JEE Main January 2024

Question Paper With Text Solution

27 January | Shift-2

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. Gives below are two statements : one is labelled as Assertion (A) and the other is labelled as Reasong (R).

Assertion (A) : The nagular speed of the moon in its orbit about the earth is more than the angular speed of the earth in its orbit about the sun.

Reason (R) : The moon takes less time to move around the earth than the time taken by the earth to move around the sun.

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

(1) (A) is correct but (R) is not correct

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) (A) is not correct but (R) is correct

(4) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Question ID: 533543502

Ans. Official Answer NTA (4)

Sol.

2. Gives below are two statements : one is labelled as Assertion (A) and the other is labelled as Reasong (R).

Assertion (A) : In Vernier calliper if positive zero error exists, then while taking measurements, the reading taken will be more than the actual reading.

Reason (R) : The zero error in Vernier Calliper might have happened due to manufacturing defect or due to rough handling.

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

(1) (A) is false but (R) is true

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(4) (A) is true but (R) is false

Question ID: 533543515

Ans. Official Answer NTA (3)

Sol.

3. Wheatstone bridge principle is ued to measure the specific resistance (S_1) of given wire, having length L, radius r. If X is the resistance of wire, then specific resistance is; $S_1 = X\left(\frac{\pi r^2}{L}\right)$.

(1) $2S_1$ (2) $\frac{S_1}{2}$ (3) S_1 (4) $\frac{S_1}{4}$

Question ID: 533543516

Ans. Official Answer NTA (3)

Sol.

4. A current of 200 μA deflects the coil of a moving coil galvanometer through 60°. The current to cause deflection through $\frac{\mu}{10}$ radian is :

(1) 60 μA (2) 120 μA (3) 30 μA (4) 180 μA

Question ID: 533543508

Ans. Official Answer NTA (1)

Sol.

5. A equation of state of a real gas is given by $\left(P+\frac{a}{V^2}\right)(V-b)=RT$, where P, V and T are pressure, volume and temperature respectively and R is the universal gas constant. The dimensions of $\frac{a}{b^2}$ is similar to that of :

(1) P (2) R (3) RT (4) PV

Question ID:

Ans. Official Answer NTA (1)

Sol. 533543497

6. A bullet is fired into a fixed target looses one third of its velocity after travelling 4 cm. It penetrates further $D\times10^{-3}$ m before coming to rest. The value of D is :

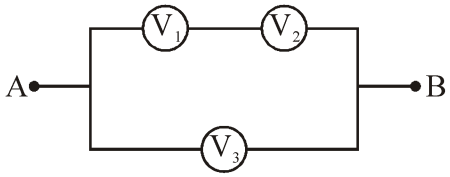
(1) 3 (2) 5 (3) 2 (4) 4

Question ID: 533543501

Ans. Matrix Answer (Bonus)

Sol.

7. Three voltmeters, all having different internal resistance are joined as shown in figure. When some potential difference is applied across A and B, their readings are V_1, V_2 and V_3. Choose the correct option.



(1) $V_1 = V_2$ (2) $V_1 + V_2 > V_3$ (3) $V_1 \neq V_3 - V_2$ (4) $V_1 + V_2 = V_3$

Question ID: 533543507

Ans. Official Answer NTA (4)

Sol.

8. A ball suspended by a thread swings in a vertical plane so that its magnitude of acceleration in the extreme position and lowest position are equal. The angle (θ) of thread deflection in the extreme position will be :

(1) $2\tan^{-1}\left(\frac{1}{2}\right)$ (2) $\tan^{-1}\left(\frac{1}{2}\right)$ (3) $2\tan^{-1}\left(\frac{1}{\sqrt{5}}\right)$ (4) $\tan^{-1}\left(\sqrt{2}\right)$

Question ID: 533543498

Ans. Official Answer NTA (1)

Sol.

9. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. the ratio of $\frac{C_P}{C_V}$ for the gas is :

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

Question ID: 533543504

Ans. Official Answer NTA (3)

Sol.

10. The threshold frequency of a metal with work function 6.63 eV is :

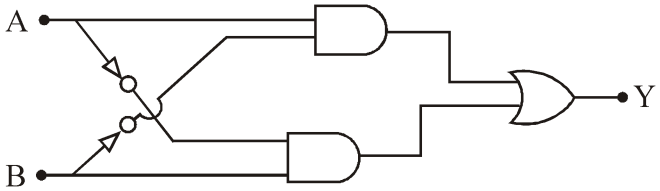
(1) 1.6×10^{12} Hz (2) 1.6×10^{15} Hz (3) 16×10^{12} Hz (4) 16×10^{15} Hz

Question ID: 533543512

Ans. Official Answer NTA (2)

Sol.

11. The truth table of the given circuit diagram is :



(1)

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

(2)

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

(3)

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

(4)

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

Question ID: 533543514

Ans. Official Answer NTA (1)

Sol.

12. Given below are two statements : one is lablled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The property of body, by virtue of which it tends to regin to regain its original shape when the external force is removed, is Elasticity.

Reason (R) : The restoring force depends upon the bonded inter atomic and inter molecular force of solid.

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

(1) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(2) (A) is true but (R) is false

(3) Both (A) and (R) are true and (R) is the correct explanation of (A)

(4) (A) is false but (R) is true

Question ID: 533543503

Ans. Official Answer NTA (3)

Sol.

13. The total kinetic energy of 1 mole of oxygen at 27°C is :

[Use universal gas constant (R) = 8.31 J/mole K]

(1) 5942.0 J (2) 6845.5 J (3) 6232.5 J (4) 5670.5 J

Question ID: 533543505

Ans. Official Answer NTA (3)

Sol.

