AUEEE SAMPLE:

PART - A : CHEMISTRY

1. The IUPAC name of neopentane is

(1) 2, 2-dimethylpropane (2) 2-methylpropane

(3) 2, 2-dimethylbutane (4) 2-methylbutane

Answer (1)

Hints : CH3

– C– CH3

CH3

CH3

1 2 3

IUPAC name : 2, 2-dimethylpropane

2. Which one of the following reactions of Xenon compounds is not feasible?

(1) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5\ O_2$ (2) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

(3) $XeF_6 + RbF \rightarrow Rb[XeF_7]$ (4) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

Answer (4)

Hints : $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

3. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is:

(1) Salicylaldehyde (2) Salicylic acid

(3) Phthalic acid (4) Benzoic acid

Answer (2)

Hints :

OH

CO

NaOH

2

OH

COOH

Salicylic acid

4. Which of the following statements is incorrect regarding physissorptions?

(1) More easily liquefiable gases are adsorbed readily

(2) Under high pressure it results into multi molecular layer on adsorbent surface

(3) Enthalpy of adsorption (ΔHadsorption) is low and positive

(4) It occurs because of van der Waal's forces

Answer (3)

Hints : Physisorption is an exothermic process with ΔH –20 kJ/mol

5. Which of the following has an optical isomer?

(1) [Co (en) (NH3)

2]

2+ (2) [Co (H2O)4 (en)]3+

(3) [Co (en)2 (NH3)

2]

3+ (4) [Co (NH3)

3 Cl]+

Answer (3)Hints :

Co

en

NH3

NH3

en Co

en

NH3

NH3

en

6. Solid Ba(NO3)

2 is gradually dissolved in a 1.0 × 10–4 M Na2CO3 solution. At what concentration of Ba2+ will a

precipitate begin to form? (Ksp for $BaCO_3 = 5.1 \times 10^{-9}$)

(1) 5.1×10^{-5} M (2) 8.1×10^{-8} M

(3) 8.1×10^{-7} M (4) 4.1×10^{-5} M

Answer (1)

Hints : $[CO_3^{2-}] = 10^{-4}$ M

$K_{sp}[BaCO_3] = [Ba^{2+}][CO_3^{2-}]$

$\Rightarrow [Ba^{2+}] = \frac{K_{sp}}{[CO_3^{2-}]} = \frac{5.1 \times 10^{-9}}{10^{-4}}$

$x = 5.1 \times 10^{-5}$ M

7. Calculate the wavelength (in nanometer) associated with a proton moving at 1.0×103 ms^{-1}

(Mass of proton = 1.67×10^{-27} kg and $h = 6.63 \times 10^{-34}$ Js)

(1) 0.40 nm (2) 2.5 nm

(3) 14.0 nm (4) 0.032 nm

Answer (1)

Hints : $\lambda = \frac{h}{h}$

p mv =

or

34

27 3

6.63 10

1.67 10 10

–

–

× λ = × × = 0.4 nm

8. In context with the transition elements, which of the following statements is incorrect?

(1) In the highest oxidation states, the transition metals show basic character and form cationic complexes

(2) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons

are used for bonding.

(3) Once the d5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases

(4) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in

complexes

Answer (1)

Hints : In the highest oxidation states, the transition metals show acidic character.9. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainity with which the

position of the electron can be located is (h = 6.6 × 10–34 kg m2s–1, mass of electron, em = 9.1 × 10–31 kg)

(1) 5.10 × 10–3 m (2) 1.92 × 10–3 m

(3) 3.84 × 10–3 m (4) 1.52 × 10–4 m

Answer (2)

Hints : h

p x 4

Δ · Δ ≥

π

h

x

4 m V

Δ =

π · Δ

=

34

31

6.6 10 100

4 3.14 9.1 10 600 0.005

−

−

× ×

× ×× × ×

= 1.92 × 10–3 m

10. Which of the following pairs represents linkage isomers?

(1) [Pd(P Ph3)2 (NCS)2] and [Pd(P Ph3)

2(SCN)2]

(2) [Co (NH3)

5 NO3]SO4 and [Co(NH3)

5SO4] NO3

(3) [Pt Cl2(NH3)

4]Br2 and [PtBr2(NH3)

4]Cl2

(4) [Cu(NH3)

4] [PtCl4] and [Pt(NH3)

4] [CuCl4]

Answer (1)

Hints : SCN^- is an ambidentate ligand.

11. In bond dissociation energy of B-F in BF_3 is 646 kJ mol^{-1} whereas that of C-F in CF_4 is 515 kJ mol^{-1}. The

correct reason for higher B-F bond dissociation energy as compared to that of C-F is

(1) Stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4

(2) Significant pπ - pπ interaction between B and F in BF_3 whereas there is no possibility of such interaction

between C an F in CF_4

(3) Lower degree of pπ - pπ interaction between B and F in BF_3 than that between C and F in CF_4

(4) Smaller size of B-atom as compared to that of C-atom

Answer (2)

Hints : In BF_3, F forms pπ - pπ back bonding with B.

12. Using MO theory predict which of the following species has the shortest bond length?

(1) O_2

$+$ (2) O_2

$-$

(3) $2\ O_2$

$-$ (4) $2\ O_2$

$+$

Answer (4)

Hints : Higher is the bond order, shorter is the bond length.

