PAPER 2

IIT JEE 2012 Question Paper & Solution

Q.1 A student is performing the experiment of Resonance Column. The diameter of the column tube is 4 cm. The frequency of the tuning fork is 512 Hz. The air temperature is 38ºC in which the speed of sound is 336 m/s. The zero of the meter scale coincides with the top end of the Resonance Column tube. When the first resonance occurs, the reading of the water level in the column is

a. 14.0 cm

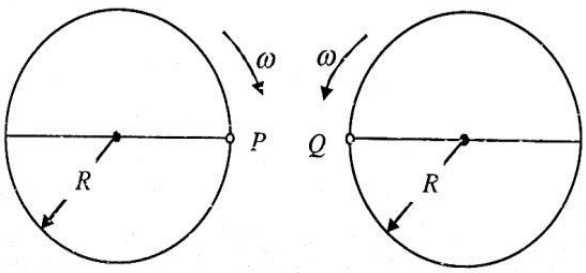
b. 15.2 cm

c. 16.4 cm

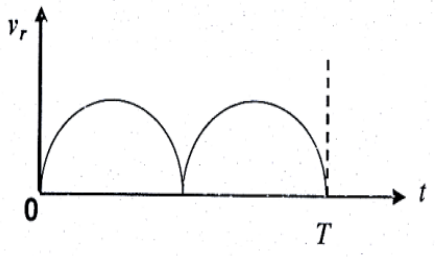
d. 17.6 cm

Answer:2

Q.2 Two identical discs of same radius R are rotating about their axes in opposite directions with the same constant angular speed . The discs are in the same horizontal plane. At time t = 0, the points P and Q are facing each other as shown in the figure. The relative speed between the two points P and Q is vr . In one time period (T) of rotation of the discs, vr as a function of time is best represented by



a.



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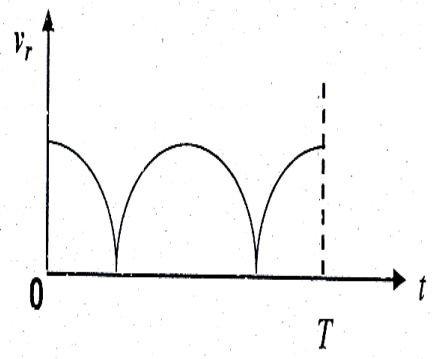

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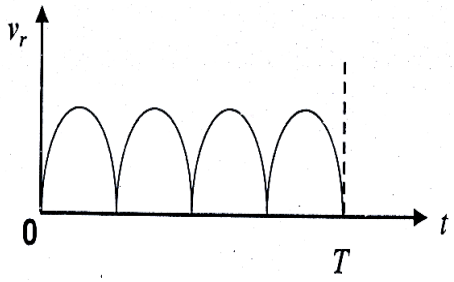
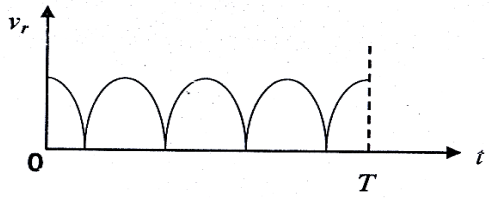
c.

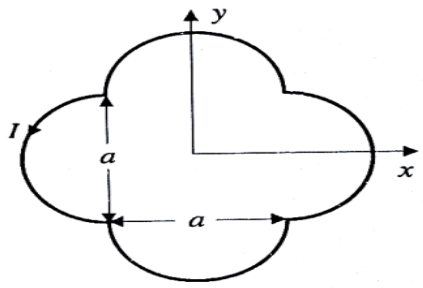


d.



