

IIT JEE 2012 Question Paper & Solution

PAPER 1

Q.1 Young's double slit experimental is carried out by using green, red and blue light, one color at a time. The fringe widths recorded are β_G , β_R and β_B respectively. Then,

- a. $\beta_G > \beta_B > \beta_R$
- b. $\beta_B > \beta_G > \beta_R$
- c. $\beta_R > \beta_B > \beta_G$
- d. $\beta_R > \beta_G > \beta_B$

Answer:4

Q.2 Two large vertical and parallel metal plates having a separation of 1 cm are connected to a DC voltage source of potential difference X. A proton is released at rest midway between the two plates. It is found to move at 45° to the vertical JUST after release. Then X is nearly

- a. $1 \times 10^{-5} \text{ V}$
- b. $1 \times 10^{-7} \text{ V}$
- c. $1 \times 10^{-9} \text{ V}$
- d. $1 \times 10^{-10} \text{ V}$

Answer:3

Q.3 A mixture of 2 moles of helium gas (atomic mass = 4 amu) and 1 mole of argon gas (atomic mass = 40 amu) is kept at 300 K in a container. The ratio of the r m s speeds

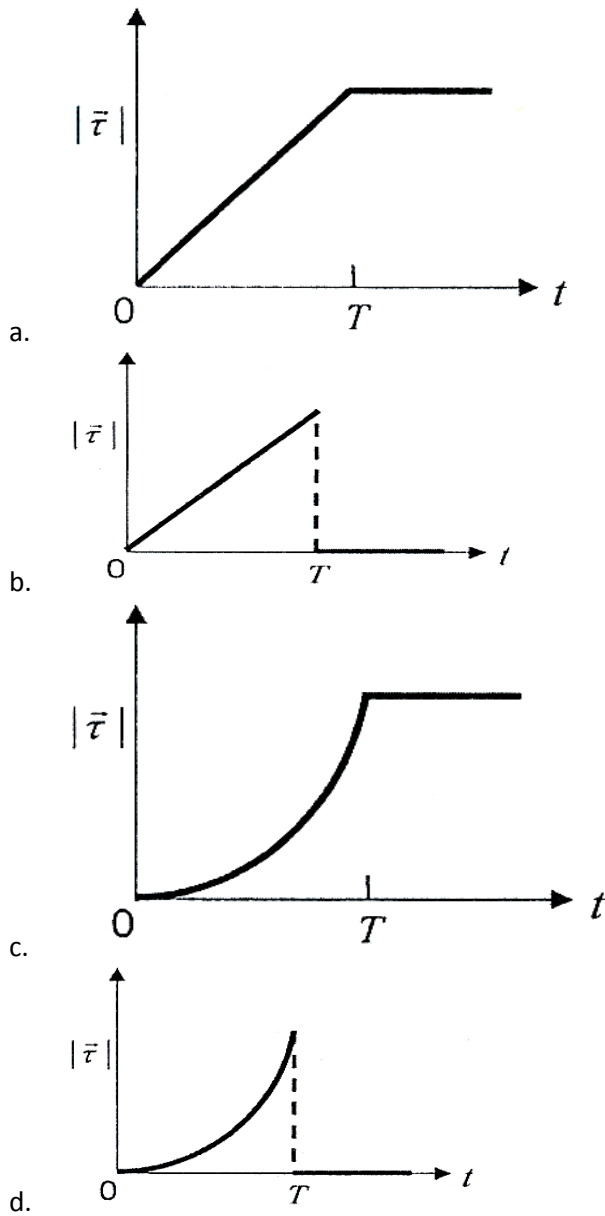
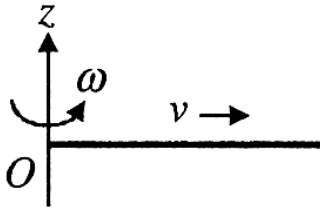
$(v_{\text{rms}}(\text{helium})/v_{\text{rms}}(\text{argon}))$ is

- a. 0.32
- b. 0.45
- c. 2.24
- d. 3.16

Answer:4

Q.4 A thin uniform rod, pivoted at O, is rotating in the horizontal plane with constant angular speed ω , as shown in the figure. At time $t = 0$, a small insect starts from O and moves with constant speed v with respect to the rod towards the other end. It reaches the end of the rod at $t = T$ and stops. The angular speed of the system remains throughout. The magnitude of the torque $|\tau|$ on the system about O, as a function of time is best represented by which plot?