14. Primary side of a transformer is connected to 230 V, 50 Hz supply. Turns ratio of primary to secondary winding is 10 : 1. Load resistance connected to secondary side is $46\,\Omega$. The power consumed in it is :

(1) 11.5 W (2) 12.0 W (3) 10.0 W (4) 12.5 W

Question ID: 533543509

Ans. Official Answer NTA (1)

Sol.

15. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Work done by electric field on moving a positive charge on an equipotnetial surface is always zero.

Reason (R) : Electric lines of forces are always perpendicular to equipotnetial surfaces.

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

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(2) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(3) (A) is not correct but (R) is correct

(4) (A) is correct but (R) is not correct

Question ID: 533543506

Ans. Official Answer NTA (2)

Sol.

16. When a polaroid sheet is rotated between two crossed polaroids then the transmitted light intensity will be maximum for a rotation of :

(1) 60^o (2) 90^o (3) 30^o (4) 45^o

Question ID : 533543511

Ans. Official Answer NTA (4)

Sol.

17. The atomic mass of ${}_6C^{12}$ is 12.000000 u and that of ${}_6C^{13}$ is 13.003354 u. The required energy to remove a neuton from ${}_6C^{13}$, if mass of neuton is 1.008665 u, will be :

(1) 6.25 MeV (2) 49.5 MeV (3) 62.5 MeV (4) 4.95 MeV

Question ID: 533543513

Ans. Official Answer NTA (4)

Sol.

18. A heavy iron bar of weight 12 kg is having its one end on the ground and the other on the shoulder of a man. The rod makes an angle 60^{o} with the horizontal, the weight experienced by the man is :

(1) 3 kg (2) 12 kg (3) 6 kg (4) $6\sqrt{3}$ kg

Question ID: 533543499

Ans. Matrix Answer (1)

Sol.

19. An object is placed in a medium of refractive index 3. An electromagnetic wave of intensity $6\times10^{8}\ W/m^{2}$ falls nromally on the object and it is absorbed completely. The radiation pressure on the object would be (speed of light in free space $=3\times10^{8}\ m/s$) :

(1) 6 Nm^{-2} (2) 18 Nm^{-2} (3) 2 Nm^{-2} (4) 36 Nm^{-2}

Question ID: 533543510

Ans. Official Answer NTA (1)

Sol.

20. Given below are two statements :

Statement (I) : The limting force of static friction depends on the area of contract and independent of materials.

Statement (II) : The limiting force of kinetic friction is independent of the area of contact and depends on materials.

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

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement I and Statement II are correct

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

(4) Both Statement I and Statement II are incorrect

Question ID: 533543500

Ans. Official Answer NTA (1)

Sol.

21. A closed organ pipe 150 cm long gives 7 beats per second with an open organ pipe of length 350 cm, both vibrating in fundamental mode. The velocity of sound is ..... m/s.

Question ID: 533543520

Ans. Official Answer NTA (294)

Sol.

22. The electric potential at the surface of an atomic nucleus (z = 50) of radius 9×10^{-13} cm is _____ $\times 10^6$V.

Question ID: 533543522

Ans. Official Answer NTA (8)

Sol.

23. A series LCR, circuit with $L = \frac{100}{\pi}$ mH, $C = \frac{10^{-3}}{\pi}$ F and $R = 10\,\Omega$ is connected across an ac source of 220 V, 50 Hz supply. The power factor of the circuit would be _____ .

Question ID: 533543524

Ans. Official Answer NTA (1)

Sol.

24. A ring and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of both bodies are identical and the ratio of their kinetic energies is $\frac{7}{x}$, where x is _____ .

Question ID: 533543518

Ans. Matrix Answer NTA (7)

Sol.

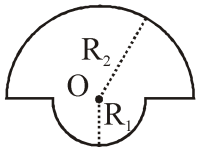
25. The reading of pressure metre attached with a closed pipe is 4.5×10^4 N / m^2 . On opening the valve, water starts flowing and the reading of pressure metre falls to 2.0×10^4 N / m^2 . The velocity of water is found to be $\sqrt{V}$ m / s . The value of V is _____ .

Question ID: 533543519

Ans. Official Answer NTA (50)

Sol.

26. The magnetic field at the centre of a wire loop formed by two semicircular wires of radii $R_1 = 2\pi$ m and $R_2 = 4\pi$ m , carrying current I = 4 A as per figure given below is $\alpha \times 10^{-7}$ T . The value of α is _____.
(Centre O is common for all segments)



Question ID: 533543523

Ans. Official Answer NTA (3)

Sol.

27. If Rydberg's constant is R, the longest wavelength of radiation in Paschen series will be $\frac{\alpha}{7R}$, where $\alpha =$ _____ .

Question ID: 533543526

Ans. Official Answer NTA (144)

Sol.

28. A parallel beam of monochromatic light of wavelength 5000 $\mathring{A}$ is incident normally on narrow slit of width 0.001 mm. The light is focused by convex lends on screen, placed on its focal plane. The first minima will be formed for the angle of diffraction of _____ (degree).

Question ID: 533543525

Ans. Official Answer NTA (30)

Sol.

29. A body falling under gravity covers two points A and B separated by 80 m in 2 s. The distance of upper point $\mathring{A}$ from the starting point is _____ m (use $g = 10\ ms^{-2}$).

Question ID: 533543517

Ans. Official Answer NTA (45)

Sol.

30. Two charges of $-4\ \mu C$ and $+4\ \mu C$ are placed at the points A(1, 0, 4)m and B(2, –1, 5)m located in an electric field $\vec{E} = 0.20\hat{i}\ V/cm$. The magnitude of the torque acting on the dipole is $8\sqrt{\alpha} \times 10^{-5}$ Nm, where $\alpha =$ _____ .

Question ID: 533543521

Ans. Official Answer NTA (2)

Sol.