Answer:1

Q.3 A loop carrying current I lies in the x-y plane as shown in the figure. The unit vector ˆ k is coming out of the plane of the paper. The magnetic moment of the current loop is



a. a^2 Ik
b. $(\pi/2 + 1)\, a^2$Ik
c. $-(\pi/2 + 1)\, a^2$Ik
d. $(2\ 1)a^2$ Ik

Answer:2

Q.4 An infinitely long hollow conducting cylinder with inner radius R/2 and outer radius R carries a uniform current density along its length. The magnitude of the magnetic field, | B | as a function of the radial distance r from the axis is best represented by

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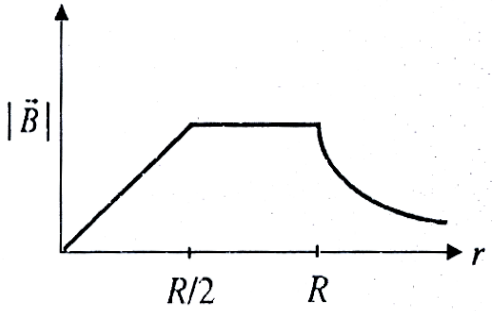
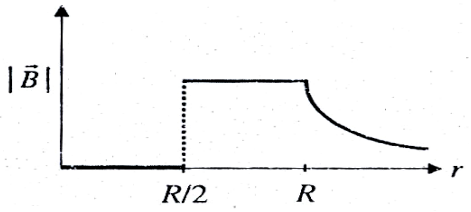
a.



b.



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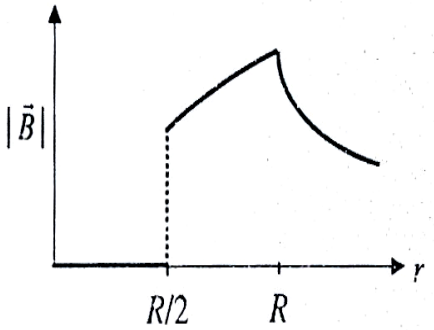
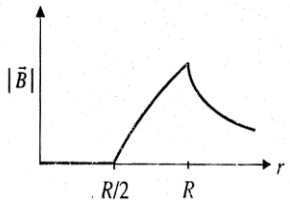


d.



Answer:4

Q.5 A thin uniform cylinder shell, closed at both ends is partially filled with water. It is floating vertically in water in half-submerged state. If p_c is the relative density of the material of the shell with respect to water, then the correct statement is that the shell is

(A) more than half-filled if p_c is less than 0.5

(B) more than half-filled if p_c is less than 1.0

(C) half-filled if p_c is more than 0.5

(D) less than half-filled if p_c is less than 0.5

Answer:1

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Q.6 In the given circuit, a charge of +80µ C is given to the upper plate of the 4 µF capacitor. Then in the steady state, the charge on the upper plate of the 3µ F capacitor is

a. +32µC

b. +40µC

c. +48µC

d. +80µC

Answer:3

Q.7 Two moles of ideal helium gas are in a rubber balloon at 30ºC. The balloon is fully expandable and can be assumed to require no energy in its expansion. The temperature of the gas in the balloon is slowly changed to 35ºC. The amount of heat required in raising the temperature is nearly (take R = 8.31 J/mol.K)

a. 62 J

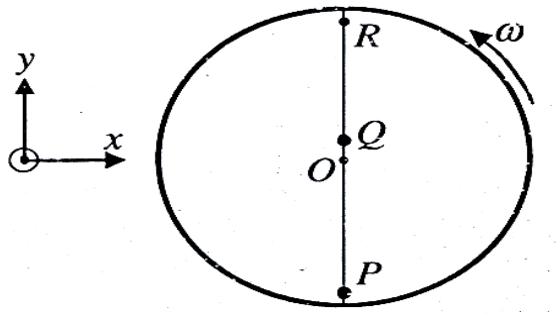
b. 104 J

c. 124 J

d. 208 J

Answer:4

Q.8Consider a disc rotating in the horizontal plane with a constant angular speedω about its centre O. The disc has a shaded region on one side of the diameter and an unshaded region on the other side a shown in the figure. When the disc is in the orientation as shown, two pebbles P and Q are simultaneously projected at an angle towards R. The velocity of projection is in the y-z plane and is same for both pebbles with respect to the disc.



