JEE Main January 2024

Question Paper With Text Solution

1 Feb Shift-2

PHYSICS

MATRIX

1. In a metre-bridge when a resistance in the left gap is 2 Ω and unknown resistance in the right gap, the balance length is found to be 40 cm. On shunting the unknown resistance with 2 Ω, the balance length changes by:

   (1) 20 cm   (2) 65 cm   (3) 22.5 cm   (4) 62.5 cm

   Question ID: 9561771265

   Ans. Official Answer NTA (3)

   Sol.

2. Monochromatic light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is 2×10^{-3} W. How many photons per second on an average, are emitted by the source?

   (Given h = 6.63×10^{-34} Js)

   (1) 6×10^{15} (2) 7×10^{16} (3) 9×10^{18} (4) 5×10^{15}

   Question ID: 9561771261

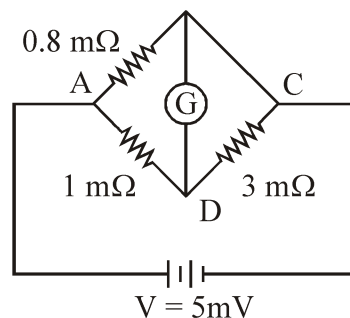   Ans. Official Answer NTA (4)

   Sol.

3. A light planet is revolving around a massive star in a circular orbit of radius R with a period of revolution T. If the force of attraction between planet and star is proportional to $R^{-3/2}$ then choose the correct option :

   (1) $T^2 \propto R^{5/2}$ (2) $T^2 \propto R^{7/2}$ (3) $T^2 \propto R^{3/2}$ (4) $T^2 \propto R^3$

   Question ID: 9561771251

   Ans. Official Answer NTA (1)

   Sol.

4. To measure the temperature coefficient of resistivity α of a semiconductor, an electrical arrangement shown in the figure is prepared. The arm BC is made up of the semiconductor. The experiment is being conducted at 25°C and resistance of the semiconductor 3 mΩ. Arm BC is cooled at a constant rate of 2°C/s. If the galvanometer G shows no deflection after 10 s, then α is :

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(1) $-2.5 \times 10^{-2°}C^{-1}$

(2) $-1.5 \times 10^{-2°}C^{-1}$

(3) $-2 \times 10^{-2°}C^{-1}$

(4) $-1 \times 10^{-2°}C^{-1}$

Question ID: 9561771264

Ans.   Official Answer NTA (4)

        Matrix Answer (4, Bonus)

Sol.

5.   A diatomic gas ($\gamma = 1.4$) does 200 J of work when it is expanded isobarically. The heat given to the gas in the process is :

     (1) 600 J   (2) 850 J   (3) 800 J   (4) 700 J

Question ID: 9561771253

Ans.   Official Answer NTA (4)

Sol.

6.   Train A is moving along two parallel rail tracks towards north with speed 72 km/h and train B is moving towards south with speed 108 km/h. Velocity of train B with respect to A and velocity of ground with respect to B are (in ms^{-1}) :

     यकिं

     (1) -30 and 50   (2) -50 and -30 (3) -50 and 30   (4) 50 and -30

Question ID:9561771247

Ans.   Official Answer NTA (3)

Sol.

7.   From the statements given below :

     (A) The angular momentum of an electron in nth orbit is an integral multiple of $\hbar$.

     (B) Nuclear forces do not obey inverse square law.

     (C) Nuclear forces are spin dependent.

     (D) Nuclear forces are central and charge independent.

(E) Stability of nucleus is inversely proportional to the value of packing fraction. Choose the correct answer from the options given below :

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(1) (A), (B), (C), (E) only

(2) (A), (C), (D), (E) only

(3) (B), (C), (D), (E) only

(4) (A), (B), (C), (D) only

Question ID: 9561771262

Ans.   Official Answer NTA (1)

Sol.

8.   Match List - I with List - II.

List - I   List - II

(Number)   (Significant figure)

(A) 1001   (I) 3

(B) 010.1   (II) 4

(C) 100.100   (III) 5

(D) 0.0010010   (IV) 6

Choose the correct answer from the options given below :

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

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

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

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

Question ID: 9561771246

Ans.   Official Answer NTA (3)

Sol.

