JEE Main January 2025

Question Paper With Text Solution

29 January | Shift-02

PHYSICS

## SECTION – A

26. A capacitor, $C_1 = 6\mu F$ is charged to a potential difference of $V_0 = 5\,V$ using a 5 V battery. The battery is removed and another capacitor, $C_2 = 12\mu F$ is inserted in place of the battery. When the switch 'S' is closed, the charge flows between the capacitors for some time until equilibrium condition is reached. What are the charges (q_1 and q_2) on the capacitors C_1 and C_2 when equilibrium condition is reached.
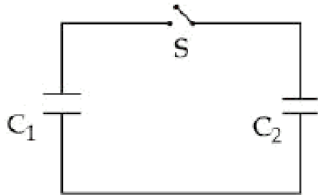
(1) $q_1 = 10\mu C, q_2 = 20\mu C$

(2) $q_1 = 15\mu C, q_2 = 30\mu C$

(3) $q_1 = 20\mu C, q_2 = 10\mu C$

(4) $q_1 = 30\mu C, q_2 = 15\mu C$

Question ID : 6564451163

Ans. Official answer NTA (1)

Sol.

27. A point charge causes an electric flux of $-2\times10^4\,Nm^2C^{-1}$ to pass through a spherical Gaussian surface of 8.0 cm radius, centred on the charge. The value of the point charge is :

(Given $\epsilon_0 = 8.85\times10^{-12}\,C^2\,N^{-1}\,m^{-2}$)

(1) $15.7\times10^{-8}\,C$ (2) $-17.7\times10^{-8}\,C$ (3) $-15.7\times10^{-8}\,C$ (4) $17.7\times10^{-8}\,C$

Question ID : 6564451160

Ans. Official answer NTA (2)

Sol.

28. Given below are two statements. One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : With the increase in the pressure of an ideal gas, the volume falls off more rapidly in an isothermal process in comparison to the adiabatic process.

Reason (R) : In isothermal process, PV = constant, while in adiabatic process $PV^\gamma =$ constant. Here γ is the ratio of specific heats, P is the pressure and V is the volume of the ideal gas.

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

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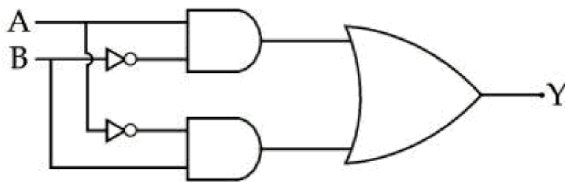**Website :** www.matrixedu.in ; Email : smd@matrixacademy.co.in

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

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

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

(4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

Question ID : 6564451158

Ans. Official answer NTA (3)

Sol.

29. The truth table for the circuit given below is :

(1)

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

(2)

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

(3)

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

(4)

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

Question ID : 6564451170

Ans. Official answer NTA (4)

Sol.

30. The difference of temperature in a material can convert heat energy into electrical energy. To harvest the heat energy, the material should have

(1) low thermal conductivity and low electrical conductivity

(2) low thermal conductivity and high electrical conductivity

(3) high thermal conductivity and high electrical conductivity

(4) high thermal conductivity and low electrical conductivity

Question ID : 6564451156

Ans. Official answer NTA (2)

Sol.

31. The number of spectral lines emitted by atomic hydrogen that is in the 4th energy level, is

(1) 1   (2) 0   (3) 6   (4) 3

Question ID : 6564451168

Ans. Official answer NTA (3)

Sol.

32. Two identical symmetric double convex lenses of focal length f are cut into two equal parts L_1, L_2 by A B plane and L_3, L_4 by X Y plane as shown in figure respectively. The ratio of focal lengths of lenses L_1 and L_3 is
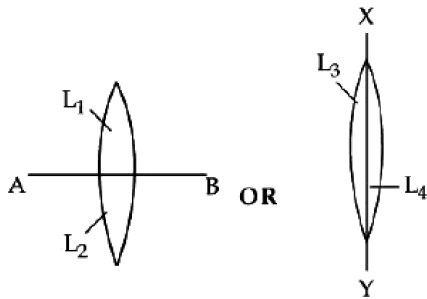
(1) 2 : 1   (2) 1 : 2   (3) 1 : 1   (4) 1 : 4

Question ID : 6564451166

Ans. Official answer NTA (2)

Sol.

33. Match List - I with List - II.

List - I	List - II
(A) Magnetic induction	(I) Ampere meter^2
(B) Magnetic intensity	(II) Weber
(C) Magnetic flux	(III) Gauss
(D) Magnetic moment	(IV) Ampere meter

Choose the correct answer from the options given below :

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

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

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

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

Question ID : 6564451161

Ans.   Official answer NTA (3)

Sol.