Assume that (i) they land back on the disc before the disc has completed 1/8 rotation, (ii) their range is less than half the disc radius, and (iii)ω remains constant throughout. Then 18

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(A) P lands in the shaded region and Q in the unshaded region.
(B) P lands in the unshaded region and Q in the shaded region.
(C) Both P and Q land in the unshaded region.
(D) Both P and Q land in the shaded region.

Answer:3

SECTION II : Paragraph Type

Q. 9 If the anti-neutrino had a mass of 3 eV/c^2 (where c is the speed of light) instead of zero mass, what should be the range of the kinetic energy, K, of the electron?

a. $0 \leq K \leq 0.8 \leq 10^6$ eV

b. 3.0 eV$\leq K \leq 0.8 \times 10^6$ eV

c. 3.0 eV$\leq K < 0.8 \times 10^6$ eV

d. $0 \leq K < 0.8 \times 10^6$ eV

Answer:4

Q.10. What is the maximum energy of the anti-neutrino?

a. Zero

b. Much less than 0.8×10^6 eV

c. Nearly 0.8×10^6eV

d. Much larger than $0.8\ 10^6$ eV

Answer:3

Q.11 Which of the following statements about the instantaneous axis (passing through the centre of mass) is correct ?

a. It is vertical for both the cases (a) and (b)

b. It is vertical for case (a); and is at 45^0 to the x - z plane and lies in the plane of the disc for case (b)

c. It is horizontal for case (a); and is at 45^0 è to the x z plane and is normal to the plane of the disc for case

d. It is vertical for case (a); and is at 45^0 to the x z plane and is normal to the plane of the disc for case (b)

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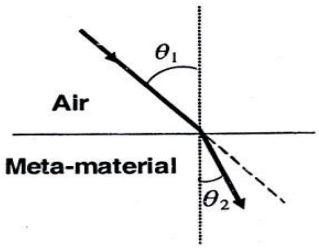
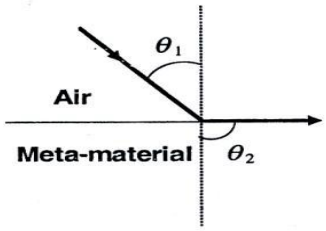
Answer:1

Q.12 For light incident from air on a meta-material, the appropriate ray diagram is

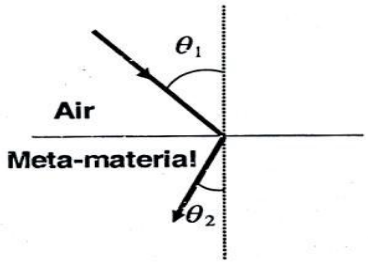
a.



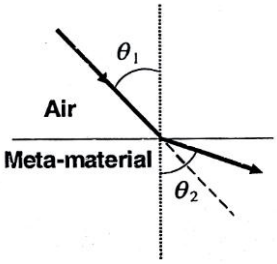
b.



c.



c.



d.

Answer:3

Q.13 A current carrying infinitely long wire is kept along the diameter of a circular wire loop, without touching it. The correct statement(s) is(are)

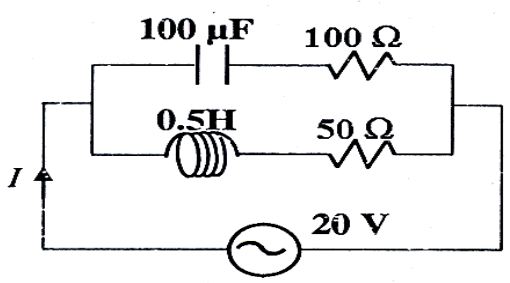
(A) The emf induced in the loop is zero if the current is constant

(B) The emf induced in the loop is finite if the current is constant

(C) The emf induced in the loop is zero if the current decreases at a steady rate
(D) The emf induced in the loop is finite if the current decreases at a steady rate

Answer: (A) (C)