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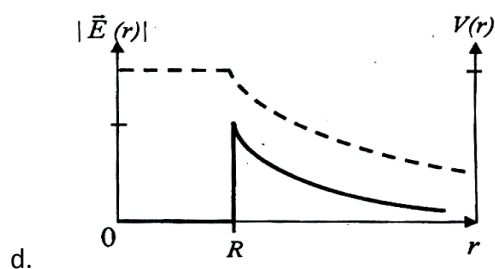
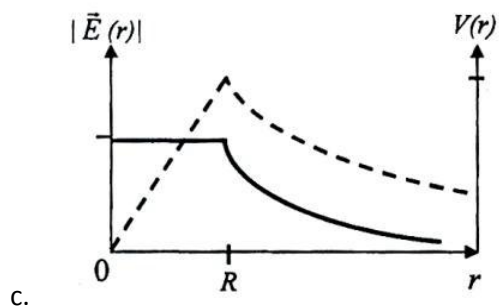
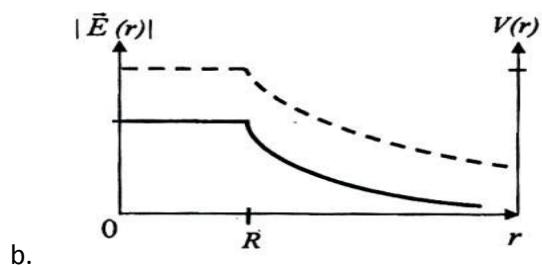
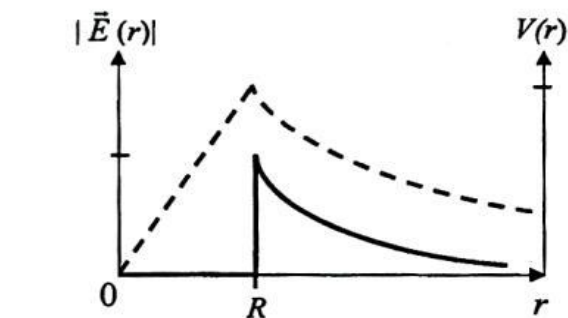
Answer:2

Q.5 Consider a thin spherical shell of radius R with its centre at the origin, carrying uniform positive surface charge density. The variation of the magnitude of the electric field $|E(r)|$ and

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the electric potential $V(r)$ with the distance r from the centre, is best represented by which graph?



Answer:4

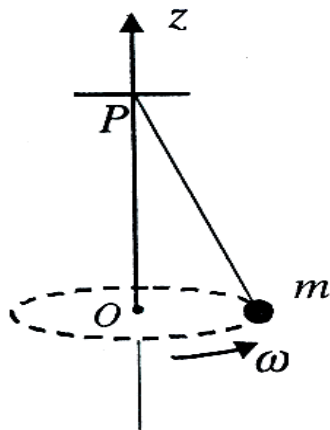
Q.6 A person blows into open-end of a long pipe. As a result, a high-pressure pulse of air travels down the pipe. When this pulse reaches the other end of the pipe

- a high-pressure pulse starts traveling up the pipe, if the other end of the pipe is open.
- a low-pressure pulse starts traveling up the pipe, if the other end of the pipe is open.
- a low-pressure pulse starts traveling up the pipe, if the other end of the pipe is closed.
- a high-pressure pulse starts traveling up the pipe, if the other end of the pipe is closed.

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Answer: 2

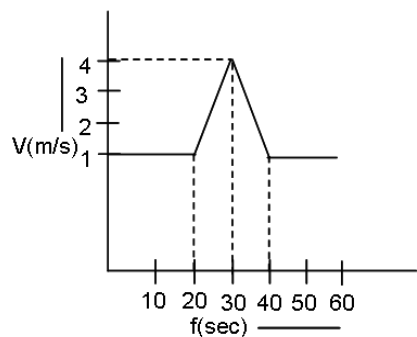
Q. 7 10. A small mass m is attached to a massless string whose other end is fixed at P as shown in the figure. The mass is undergoing circular motion in the x - y plane with centre at O and constant angular speed ω . If the angular momentum of the system, calculated about O and P are denoted by L_O and L_P respectively, then



- A) L_O and L_P do not vary with time.
- (B) L_O varies with time while L_P remains constant.
- (C) L_O remains constant while L_P varies with time.
- D) L_O and L_P both vary with time.

