $Q = \dfrac{a^4 b^3}{c^2}$. The percentage error in a, b and c are 3%, 4% and 5% respectively. Then, the percentage error in Q is:

   (1) 14% 　　　 (2) 66 % 　　　 (3) 34 % 　　　 (4) 43%

   Question ID:405859775

   Ans.　Official Answer NTA (3)

   Sol.

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4. In Young's double slit experiment, light from two identical sources are superimposing on a screen. The path difference between the two lights reaching at a point on the screen is $\dfrac{7\lambda}{4}$. The ratio of intensity of fringe at this point with respect to the maximum intensity of the fringe is:

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

   Question ID:405859789

   Ans.   Official Answer NTA (2)

   Sol.

5. A stone of mass 900 g is tied to a string and moved in a vertical circle of radius 1 m making 10 rpm. The tension in the string, when the stone is at the lowest point is (if $\pi^2 = 9.8$ and g = 9 m/s^2):

   (1) 97 N   (2) 8.82 N   (3) 17.8 N   (4) 9.8 N

   Question ID:405859778

   Ans.   Official Answer NTA (4)

   Sol.

6. A planet takes 200 days to complete one revolution around the Sun. If the distance of the planet from Sun is reduced to one fourth of the original distance, how many days will it take to complete one revolution:

   (1) 25   (2) 50   (3) 20   (4) 100

   Question ID:405859780

   Ans.   Official Answer NTA (1)

   Sol.

7. If the distance between object and its two times magnified virtual image produced by a curved mirror is 15 cm, the focal length of the mirror must be:

   (1) –10 cm   (2) –12 cm   (3) 10/3 cm   (4) 15 cm
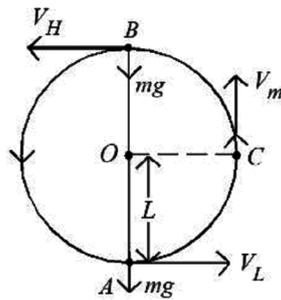
   Question ID:405859794

   Ans.   Official Answer NTA (1)

   Sol.

8. A bob of mass 'm' is suspended by a light string of length 'L'. It is imparted a minimum horizontal velocity at the lowest point A such that it just completes half circle reaching the top most position B. The ratio of kinetic energies $\dfrac{(K.E.)_A}{(K.E.)_B}$ is:

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(1) 2:5   (2) 1:5   (3) 5:1   (4) 3:2

Question ID:405859777

Ans.   Official Answer NTA (3)

Sol.

9.   Two sources of light emit with a power of 200 W. The ratio of number of photons of visible light emitted by each source having wavelengths 300 nm and 500 nm respectively, will be:

(1) 3:5   (2) 1:3   (3) 1:5   (4) 5:3
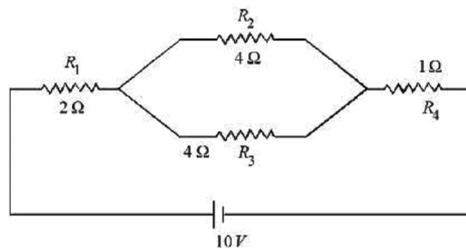
Question ID:405859790

Ans.   Official Answer NTA (1)

Sol.

10.   In the given circuit, the current in resistance R_3 is:

(1) 2 A   (2) 1.5 A   (3) 2.5 A   (4) 1 A

Question ID:405859785

Ans.   Official Answer NTA (4)

Sol.

11. The bob of a pendulum was released from a horizontal position. The length of the pendulum is 10 m. If it dissipates 10% of its initial energy against air resistance, the speed with which the bob arrives at the lowest point is: [Use, g : 10 ms⁻²]

   (1) $2\sqrt{5}$ ms⁻¹   (2) $5\sqrt{6}$ ms⁻¹   (3) $6\sqrt{5}$ ms⁻¹   (4) $5\sqrt{5}$ ms⁻¹

Question ID:405859779

Ans.   Official Answer NTA (1)

Sol.

12. The temperature of a gas having 2.0×10^{25} molecules per cubic meter at 1.38 atm (Given, k = 1.38×10^{-23} JK⁻¹) is:

   (1) 300 K   (2) 100 K   (3) 200 K   (4) 500 K

Question ID:405859783

Ans.   Official Answer NTA (4)

Sol.

13. An electric field is given by $\left(6\hat{i} + 5\hat{j} + 3\hat{k}\right)$ N/C. The electric flux through a surface area $30\hat{i}$ m² lying in YZ-plane (in SI unit) is:

   (1) 150   (2) 180   (3) 90   (4) 60

Question ID:405859784

Ans.   Official Answer NTA (2)

Sol.

44. A plane electromagnetic wave of frequency 35 MHz travels in free space along the X-direction. At a particular point (in space and time) $\vec{E} = 9.6\ \hat{j}V / m$. The value of magnetic field at this point is:

   (1) $3.2 \times 10^{-8}\ \hat{i}T$ (2) $9.6 \times 10^{-8}\ \hat{k}T$ (3) $9.6\ \hat{j}T$ (4) $3.2 \times 10^{-8}\ \hat{k}T$

Question ID:405859788

Ans.   Official Answer NTA (4)

Sol.

45. A wire of length L and radius r is clamped at one end. If its other end is pulled by a force F, its length increases by l. If the radius of the wire and the applied force both are reduced to half of their original values keeping original length constant, the increase in length will become:

   (1) 2 times   (2) 3/2 times   (3) 3 times   (4) 4 times

Question ID:405859793

Ans.   Official Answer NTA (1)

Sol.

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46. In an a.c. circuit, voltage and current are given by:

    V = 100 sin (100 t) V and

    I = 100 sin (100 t + $\frac{\pi}{3}$) mA respectively.