Q.14 In the given circuit, the AC source hasω = 100 rad/s. Considering the inductor and capacitor to be ideal, the correct choice(s) is(are)



a.

a. The current through the circuit, I is 0.3 A

b. The current through the circuit, I is 0.3√2A

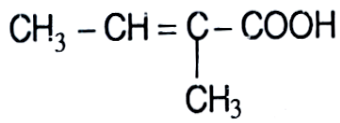
c. The voltage across 100 Ω resistor = 10 √2 V

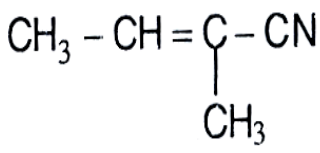
d. The voltage across 50 Ω resistor = 10 V

Answer:3

CHEMISTRY

Q.15 The major product H of the given reaction sequence is





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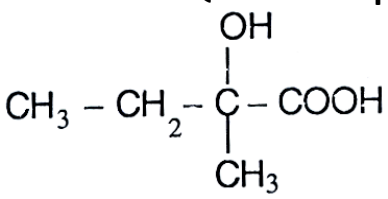

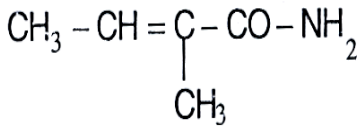

Answer:1

Q.16 . $NiCl_2$ $\{P(C_2H_5)_2(C_6H_5)\}2$ exhibits temperature dependent magnetic behavior (paramagnetic / diamagnetic). The coordination geometries of Ni^{2+} in the paramagnetic and diamagnetic states are respectively

a. tetrahedral and tetrahedral

b. square planar and square planar

c. tetrahedral and square planar

d. square planar and tetrahedral

Answer:3

Q.17 The reaction of white phosphorus with aqueous NaOH gives phosphine along with another phosphorus containing compound. The reaction type ; the oxidation states of phosphorus in phosphine and the other product are respectively

a. redox reaction ; 3 and 5

b. redox reaction; +3 and +5

c. disproportionation reaction ; - 3 and + 5

d. disproportionation reaction ; - 3 and + 3

Answer:2

Q.18 The shape of XeO_2F_2 molecule is

a. trigonal bipyramidal

b. square planar

c. tetrahedral

d. see saw

Answer:4

Q.19 . For a dilute solution containing 2.5 g of a non volatile non- electrolyte solute in 100 g of water, the elevation in boiling point at 1 atm pressure is 2 C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take K_b = 0.76 K kg mol^{-1})

a. 724

b. 740

c. 736

d. 718

Answer:1

Q.20 Consider the decay series: $A \rightarrow B \rightarrow C \rightarrow D$, where A, B and C are radioactive elements with half-life of 4.5 s, 15.0 s and 1.00 s respectively, and D is a non-radioactive element. Starting with 1.00 mole of A, the number of moles of A, B, C and D left after 30 days is/are

a. one mole of D and none of A, B or C

b. ¾ mole of B, ¼ mole of D and none of A or C

c. ¼ mole of B, ¾ mole of D and none of A or C

d. ½ mole of B, ¼ mole of C, ¼ mol of D and none of A

Answer3

Q.21 The value ofΔG (kJ mol^{-1}) for the given cell is (take 1F = 96500 C mol^{-1})

a. - 5.7

b. 5.7

C. 11.4

d. -11.4

Answer:4

Q.22 The compound **K** is

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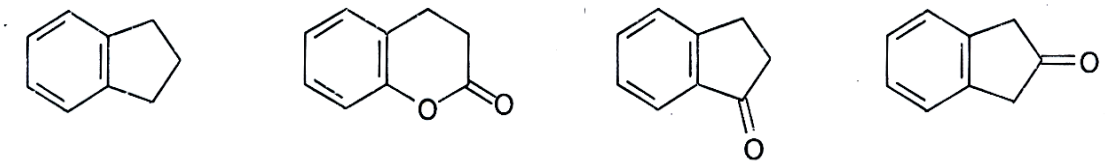


a.

