

**JEE Main January 2024**  
**Question Paper With Text Solution**  
**27 January | Shift-1**

**PHYSICS**



**JEE Main & Advanced | XI-XII Foundation | VI-X Pre-Foundation**

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1. A wire of resistance  $R$  and length  $L$  is cut into 5 equal parts. If these parts are joined parallelly, then resultant resistance will be :

- (1)  $5R$                       (2)  $\frac{1}{5}R$                       (3)  $\frac{1}{25}R$                       (4)  $25R$

Question ID: 533543417

Ans. Official Answer NTA (3)

Sol.

2. Two bodies of mass 4 g and 25 g are moving with equal kinetic energies. The ratio of magnitude of their linear momentum is :

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

Question ID: 533543411

Ans. Official Answer NTA (1)

Sol.

3. A body of mass 1000 kg is moving horizontally with a velocity 6 m/s. If 200 kg extra mass is added, the final velocity (in m/s) is :

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

Question ID: 533543409

Ans. Official Answer NTA (3)

Sol.

4. Given below are two statements :

Statement (I) : Planck's constant and angular momentum have same dimensions.

Statement (II) : Linear momentum and moment of force have same dimensions.

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

- (1) Both Statement I and Statement II are true  
(2) Both Statement I and Statement II are false  
(3) Statement I is false but Statement II is true  
(4) Statement I is true but Statement II is false

Question ID: 533543407

Ans. Official Answer NTA (4)



Sol.

5. The average kinetic energy of a monoatomic molecule is 0.414 eV at temperature :

(Use  $K_B = 1.38 \times 10^{-23}$  J/mol-K)

- (1) 3000 K                      (2) 1500 K                      (3) 3200 K                      (4) 1600 K

Question ID: 533543415

Ans. Official Answer NTA (3)

Sol.

6. A proton moving with a constant velocity passes through a region of space without any change in its velocity. If

$\vec{E}$  and  $\vec{B}$  represent the electric and magnetic fields respectively, then the region of space may have :

- (A)  $E = 0, B = 0$   
(B)  $E = 0, B \neq 0$   
(C)  $E \neq 0, B = 0$   
(D)  $E \neq 0, B \neq 0$

Choose the most appropriate answer from the options given below :

- (1) (A), (B) and (C) only  
(2) (B), (C) and (D) only  
(3) (A), (C) and (D) only  
(4) (A), (B) and (D) only

Question ID: 533543418

Ans. Official Answer NTA (4)

Sol.

7. Position of an ant (S in metres) moving in Y-Z plane is given by  $S = 2t^2\hat{j} + 5t\hat{k}$  (where t is in second). The magnitude and direction of velocity of the ant at  $t = 1$  s will be :

- (1) 9 m/s in z-direction  
(2) 4 m/s in x- direction  
(3) 4 m/s in y- direction  
(4) 16 m/s in y-direction

Question ID: 533543408

Ans. Official Answer NTA (3)

Sol.



8. Given below are two statements :

Statement (I) : Viscosity of gases is greater than that of liquids.

Statement (II) : Surface tension of a liquid decreases due to the presence of insoluble impurities.

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

- (1) Statement I is correct but Statement II is incorrect
- (2) Both Statement I and Statement II are incorrect
- (3) Both Statement I and Statement II are correct
- (4) Statement I is incorrect but Statement II is correct

Question ID: 533543413

Ans. Official Answer NTA(4)

Sol.

9. A wire of length 10 cm and radius  $\sqrt{7} \times 10^{-4}$  m is connected across the right gap of a meter bridge. When a resistance of  $4.5 \Omega$  is connected on the left gap by using a resistance box, the balance length is found to be at 60 cm from the left end. If the resistivity of the wire is  $R \times 10^{-7} \Omega\text{m}$ , the value of R is :

- (1) 66
- (2) 35
- (3) 63
- (4) 70

Question ID: 533543426

Ans. Official Answer NTA(1)

Sol.

10. A convex lens of focal length 40 cm forms an image of an extended source of light on a photoelectric cell. A current I is produced. The lens is replaced by another convex lens having the same diameter but length 20 cm. The photoelectric current now is :

- (1) 2 I
- (2) I
- (3)  $\frac{I}{2}$
- (4) 4 I

Question ID: 533543422

Ans. Official Answer NTA(2)

Sol.

11. An electric charge  $10^{-6} \mu\text{C}$  is placed at origin (0, 0)m of X - Y co-ordinate system. Two points P and Q are situated at  $(\sqrt{3}, \sqrt{3})\text{m}$  and  $(\sqrt{6}, 0)\text{m}$  respectively. The potential difference between the points P and Q will be :

- (1) 3 V
- (2)  $\sqrt{6}$  V
- (3) 0 V
- (4)  $\sqrt{3}$  V

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Question ID: 533543416

Ans. Official Answer NTA (3)

Sol.