34.   A plane electromagnetic wave propagates along the +x direction in free space. The components of the electric field, $\vec{E}$ and magnetic field, $\vec{B}$ vectors associated with the wave in Cartesian frame are
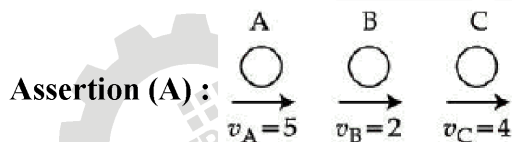
(1) E_x, B_y (2) E_z, B_y (3) E_y, B_x (4) E_y, B_z

Question ID : 6564451164

Ans.   Official answer NTA (4)

Sol.

35.   Given below are two statements. One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) :

Three identical spheres of same mass undergo one dimensional motion as shown in figure with initial velocities $v_A = 5\,m/s$, $v_B = 2\,m/s$, $v_C = 4\,m/s$. If we wait sufficiently long for elastic collision to happen, then $v_A = 4\,m/s$, $v_B = 2\,m/s$, $v_C = 5\,m/s$ will be the final velocities.

Reason (R): In an elastic collision between identical masses, two objects exchange their velocities.

In the light of the above statements, choose the correct answer from the options given below :
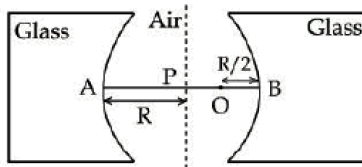
(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

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

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

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

Question ID : 6564451153

Ans.   Official answer NTA (4)

36.

Two concave refracting surfaces of equal radii of curvature and refractive index 1.5 face each other in air as shown in figure. A point object O is placed midway, between P and B . The separation between the images of O , formed by each refracting surface is :

(1) 0.114 R   (2) 0.411 R   (3) 0.124 R   (4) 0.214 R

Question ID : 6564451167

Ans.   Official answer NTA (1)

Sol.

37.   A sand dropper drops sand of mass m(t) on a conveyer belt at a rate proportional to the square root of speed (v) of the belt, i.e. $\dfrac{dm}{dt} \propto \sqrt{v}$. If P is the power delivered to run the belt at constant speed then which of the following relationship is true ?

(1) $P \propto v$ (2) $P^2 \propto v^3$ (3) $P \propto \sqrt{v}$ (4) $P^2 \propto v^5$

Question ID : 6564451152

Ans.   Official answer NTA (4)

Sol.

38.   A cup of coffee cools from 90°C to 80°C in t minutes when the room temperature is 20°C. The time taken by the similar cup of coffee to cool from 80°C to 60°C at the same room temperature is :

(1) $\dfrac{5}{13}t$ (2) $\dfrac{13}{10}t$ (3) $\dfrac{13}{5}t$ (4) $\dfrac{10}{13}t$

Question ID : 6564451155

Ans.   Official answer NTA (3)

Sol.

39.   Match List - I with List - II.

List - I

List - II

(A) Young's Modulus

(I) $ML^{-1}T^{-1}$

(B) Torque

(II) $ML^{-1}T^{-2}$

(C) Coefficient of Viscosity

(III) $M^{-1}L^3T^{-2}$

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(D) Gravitational Constant   (IV) $ML^2 T^{-2}$

Choose the correct answer from the options given below :

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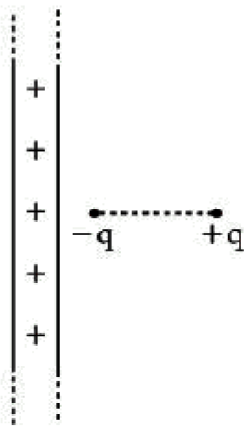
(2) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

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

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

Question ID : 6564451151

Ans.   Official answer NTA (3)

Sol.

40.   An electric dipole is placed at a distance of 2 cm from an infinite plane sheet having positive charge density σ_o. Choose the correct option from the following.
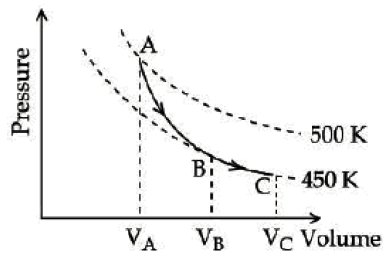

(1) Potential energy of dipole is minimum and torque is zero.

(2) Torque on dipole is zero and net force is directed away from the sheet.

(3) Potential energy and torque both are maximum.

(4) Torque on dipole is zero and net force acts towards the sheet.

Question ID : 6564451162

Ans.   Official answer NTA (1)

Sol.

41.

A poly-atomic molecule $(C_V = 3R, C_P = 4R$, where R is gas constant) goes from phase space point $A\left(P_A = 10^5 \, Pa, V_A = 4 \times 10^{-6} \, m^3\right)$ to point $B\left(P_B = 5 \times 10^4 \, Pa, V_B = 6 \times 10^{-6} \, m^3\right)$ to point $C\left(P_C = 10^4 \, Pa, V_C = 8 \times 10^{-6} \, m^3\right)$. A to B is an adiabatic path and B to C is an isothermal path. The net heat absorbed per unit mole by the system is :

(1) $500R \ln 2$ (2) $400R \ln 4$ (3) $450R(\ln 4 - \ln 3)$ (4) $500R(\ln 3 + \ln 4)$

Question ID : 6564451157

Ans.   Official answer NTA (3)

Sol.