Answer: c

Q.8 Velocity-time (v - t) graph for a moving object is shown in the figure. Total displacement of the object during the time interval when there is non-zero acceleration and retardation is



- a. 60 m
- b. 50 m
- c. 40 m
- d. 30 m

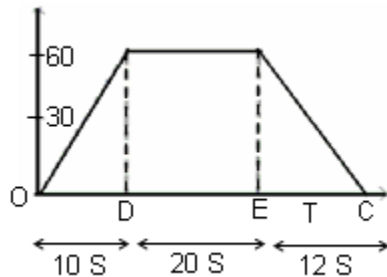
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Answer:2

Between time interval 20 s to 40 s, there is non-zero acceleration and retardation. Hence, distance travelled during this interval
= Area between time interval 20 s to 40 s
Solve : $= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20 = 50 \text{ m}$

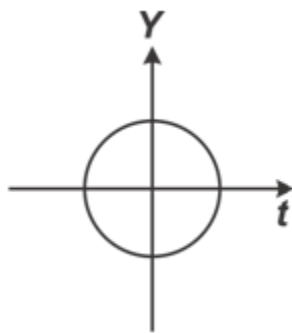
Q.9 The velocity-time graph of a moving train is depicted in the figure. The average velocity in time OD is



- a. 30 m/s
- b. 60 m/s
- c. 45 m/s
- d. 23 m/s

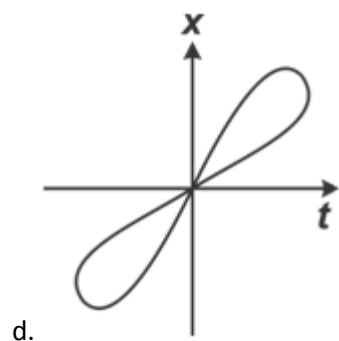
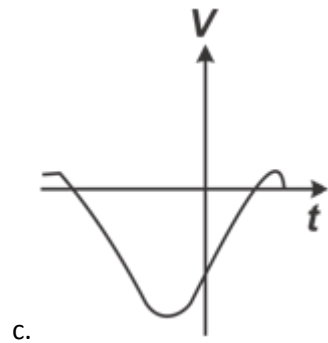
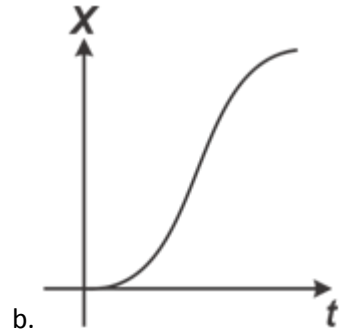
Answer:1

Q.10 Look at the graphs (a) to (d) carefully and indicate which of these possibly represents one dimensional motion of a particle?



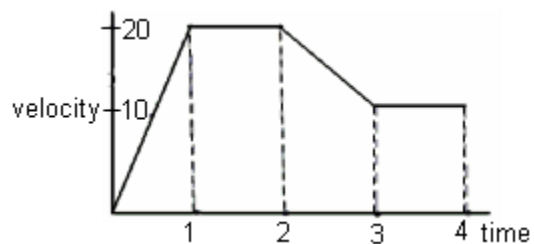
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Answer:2

Q.11 The variation of velocity (in cm/s) of a particle going along a straight line is shown in the fig. Calculate the distance traversed in 4 seconds.



- a. 25 cm
- b. 55 cm

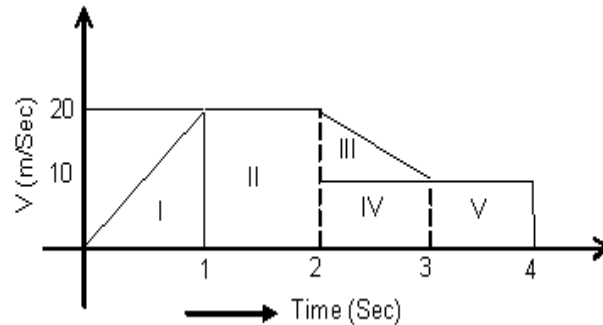
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c. 105 cm

d. 20 cm

Answer:2



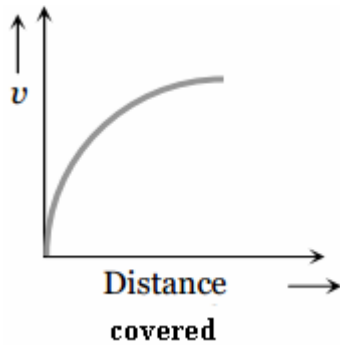
Explanation:

The distance covered by the body in 4 sec. is equal to the area under v- t graph.