12. A rectangular loop of length 2.5 m and width 2 m is placed at  $60^\circ$  to a magnetic field of 4 T. The loop is removed from the field in 10 s. The average emf induced in the loop during this time is :

- (1) + 2 V                      (2) - 2 V                      (3) + 1 V                      (4) - 1 V

Question ID: 533543419

Ans. Official Answer NTA (3)

Sol.

13. A plane electromagnetic wave propagating in x-direction is described by  $E_y = (200 \text{Vm}^{-1}) \sin[1.5 \times 10^7 t - 0.05x]$ ; The intensity of the wave is :

- (1)  $53.1 \text{ Wm}^{-2}$                       (2)  $26.6 \text{ Wm}^{-2}$                       (3)  $35.4 \text{ Wm}^{-2}$                       (4)  $106.2 \text{ Wm}^{-2}$

Question ID: 533543420

Ans. Official Answer NTA (1)

Sol.

14. 0.08 kg air is heated at constant volume through  $5^\circ\text{C}$ . The specific heat of air at constant volume is  $0.17 \text{ kcal/kg}^\circ\text{C}$  and  $J = 4.18 \text{ Joule/cal}$ . The change in its internal energy is approximately.

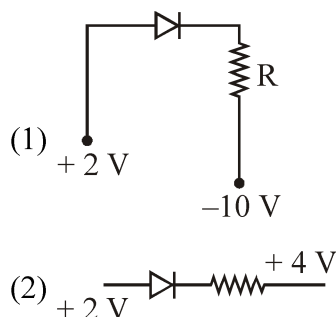
- (1) 284 J                      (2) 318 J                      (3) 298 J                      (4) 142 J

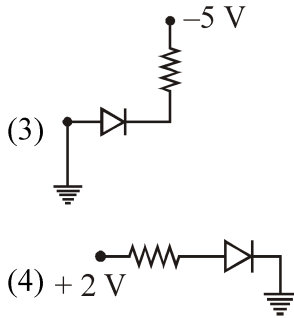
Question ID: 533543414

Ans. Official Answer NTA (1)

Sol.

15. Which of the following circuits is reverse - biased ?





Question ID: 533543424

Ans. Official Answer NTA (2)

Sol.

16. The acceleration due to gravity on the surface of earth is  $g$ . If the diameter of earth reduces to half of its original value and mass remains constant, then acceleration due to gravity on the surface of earth would be :

- (1)  $\frac{g}{2}$                       (2)  $4g$                       (3)  $2g$                       (4)  $\frac{g}{4}$

Question ID: 533543412

Ans. Official Answer NTA (2)

Sol.

17. Identify the physical quantity that cannot be measured using spherometer :

- (1) Specific rotation of liquids  
(2) Radius of curvature of convex surface  
(3) Radius of curvature of concave surface  
(4) Thickness of thin plates

Question ID: 533543425

Ans. Official Answer NTA (1)

Sol.

18. A train is moving with a speed of 12 m/s on rails which are 1.5 m apart. To negotiate a curve of radius 400 m, the height by which the outer rail should be raised with respect to the inner rail is (Given,  $g = 10 \text{ m/s}^2$ ) :

- (1) 5.4 cm                      (2) 6.0 cm                      (3) 4.2 cm                      (4) 4.8 cm

Question ID: 533543410

Ans. Official Answer NTA (1)

Sol.



19. The radius of third stationary orbit of electron for Bohr's atom is R. The radius of fourth stationary orbit will be :

- (1)  $\frac{9}{16}R$                       (2)  $\frac{16}{9}R$                       (3)  $\frac{3}{4}R$                       (4)  $\frac{4}{3}R$

Question ID: 533543423

Ans. Official Answer NTA(2)

Sol.

20. If the refractive index of the material of a prism is  $\cot\left(\frac{A}{2}\right)$ , where A is the angle of prism then the angle of minimum deviation will be :

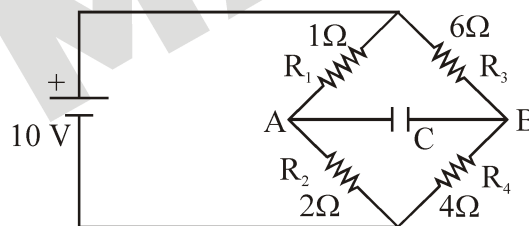
- (1)  $\pi - A$                       (2)  $\pi - 2A$                       (3)  $\frac{\pi}{2} - A$                       (4)  $\frac{\pi}{2} - 2A$

Question ID: 533543421

Ans. Official Answer NTA(2)

Sol.

21. The charge accumulated on the capacitor connected in the following circuit is \_\_\_\_\_  $\mu\text{C}$ .



Question ID: 533543432

Ans. Official Answer NTA(400)

Sol.