42.   In an experiment with photoelectric effect, the stopping potential,

(1) increases with increase in the intensity of the incident light

(2) is $\left(\dfrac{1}{e}\right)$ times the maximum kinetic energy of the emitted photoelectrons

(3) increases with increase in the wavelength of the incident light

(4) decreases with increase in the intensity of the incident light

Question ID : 6564451169

Ans.   Official answer NTA (2)

Sol.

43.
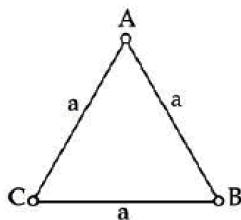
Three equal masses m are kept at vertices (A, B, C) of an equilateral triangle of side a in free space. At

t = 0, they are given an initial velocity $\vec{V}_A = V_0\overrightarrow{AC}, \vec{V}_B = V_0\overrightarrow{BA}$ and $\vec{V}_C = V_0\overrightarrow{CB}$. Here, $\overrightarrow{AC}, \overrightarrow{CB}$ and $\overrightarrow{BA}$ are unit vectors along the edges of the triangle. If the three masses interact gravitationally, then the magnitude of the net angular momentum of the system at the point of collision is :

(1) $\dfrac{\sqrt{3}}{2}a\,mV_0$ 　　　(2) $\dfrac{3}{2}a\,mV_0$ 　　　(3) $3a\,mV_0$ 　　　(4) $\dfrac{1}{2}a\,mV_0$

Question ID : 6564451154

Ans. Official answer NTA (1)

Sol.

44. A convex lens made of glass (refractive index = 1.5) has focal length 24 cm in air. When it is totally immersed in water (refractive index =1.33), its focal length changes to

(1) 96 cm 　　　(2) 72 cm 　　　(3) 24 cm 　　　(4) 48 cm

Question ID : 6564451165

Ans. Official answer NTA (1)

Sol.

45. Two bodies A and B of equal mass are suspended from two massless springs of spring constant k_1 and k_2, respectively. If the bodies oscillate vertically such that their amplitudes are equal, the ratio of the maximum velocity of A to the maximum velocity of B is

(1) $\dfrac{k_2}{k_1}$ 　　　(2) $\sqrt{\dfrac{k_2}{k_1}}$ 　　　(3) $\sqrt{\dfrac{k_1}{k_2}}$ 　　　(4) $\dfrac{k_1}{k_2}$

Question ID : 6564451159

Ans. Official answer NTA (3)

Sol.

SECTION – B

46. A physical quantity Q is related to four observables a, b, c, d as follows :

$$Q = \dfrac{ab}{cd}$$

where, $a = (60 \pm 3)Pa; b = (20 \pm 0.1)m; c = (40 \pm 0.2)Nsm^{-2}$ and $d = (50 \pm 0.1)m$, then the percentage error in Q is $\dfrac{x}{1000}$, where x = _____.

Question ID : 6564451171

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Ans. Official answer NTA (7700)

Sol.

47. Two cars P and Q are moving on a road in the same direction. Accleration of car P increases linearly with time whereas car Q moves with a constant accleration. Both cars cross each other at time t = 0, for the first time. The maximum possible number of crossing(s) (including the crossing at t = 0) is _____.

Question ID : 6564451172

Ans. Official answer NTA (3)

Sol.

48. The magnetic field inside a 200 turns solenoid of radius 10 cm is 2.9×10^{-4} Tesla. If the solenoid carries a current of 0.29 A , then the length of the solenoid is _____ π cm.

Question ID : 6564451174

Ans. Official answer NTA (8)

Sol.

49. Two planets, A and B are orbiting a common star in circular orbits of radii R_A and R_B, respectively, with $R_B = 2R_A$. The planet B is $4\sqrt{2}$ times more massive than planet A. The ratio $\left(\dfrac{L_B}{L_A} \right)$ of angular momentum (L_B) of planet B to that of planet A(L_A) is closest to integer _____.

Question ID : 6564451173

Ans. Official answer NTA (8)

Sol.

50. A parallel plate capacitor consisting of two circular plates of radius 10 cm is being charged by a constant current of 0.15 A . If the rate of change of potential difference between the plates is 7×10^8 V/s then the integer value of the distance between the parallel plates is

$\left(\text{Take}, \epsilon_0 = 9 \times 10^{-12} \dfrac{F}{m}, \pi = \dfrac{22}{7} \right)$ _____μm.

Question ID : 6564451175

Ans. Official answer NTA (1320)

Sol.

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