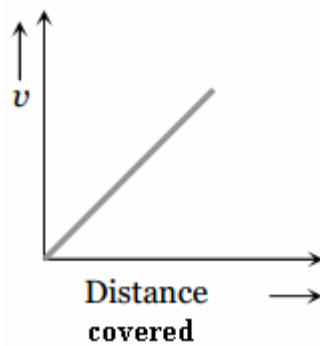
$$\therefore S = \text{Area I} + \text{Area II} + \text{Area III} + \text{Area IV} + \text{Area V}$$

$$S = \frac{1}{2} \times 1 \times 20 + (2 - 1) \times 20 + \frac{1}{2} (3 - 2) \times (20 - 10) \\ + (3 - 2) \times (10 - 0) + (4 - 3) \times (10 - 0) \\ S = 55 \text{ m.}$$

Q.12 A lead shot of a 1mm diameter falls through a long column of glycerine. The variation of its velocity 'v' with distance covered is represented by

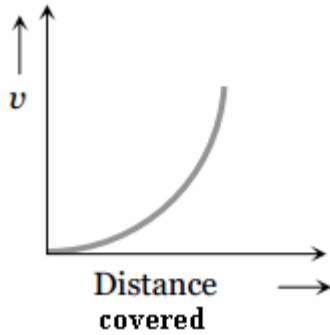


a.

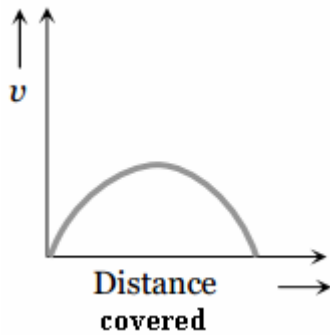


b.

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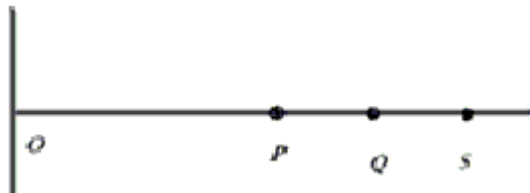
c.



d.

Answer:1

Q.13 A particle is moving with uniform acceleration along a straight line. The average velocity of the particle from P to Q is 8 m/s and from Q to S is 12 m/s. If $QS = PQ$, the average velocity from P to S is



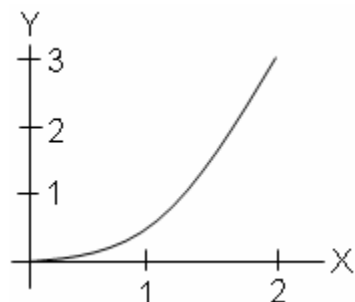
- a. 9.6 m/s
- b. 12.87 m/s
- c. 64 m/s
- d. 327 m/s

Answer:1

Q.14 If the figure below represents a parabola, identify the physical quantities

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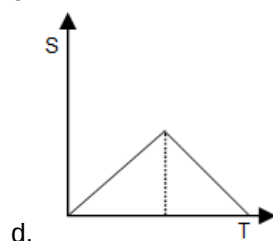
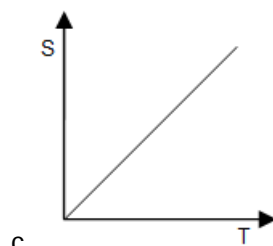
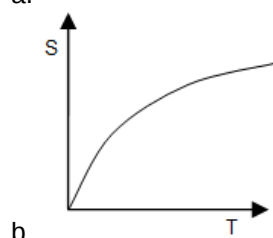
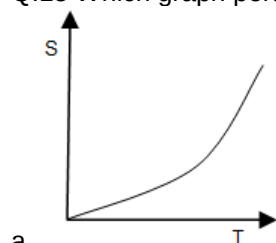
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- a. $X = \text{time}, Y = \text{velocity}$
- b. $X = \text{velocity}, Y = \text{time}$
- c. $X = \text{time}, Y = \text{displacement}$
- d. $X = \text{time}, Y = \text{acceleration}$

Answer:3

Q.15 Which graph pertains to uniform acceleration?