9.   A microwave of wavelength 2.0 cm falls normally on a slit of width 4.0 cm. The angular spread of the central maxima of the diffraction pattern obtained on a screen 1.5 m away from the slit, will be:

(1) 15°   (2) 60°   (3) 30°   (4) 45°

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Question ID: 9561771260

Ans.   Official Answer NTA (2)

Sol.

10.   A cricket player catches a ball of mass 120 g moving with 25m/s speed. If the catching process is completed in 0.1 s then the magnitude of force exerted by the ball on the hand of player will be (in SI unit) :

(1) 24   (2) 30   (3) 25   (4) 12

Question ID: 9561771248

Ans.   Official Answer NTA (2)

Sol.

11.   If frequency of electromagnetic wave is 60 MHz and it travels in air along z direction then the corresponding electric and magnetic field vectors will be mutually perpendicular to each other and the wavelength of the wave (in m) is :

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

Question ID: 9561771259

Ans.   Official Answer NTA (4)

Sol.

12.   Conductivity of a photodiode starts changing only if the wavelength of incident light is less than 660 nm. The band gap of photodiode is found to be $\left(\dfrac{X}{8}\right)$ eV. The value of X is :

(Given, h = 6.6×10^{-34} Js, e = 1.6×10^{-19}C)

(1) 13   (2) 15   (3) 21   (4) 11

Question ID: 9561771263

Ans.   Official Answer NTA (2)

Sol.

13.   In an ammeter, 5% of the main current passes through the galvanometer. If resistance of the galvanometer is G, the resistance of ammeter will be :

(1) 199 G   (2) 200 G   (3) $\dfrac{G}{200}$ (4) $\dfrac{G}{199}$

Question ID: 9561771257

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Ans.   Official Answer NTA (3)

        Matrix Answer (Bonus)

Sol.

14.   A transformer has an efficiency of 80% and works at 10 V and 4 kW. If the secondary voltage is 240 V, then the current in the secondary coil is :

        (1) 1.33 A   (2) 1.59 A   (3) 15.1 A   (4) 13.33 A

Question ID: 9561771258

Ans.   Official Answer NTA (4)

Sol.

15.   If the root mean square velocity of hydrogen molecule at a given temperature and pressure is 2 km/s, the root mean square velocity of oxygen at the same condition in km/s is :
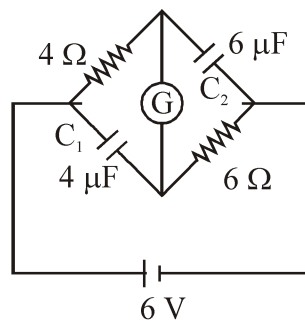
        (1) 1.5   (2) 0.5   (3) 2.0   (4) 1.0

Question ID: 9561771254

Ans.   Official Answer NTA (2)

Sol.

16.   A galvanometer (G) of $2\,\Omega$ resistance is connected in the given circuit. The ratio of chage stored in C_1 and C_2 is:

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

Question ID: 9561771256

Ans.   Official Answer NTA (1)

Sol.

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17. A big drop is formed by coalescing 1000 small droplets of water. The surface energy will become :
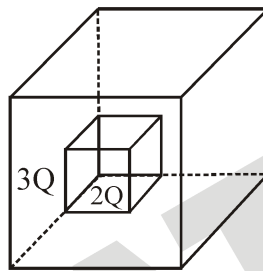
(1) $\dfrac{1}{100}$ th   (2) 100 times   (3) 10 times   (4) $\dfrac{1}{10}$ th

Question ID: 9561771252

Ans. Official Answer NTA (4)

Sol.

18. C_1 and C_2 are two hollow concentric cubes enclosing charges 2Q and 3Q respectively as shown in figure. The ratio of electric flux passing throug C_1 and C_2 is :

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

Question ID: 9561771255

Ans. Official Answer NTA (4)

Sol.

19. A body of mass 4 kg experiences two forces $\vec{F}_1 = 5\hat{i} + 8\hat{j} + 7\hat{k}$ and $\vec{F}_2 = 3\hat{i} - 4\hat{j} - 3\hat{k}$. The acceleration acting on the body is :

(1) $2\hat{i} + \hat{j} + \hat{k}$ (2) $4\hat{i} + 2\hat{j} + 2\hat{k}$ (3) $-2\hat{i} - \hat{j} - \hat{k}$ (4) $2\hat{i} + 3\hat{j} + 3\hat{k}$

Question ID: 9561771249

Ans. Official Answer NTA (1)

Sol.