Answer:3

Q.23 25 mL of household bleach solution was mixed with 30 mL of 0.50 M KI and 10 mL of 4 N acetic acid. In the titration of the liberated iodine, 48 mL of 0.25 N $Na_2S_2O_3$ was used to reach the end point. The molarity of the household bleach solution is

a. 0.48 M

b. 0.96 M

c. 0.24 M

d. 0.024 M

Answer:3

Q.24 Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is

a. Cl_2O

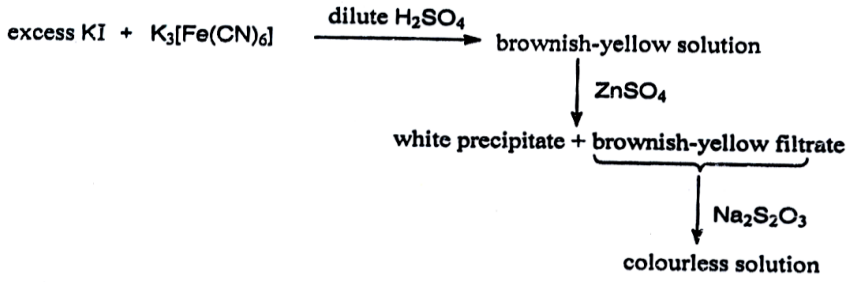
b. Cl_2O_7

c. ClO_2

d. Cl_2O_6

Answer:1

Q.25 For the given aqueous reactions, which of the statement(s) is (are) true?



a. The first reaction is a redox reaction

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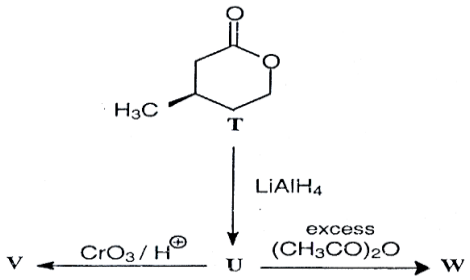
b. White precipitate is $Zn_3[Fe(ON)_6]_2$.

c. Addition of filtrate to starch solution gives blue colour

d. White precipitate is soluble in NaOH solution.

Answer:1

Q.26 With reference to the scheme given, which of the given statement(s) about **T, U, V** and **W** is (are) correct?



a. **T** is soluble in hot aqueous NaOH

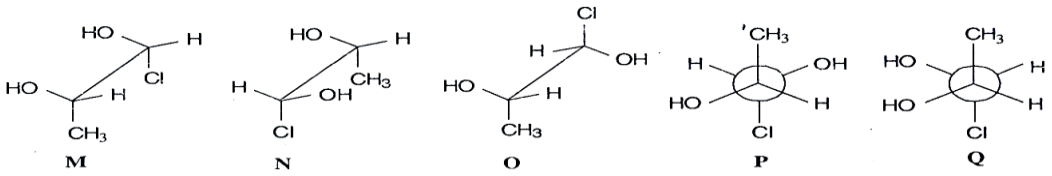
b. U is optically active

c. C. Molecular formula of W is $C_{10}H_{18}O_4$

d. V gives effervescence on treatment with aqueous $NaHCO_3$

Answer:1

Q.27 Which of the given statement(s) about N, O, P and Q with respect to M is (are) correct?



a. **M** and **N** are non mirror image stereoisomers

b. **M** and **O** are identical

c. **M** and **P** are enantiomers

d. **M** and **Q** are identical

Answer:1

Q.28 With respect to graphite and diamond, which of the statement(s) given below is (are) correct?

a. Graphite is harder than diamond.