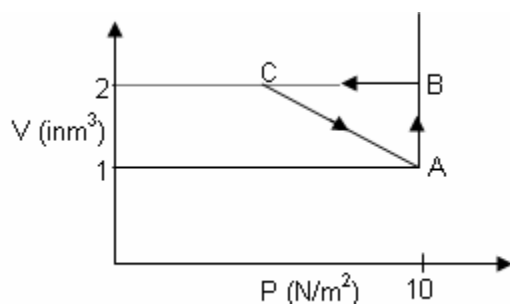


Answer:1

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Q.16 An ideal gas is taken through the cycle $A \rightarrow B \rightarrow C \rightarrow A$, as shown in figure. If the net heat supplied to the gas in the cycle is 5 J, what is the work done by the gas in the process, $C \rightarrow A$?



- a. - 5 J
- b. - 10 J
- c. - 15 J
- d. - 20 J

Answer:1

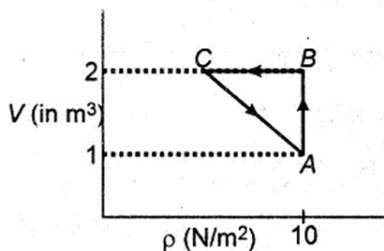
Process is cyclic, so change in internal energy is zero.

We know that work done by gas is given by

$$W = P\Delta V$$

where P is pressure and ΔV the change in volume.

Total work done by gas is



$$W = W_{AB} + W_{BC} + W_{CA} \quad \dots(i)$$

From first law of thermodynamics

$$\Delta Q = \Delta U + W \quad \dots(ii)$$

where ΔQ is heat supplied, ΔU the change in internal energy which is zero and W the work done.

$$\therefore W_{AB} = P\Delta V = 10(2 - 1) = 10 \text{ J}$$

$$W_{BC} = P\Delta V = 2 \times 0 = 0$$

Hence, Eqs. (i) and (ii) will be written as

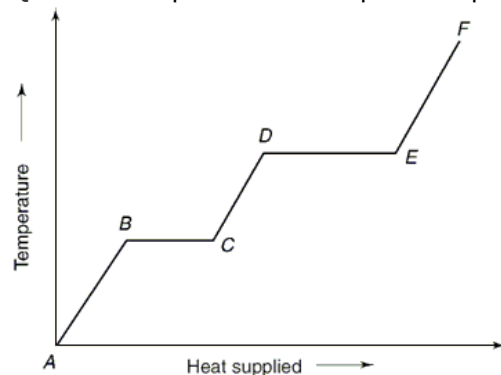
$$5 = (10 + 0 + W_{CA})$$

Solve: $\Rightarrow W_{CA} = -5 \text{ J}$

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Q.17 The reciprocal of the slope of the portion EF of the graph shown below represents



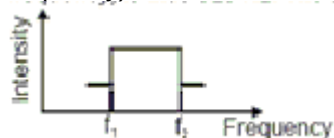
- a. latent heat of fusion
- b. latent heat of vaporization
- c. thermal capacity of the liquid
- d. thermal capacity of the vapour

Answer:4

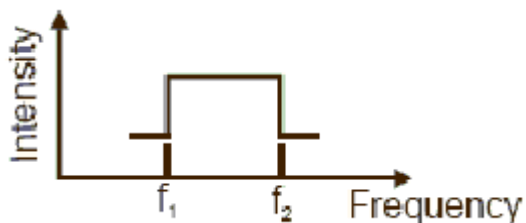
Q.18 **Directions:** The following question is based on the paragraph given below.

Two trains A and B are moving with speeds 20 m/s and 30 m/s respectively, in the same direction on the same straight track with B ahead of A. The engines are at the front ends. The engine of train A blows a long whistle.

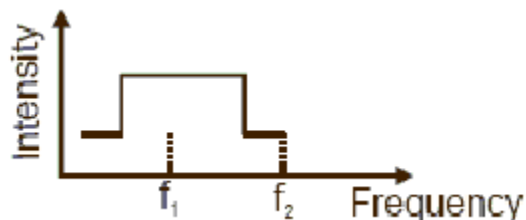
Assume that the sound of the whistle is composed of components varying in frequency from $f_1 = 800$ Hz to $f_2 = 1120$ Hz, as shown in the figure. The spread in the frequency (highest frequency – lowest frequency) is thus, 320 Hz. The speed of sound in still air is 340 m/s.