20. A disc of radius R and mass M is rolling horizontally without slipping with speed υ. it then moves up an inclined smooth surface as shown in figure. The maximum height that the disc can go up the incline is :

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(1) $\dfrac{2}{3}\dfrac{\upsilon^2}{g}$ (2) $\dfrac{\upsilon^2}{g}$ (3) $\dfrac{1}{2}\dfrac{\upsilon^2}{g}$ (4) $\dfrac{3}{4}\dfrac{\upsilon^2}{g}$

Question ID: 9561771250

Ans.   Official Answer NTA (4)

        Matrix Answer (3)

Sol.

21.   A particular hydrogen - like ion emits the radiation of frquency 3×10^{15} Hz when it makes transition from n = 2 to n = 1. The frquency of radiation emitted in transition from n = 3 to n = 1 is $\dfrac{x}{9} \times 10^{15}$ Hz , when x = _____ .

Question ID: 9561771275

Ans.   Official Answer NTA (32)

Sol.

22.   A particle initially at rest starts moving from reference point x = 0 along x - axis, with velocity v that varies as $v = 4\sqrt{x}$ m / s . The acceleration of the particle is _____ ms^{-2}.

Question ID: 9561771266

Ans.   Official Answer NTA (8)

Sol.

23.   A uniform rod AB of mass 2 kg and length 30 cm at rest on a smooth horizontal surface. An impulse of force 0.2 Ns is applied to end B. The time taken by the rod of turn through at right angles will be $\dfrac{\pi}{x}$ s , where x = _____ .

Question ID: 9561771267

Ans.   Official Answer NTA (4)

Sol.

24.   A mass m is suspended from a spring of negligible mass and the system oscillates with a frequency f_1. The frequency of oscillations if a mass 9 m is suspended from the same spring is f_2. The value of $\dfrac{f_1}{f_2}$ is _____ .

Question ID: 9561771269

Ans.   Official Answer NTA (3)

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Sol.

25. A coil of 200 turns and area 0.20 m² is rotated at half a revolution per second and is placed in uniform magnetic field of 0.01 T perpendicular to axis of rotation of the coil. The maximum voltage generated in the coil is $\frac{2\pi}{\beta}$ volt. The value of β is _____ .

Question ID: 9561771273

Ans. Official Answer NTA (5)

Sol.

26. In an electrical circuit drawn below the amount of charge stored in the capacitor is _____ μ C.
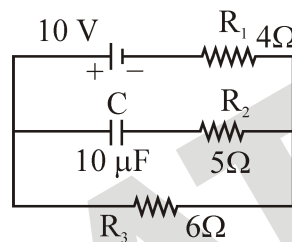
Question ID: 9561771271

Ans. Official Answer NTA (60)

Sol.

27. A moving coil galvanometer has 100 turns and each turn has an area of 2.0 cm². The magnetic field produced by the magnet is 0.01 T and the deflection in the coil is 0.05 radian when a current of 10 mA is passed through it. The torsional constant of the suspension wire is x ×10⁻⁵ N-m/rad. The value of x is _____ .

Question ID: 9561771272

Ans. Official Answer NTA (4)

Sol.

28. In Young's double slit experiment, monochromatic light of wavelength 5000 Å is used. The slits are 1.0 mm apart and screen is placed at 1.0 m away from slits. The distance from the centre of the screen where intensity becomes half of the maximum intensity for the first time is _____ ×10⁻⁶ m.

Question ID: 9561771274

Ans. Official Answer NTA (125)

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Sol.

29.   Suppose a uniformly charged wall provides a uniform electric field of 2×10^4 N/C normally. A charge particle of mass 2 g being suspended through a silk thread of length 20 cm and remain stayed at a distance of 10 cm from the wall. Then the charge on the particle will be $\dfrac{1}{\sqrt{x}} \mu C$ where x = . [use g = 10 m/s²]

Question ID: 9561771270

Ans.   Official Answer NTA (3)

Sol.

30.   One end of a metal wire is fixed to a ceiling and a load of 2 kg hangs from the other end. A similar wire is attached to the bottom of the load and another load of 1 kg hangs from this lower wire. Then the ratio of longitudinal strain of upper wire to that of the lower wire will be _____.

[Area of cross section of wire = 0.005 cm², Y = 2×10^{11} Nm⁻² and g = 10 ms⁻²]

Question ID: 9561771268

Ans.   Official Answer NTA (3)

Sol.