    The average power dissipated in one cycle is:

    (1) 10 W   (2) 2.5 W   (3) 5 W   (4) 25 W

Question ID:405859787

Ans.   Official Answer NTA (2)

Sol.

17. A small liquid drop of radius R is divided into 27 identical liquid drops. If the surface tension is T, then the work done in the process will be:

    (1) $\frac{1}{8}\pi R^2 T$ (2) $4\pi R^2 T$ (3) $3\pi R^2 T$ (4) $8\pi R^2 T$

Question ID:405859781

Ans.   Official Answer NTA (4)

Sol.

18. N moles of a polyatomic gas ($f = 6$) must be mixed with two moles of a monoatomic gas so that the mixture behaves as a diatomic gas. The value of N is:

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

Question ID:405859782

Ans.   Official Answer NTA (1)

Sol.

19. A particle is moving in a straight line. The variation of position 'x' as a function of time 't' is given as

    x = ($t^3 - 6t^2 + 20t + 15$)m. The velocity of the body when its acceleration becomes zero is:

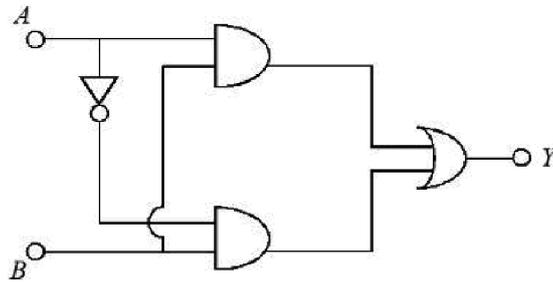   (1) 8 m/s   (2) 10 m/s   (3) 4 m/s   (4) 6 m/s

Question ID:405859776

Ans.   Official Answer NTA (1)

Sol.

20. The truth table for this given circuit is:

(1)

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

(2)

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

(3)

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

(4)

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

Question ID:405859792

Ans. Official Answer NTA (4)

Sol.

21. Two metallic wires P and Q have same volume and are made up of same material. If their area of cross sections are in the ratio 4:1 and force F_1 is applied to P, an extension of Δl is produced. The force which is required to produce same extension in Q is F_2. The value of $\dfrac{F_1}{F_2}$ is _____.

Question ID:405859797

Ans. Official Answer NTA (16)

Sol.

22. A charge of $4.0\ \mu C$ is moving with a velocity of $4.0 \times 10^6\ ms^{-1}$ along the positive y-axis under a magnetic field $\vec{B}$ of strength $\left(2\hat{k}\right)$ T. The force acting on the charge is $x\ \hat{i}\ N$. The value of x is _____.

Question ID:405859801

Ans. Official Answer NTA (32)

Sol.

23. A particle is moving in a circle of radius 50 cm in such a way that at any instant the normal and tangential components of it's acceleration are equal. If its speed at t = 0 is 4 m/s, the time taken to complete the first
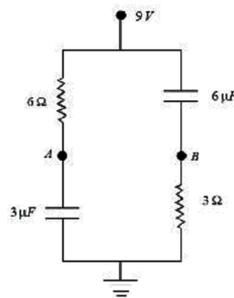
revolution will be $\frac{1}{\alpha}\left[1-e^{-2\pi}\right]$ s, where $\alpha =$ _____.

Question ID:405859795

Ans.   Official Answer NTA (8)

Sol.

24.   In the given figure, the charge stored in 6 µF capacitor, when points A and B are joined by a connecting wire is _____ µC.
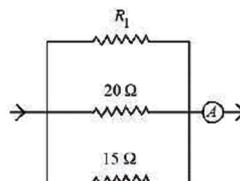

Question ID:405859799

Ans.   Official Answer NTA (36)

Sol.

25.   In the given circuit, the current flowing through the resistance 20 Ω is 0.3 A, while the ammeter reads 0.9 A. The value of R_1 is _____ Ω.

Question ID:405859800

Ans.   Official Answer NTA (30)

Sol.

26.   A horizontal straight wire 5 m long extending from east to west falling freely at right angle to horizontal component of earths magnetic field 0.60×10^{-4} Wbm^{-2}. The instantaneous value of emf induced in the wire when its velocity is 10 ms^{-1} is _____ $\times 10^{-3}$ V.

Question ID:405859802

Ans.   Official Answer NTA (3)

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Sol.

27. Hydrogen atom is bombarded with electrons accelerated through a potential difference of V, which causes excitation of hydrogen atoms. If the experiment is being performed at T = 0 K, the minimum potential difference needed to observe any Balmer series lines in the emission spectra will be $\dfrac{\alpha}{10}$ V , where α = _____ .

Question ID:405859804

Ans.   Official Answer NTA (121)

Sol.

58. In a single slit diffraction pattern, a light of wavelength 6000 Å is used. The distance between the first and third minima in the diffraction pattern is found to be 3 mm when the screen in placed 50 cm away from slits. The width of the slit is _____ $\times 10^{-4}$ m.

Question ID:405859803

Ans.   Official Answer NTA (2)

Sol.

29. A body of mass 5 kg moving with a uniform speed $3\sqrt{2}\,\text{ms}^{-1}$ in X - Y plane along the line y = x + 4. The angular momentum of the particle about the origin will be _____ kg m^2 s^{-1}.

Question ID:405859796

Ans.   Official Answer NTA (60)

Sol.

30. A simple harmonic oscillator has an amplitude A and time period 6π second. Assuming the oscillation starts from its mean position, the time required by it to travel from x = A to $x = \dfrac{\sqrt{3}}{2}A$ will be $\dfrac{\pi}{x}$ s , where x = _____ .

Question ID:405859798

Ans.   Official Answer NTA (2)

Sol.

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