The distribution of the sound intensity of the whistle as observed by the passengers in train A, is best represented by



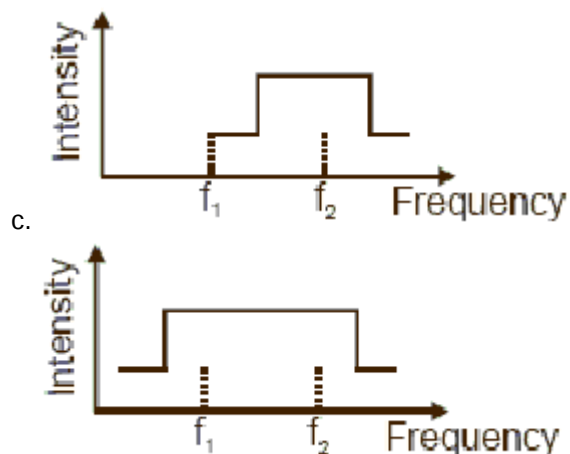
a.



b.

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d.
Answer:1

CHEMISTRY

Q.19 . The colour of light absorbed by an aqueous solution of CuSO_4 is

- orange red
- blue green
- yellow
- violet

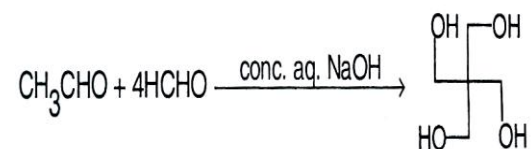
Answer:1

Q.20 Which ordering of compounds is according to the decreasing order of the oxidation state of nitrogen ?

- HNO_3 , N_2 , NH_4Cl , N_2
- HNO_3 , N_2 , NH_4Cl , N_2
- HNO_3 , NH_4Cl , NO , N_2
- N_2 , HNO_3 , NH_4Cl , N_2

Answer:2

Q.21 . The number of aldol reaction(s) that occurs in the given transformation is

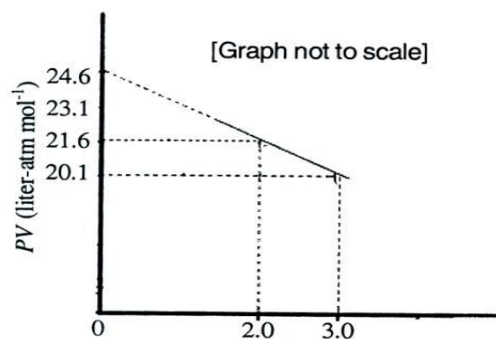


- 1
- 2
- 3
- 4

Answer:3

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Q.22 For one mole of a van der Waals gas when $b = 0$ and $T = 300$ K, the PV vs. $1/V$ plot is shown below. The value of the van der Waals constant a ($\text{atm} \cdot \text{liter}^2 \text{mol}^{-2}$) is



- a. 1.0
- b. 4.5
- c. 1.5
- d. 3.0

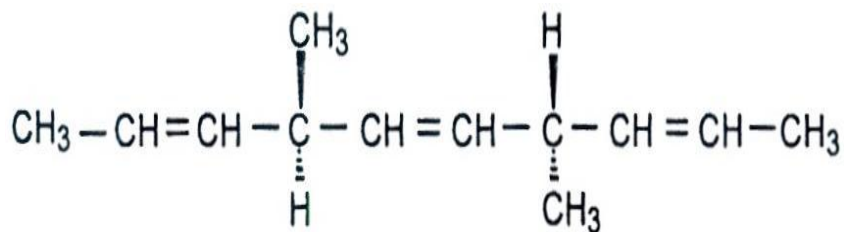
Answer:3

Q.23 In allene (C_3H_4), the type(s) of hybridization of the carbon atoms is (are)

- a. sp and sp^3
- b. sp and sp^2
- c. only sp^2
- d. sp^2 and sp^3

Answer:2

Q.23 The number of optically active products obtained from the complete ozonolysis of the given



compound is

- a. 1
- b. 0
- c. 2

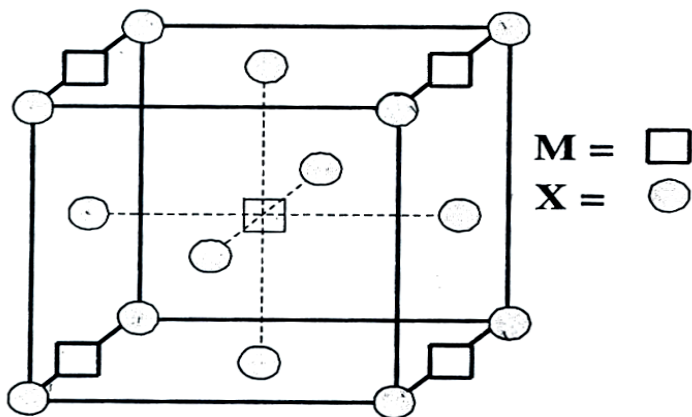
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d. 4