22. If average depth of an ocean is 4000 m and the bulk modulus of water is  $2 \times 10^9 \text{ Nm}^{-2}$ , then fractional compression  $\frac{\Delta V}{V}$  of water at the bottom of ocean is  $\alpha \times 10^{-2}$ . The value of  $\alpha$  is \_\_\_\_\_. (Given,  $g = 10 \text{ ms}^{-2}$ ,  $\rho = 1000 \text{ kg m}^{-3}$ )

Question ID: 533543429



Ans. Official Answer NTA (2)

Sol.

23. A particle starts from origin at  $t = 0$  with a velocity  $5\hat{i}$  m/s and moves in x - y plane under action of a force which produces a constant acceleration of  $(3\hat{i} + 2\hat{j})$  m/s<sup>2</sup>. If the x-coordinate of the particle at that instant is 84 m, then the speed of the particle at this time is  $\sqrt{\alpha}$  m/s. The value of  $\alpha$  is \_\_\_\_\_.

Question ID: 533543427

Ans. Official Answer NTA (673)

Sol.

24. A particle executes simple harmonic motion with an amplitude of 4 cm. At the mean position, velocity of the particle is 10 cm/s. the distance of the particle from the mean position when its speed becomes  $5\sqrt{\alpha}$  cm, where  $\alpha =$  \_\_\_\_\_.

Question ID: 533543430

Ans. Official Answer NTA (12)

Sol.

25. Two coils have mutual inductance 0.002 H. The current changes in the first coil according to the relation  $i = i_0 \sin \omega t$ , where  $i_0 = 5$  A and  $\omega = 50\pi$  rad/s. The maximum value of emf in the second coil is  $\frac{\pi}{\alpha}$  V. The value of  $\alpha$  is \_\_\_\_\_.

Question ID: 533543434

Ans. Official Answer NTA (2)

Sol.

26. In a nuclear fission process, a high mass nuclide ( $A \approx 236$ ) with binding energy 7.6 MeV/Nucleon dissociated into middle mass nuclides ( $A \approx 118$ ), having binding energy of 8.6 MeV/Nucleon. The energy released in the process would be \_\_\_\_\_ MeV.

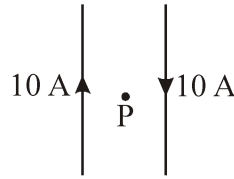
Question ID: 533543436

Ans. Official Answer NTA (236)

Sol.

27. Two long, straight wires carry equal currents in opposite directions as shown in figure. The separation between the wires is 5.0 cm. The magnitude of the magnetic field at a point P midway between the wires is \_\_\_\_\_  $\mu$ T. (Given :  $\mu_0 = 4\pi \times 10^{-7}$  TmA<sup>-1</sup>)



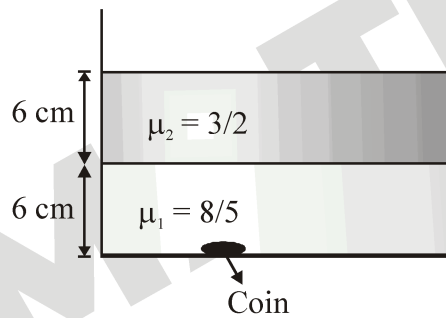


Question ID: 533543433

Ans. Official Answer NTA (160)

Sol.

28. Two immiscible liquids of refractive indices  $\frac{8}{5}$  and  $\frac{3}{2}$  respectively are put in a beaker as shown in the figure. The height of each column is 6 cm. A coin is placed at the bottom of the beaker. For near normal vision, the apparent depth of the coin is  $\frac{\alpha}{4}$  cm. The value of  $\alpha$  is \_\_\_\_\_.



Question ID: 533543435

Ans. Official Answer NTA (31)

Sol.

29. Four particles each of mass 1 kg are placed at four corners of a square of side 2 m. Moment of inertia of system about an axis perpendicular to its plane and passing through one of its vertex is \_\_\_\_\_  $\text{kgm}^2$ .

Question ID: 533543428

Ans. Official Answer NTA (16)

Sol.

30. A thin metallic wire having cross sectional area of  $10^{-4} \text{m}^2$  is used to make a ring of radius 30 cm. A positive charge of  $2\pi \text{ C}$  is uniformly distributed over the ring, while another positive charge of  $30 \text{ pC}$  is kept at the centre of the ring. The tension in the ring is \_\_\_\_\_ N; provided that the ring does not get deformed (neglect the influence of gravity).



$$\left( \text{given, } \frac{1}{4\pi \epsilon_0} = 9 \times 10^9 \text{ SI units} \right)$$

Question ID: 533543431

Ans. Official Answer NTA (3)

Sol.