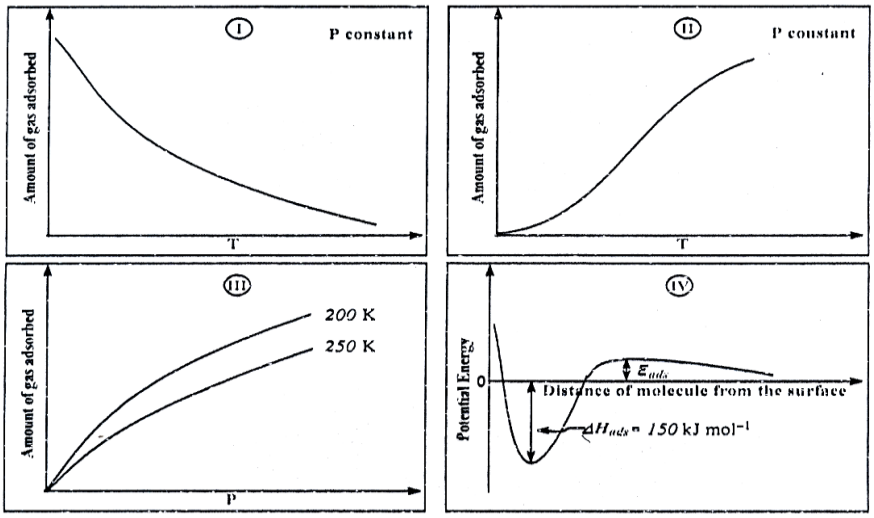
b. Graphite has higher electrical conductivity than diamond.

c. Graphite has higher thermal conductivity than diamond.

d. Graphite has higher C C bond order than diamond.

Answer:2

Q.29The given graphs/data **I, II, III** and **IV** represent general trends observed for different physisorption and chemisorption processes under mild conditions of temperature and pressure. Which of the following choice(s) about **I, II, III** and **IV** is (are) correct?



a. **I** is physisorption and **II** is chemisorptions
b. **I** is physisorption and **III** is chemisorptions
c. **IV** is chemisorption and **II** is chemisorptions
d. **IV** is chemisorption and **III** is chemisorptions

Answer:1

Q.30 The reversible expansion of an ideal gas under adiabatic and isothermal conditions is shown in the figure. Which of the following statement(s) is (are) correct?

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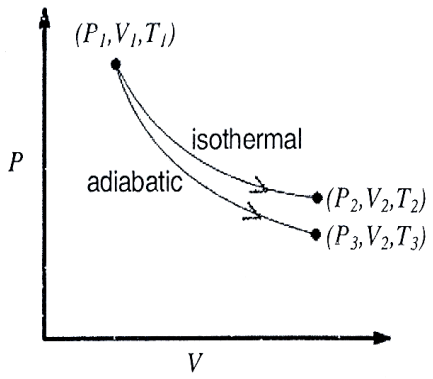

a. $T_1 = T_2$

b. $T_3 > T_1$

c. $W_{isothermal} > W_{adiabatic}$

d. $\Delta U_{isothermal} > U_{adiabatic}$

Answer:1

MATHEMATICS

Q. 31 Let $a_1, a_2, a_3, \ldots$ be in harmonic progression with $a_1 = 5$ and $a_{20} = 25$. The least positive integer n for which $a_n < 0$ is

a. 22

b. 23

c. 24

d. 25

Answer:4

Q.32 Four fair dice D_1, D_2, D_3 and D_4, each having six faces numbered 1, 2, 3, 4, 5 and 6, are rolled simultaneously. The probability that D_4 shows a number appearing on one of D_1, D_2 and D_3 is

a. 91/216

b. 108/216

c. 125/216

d.127/216

Answer:1

Q.33 If α, β, γ are the roots of the equation $4x^3 - 28x^2 + 43x - 15 = 0$, then $\sum \alpha^2 \beta$ is equal to

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a. 64

b. -64

c. 173/2

d. 173/2

Answer:1

Let α, β, γ are taken roots of the equation $\sum a = 7$ $\sum ab = \frac{43}{4}$ and $\alpha\beta\gamma = \frac{15}{4}$

Now use $\sum a^2\beta = (\sum a)(\sum ab) - 3\alpha\beta\gamma = 7 \times 43/4 - 45/4 = 256/4 = 64$.