Answer:1

Q.24 A compound M_pX_q has cubic close packing (ccp) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



a. MX

b. MX_2

c. M_2X

d. M_5X_{14}

Answer:2

Q.25 As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is

a. Tetraaquadiaminecobalt (III) chloride

b. Tetraaquadiaminecobalt (III) chloride

c. Diaminetetraaquacobalt (III) chloride

d. Diamminetetraaquacobalt (III) chloride

Answer:4

Q.26 The carboxyl functional group (COOH) is present in

a. picric acid

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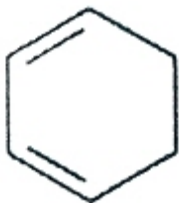
b. barbituric acid

c. ascorbic acid

d. aspirin

Answer:4

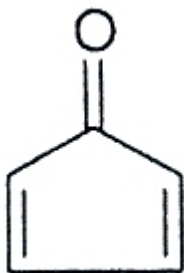
Q.27 Which of the following molecules, in pure form, is (are) unstable at room temperature?



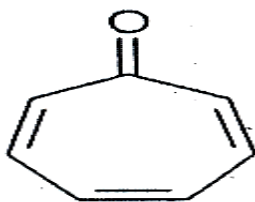
a.



b.



c.



Answer:2

Q.28 Identify the binary mixture(s) that can be separated into individual compounds, by differential extraction, as shown in the given scheme

a. $\text{C}_6\text{H}_5\text{OH}$ and $\text{C}_6\text{H}_5\text{COOH}$

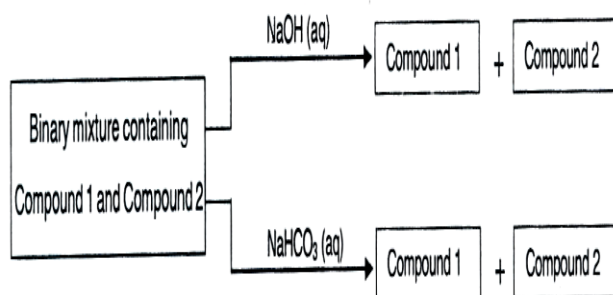
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$\text{C}_6\text{H}_5\text{COOH}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

$\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ and $\text{C}_6\text{H}_5\text{OH}$

$\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ and $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$

Answer:1



Q.29 Choose the correct reason(s) for the stability of the lyophobic colloidal particles.

- a. Preferential adsorption of ions on their surface from the solution
- b. Preferential adsorption of solvent on their surface from the solution
- c. Attraction between different particles having opposite charges on their surface
- d. Potential difference between the fixed layer and the diffused layer of opposite charges around the colloidal particles

Answer:1

Q.30 The number of oxygen atoms contained in 1000 g of water is

- a. 3.341×10^{25}
- b. 6.023×10^{23}
- c. 6.692×10^{25}
- d. 3.341×10^{23}

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Answer:1

Q.31 Which of the following hydrogen halides react(s) with $\text{AgNO}_3(\text{aq})$ to give a precipitate that dissolves in $\text{Na}_2\text{S}_2\text{O}_3(\text{aq})$?

- a. HC
- b. HF
- c. HBr
- d. HI

Answer:1

Q.32 The reaction $v_1\text{A} + v_2\text{B} \longrightarrow \text{products}$ is first order with respect to A and zero-order with respect to B. If the reaction is started with $[\text{A}]_0$ and $[\text{B}]_0$, the integrated rate expression of this reaction would be

- a. $\ln \frac{[\text{A}]_0}{[\text{A}]_0 - x} = k_1 t$
- b. $\ln \frac{[\text{A}]_0}{[\text{A}]_0 - v_1 x} = k_1 t$
- c. $\ln \frac{[\text{A}]_0}{[\text{A}]_0 - v_1 x} = v_1 k_1 t$
- d. $\ln \frac{[\text{A}]_0}{[\text{A}]_0 - x} = v_1 k_1 t$

Answer:3

PART III – MATHEMATICS

Q.33 The point P is the intersection of the straight line joining the points Q(2, 3, 5) and R (1, -1, 4) with the plane $5x - 4y + z = 1$. If S is the foot of the perpendicular drawn from the point T(2, 1, 4) to QR, then the length of the line segment PS is

- a. $1/\sqrt{2}$
- b. $\sqrt{2}$
- c. 2

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2V2

Answer:1

Q.34 Let z be a complex number such that the imaginary part of z is nonzero and $a = z^2 + z + 1$ is real. Then a cannot take the value

- a. -1
- b. $1/3$
- c. $\frac{1}{2}$
- d. $\frac{3}{4}$

Answer:4

Q.35 The total number of ways in which 5 balls of different colours can be distributed among 3 persons so that each person gets at least one ball is

- a. 75
- b. 150
- c. 210
- d. 243

Answer:2

Q.36 The function $f : [0, 3] \rightarrow [1, 29]$, defined by $f(x) = 2x^3 - 15x^2 + 36x + 1$, is

- a. one-one and onto
- b. onto but not one-one.
- c. one-one but not onto.
- d. neither one-one nor onto.

Answer:2

Q.37 . The locus of the mid-point of the chord of contact of tangents drawn from points lying on the straight line $4x - 5y = 20$ to the circle $x^2 + y^2 = 9$ is

- a. $20(x^2 + y^2) - 36x + 45y = 0$
- b. $20(x^2 + y^2) + 36x - 45y = 0$

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c. $36(x^2 + y^2) - 20x + 45y = 0$

d. $36(x^2 + y^2) - 20x - 45y = 0$

Answer:1

Q.38 Let $P = [a_{ij}]$ be a 3×3 matrix and let $Q = [b_{ij}]$, where $b_{ij} = 2^{i+j} a_{ij}$ for $1 \leq i, j \leq 3$. If the determinant of P is 2, then the determinant of the matrix Q is

a. 2^{10}

b. 2^{11}

c. 2^{12}

d. 2^{13}

Answer:4

Q.39 For which of the following values of m , is the area of the origin bounded by the curve $y = x - x^2$ and the line $y = mx$ equals $9/2$?

a. -4

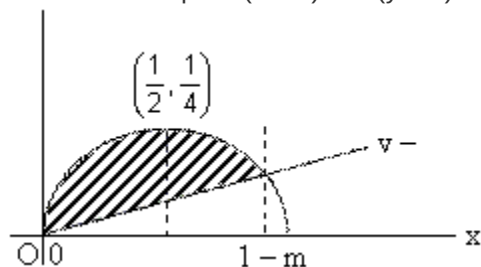
b. -2

c. 2

d. 4

Answer:3

Solve The equation of curve is $y = x - x^2$ which implies $x^2 - x = -y$ which implies $(x - \frac{1}{2})^2 = - (y - \frac{1}{4})$.



This is parabola whose vertex is $(\frac{1}{2}, \frac{1}{4})$.

Hence, point of intersection of the curve and the line $x - x^2 = mx$

which implies $x(1 - x - m) = 0$ i.e., $x = 0$

or $x = 1 - m$

IIT JEE 2012 Question Paper & Solution

PAPER 1

Q.40 The area enclosed between the curves $y = ax^2$ and $x = ay^2$ ($a > 0$) is 1 square unit. Find the value of

a. $\frac{1}{\sqrt{3}}$

b. $\frac{1}{2}$

c. 1

d. $\frac{1}{3}$

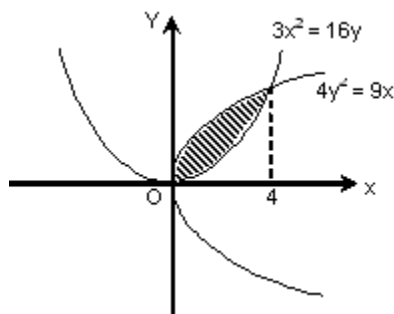
Answer:1

The two curves meet where

$$x = a(ax^2)^2 \Rightarrow x = a^3 x^4 \Rightarrow x = 0, \frac{1}{a}$$

Area in reference

$$= \int_0^{1/a} \left(\sqrt{\frac{x}{a}} - ax^2 \right) dx$$



$$\Rightarrow 1 = \frac{1}{\sqrt{a}} \frac{2}{3} \left[x^{3/2} \right]_0^{1/a} - \left[\frac{ax^3}{3} \right]_0^{1/a}$$

$$\Rightarrow 1 = \frac{2}{3} \frac{1}{\sqrt{a}} \frac{1}{a^{3/2}} - \frac{a}{3} \left(\frac{1}{a^3} \right) \Rightarrow 1 = \frac{1}{3a^2}$$

$$\Rightarrow a^2 = \frac{1}{3} \Rightarrow a = \frac{1}{\sqrt{3}}$$