Bond order of $2\ O_2$

$+$ is 3.013. A liquid was mixed with ethanol and a drop of concentrated H_2SO_4 was added. A compound with a fruity smell

was formed. The liquid was

(1) HCHO (2) CH_3COCH_3 (3) CH_3COOH (4) CH_3OH

Answer (3)

Hints : Liquid + ethanol H^+

⟶ Fruity smell compound

↓ ↓

Carboxylic acid Must be ester

CH3COOH + C2H5OH H+

⟶ CH3COOC2H5

14. Which of the following on heating with aqueous KOH, produces acetaldehyde?

(1) CH3CH2Cl (2) CH2ClCH2Cl (3) CH3CHCl2 (4) CH3COCl

Answer (3)

Hints : CH CHCl 3 2

aq. KOH CH3CH

OH

OH

unstable

–H2O

CH3CHO

gem-dihalide

15. Buna-N synthetic rubber is a copolymer of

(1) H2C = CH – CH = CH2 and H5C6 – CH = CH2 (2) H2C = CH – CN and H2C = CH – CH = CH2

(3) H2C = CH – CN and 2 2

3

H C CH C CH

|

CH

= −= (4) 2 2

Cl

|

HC C= −= H C CH and H2C = CH – CH = CH2

Answer (2)

Hints : Acrylonitrile + 1, 3-butadiene → Buna-N

(Bu = Butadiene, na → Sodium, a polymerising agent, N = Nitrile)

16. The two functional groups present in a typical carbohydrate are

(1) –CHO and –COOH (2) >C = O and –OH

(3) –OH and –CHO (4) –OH and –COOH

Answer (2)

Hints :

A typical carbohydrate contains –OH and >C = O.

17. In Which of the following arrangements, the sequence is not strictly according to the property written against

it?

(1) HF < HCl < HBr < HI : increasing acid strength

(2) NH_3 < PH_3 < AsH_3 < SbH_3 : increasing basic strength

(3) B < C < O < N : increasing first ionization enthalpy

(4) CO_2 < SiO_2 < SnO_2 < PbO_2 : increasing oxidising power

Answer (2)

Hints :

NH_3 is more basic.18. A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements

is correct regarding the behaviour of the solution?

(1) The solution is non-ideal, showing +ve deviation from Raoult's Law

(2) The solution is non-ideal, showing –ve deviation from Raoult's Law

(3) n-heptane shows +ve deviation while ethanol shows –ve deviation from Raoult's Law

(4) The solution formed is an ideal solution

Answer (1)

Hints : Ethanol has H-Bonding, n-heptane tries to break the H-bonds of ethanol, hence, V.P. increases. Such a

solution shows positive deviation from Raoult's Law.

19. The set representing the correct order of ionic radius is

(1) Na+ > Li+ > Mg2+ > Be2+

(2) Li

+ > Na+ > Mg2+ > Be2+

(3) Mg2+ > Be2+ > Li+ > Na+

(4) Li

+ > Be2+ > Na+ > Mg2+

Answer (1)

Hints :

Na+ > Li+ > Mg2+ > Be2+

20. Arrange the carbanions, (CH3)3 C , CCl3 , (CH3)2CH , C6H5CH2 , in order of their decreasing stability

(1) (CH3)

2CH > CCl3> C6H5CH2 > (CH3)

3 C

(2) CCl3 > C6H5CH2 > (CH3)2CH > (CH3)

3 C

(3) (CH3)

3 C > (CH3)

2CH > C6H5CH2 > CCl3

(4) C6H5CH2 > CCl3 > (CH3)3 C > (CH3)2CH

Answer (2)

Hints :

CCl

3 > C6H5CH2 > (CH3)2CH > (CH3)3C

21. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following

statements is incorrect?

(1) The ionic sizes of Ln (III) decrease in general with increasing atomic number

(2) Ln (III) compounds are generally colourless

(3) Ln (III) hydroxides are mainly basic in character

(4) Because of the large size of the Ln (III) ions the bonding in its compounds is predominently ionic in character

Answer (2)

Hints :

Ln (III) compounds are generally coloured.22. The alkene that exhibits geometrical isomerism is

(1) 2 - methyl propene (2) 2 - butene

(3) 2 - methyl - 2 - butene (4) Propene

Answer (2)

Hints :

C

CH3

H

C

cis-2-Butene

CH3

H

and C

CH3 H

C

trans-2-Butene

H CH3

23. The number of stereoisomers possible for a compound of the molecular formula CH3 – CH = CH – CH(OH) – Me is

(1) 2 (2) 4

(3) 6 (4) 3

Answer (2)

Hints :

CH3CH = CH – CH

*

(OH)Me has

C

CH3 H

C

H CH(OH)Me

+ its enantiomer

Me

H

H

C

C = C

Me

H OH

H

C

Me

H

C = C

HO H

Me

C CH3

H

C

CH(OH)Me

H + its enantiomer

H

Me

H

C

C = C

Me

H OH

H

C

H

Me

C = C

HO H

Me

24. In Cannizzaro reaction given below

2PhCHO : OH PhCH2OH + PhCO2

:

the slowest step is

(1) The transfer of hydride to the carbonyl group

(2) The abstraction of proton from the carboxylic group

(3) The deprotonation of PhCH2OH

(4) The attack of : OH at the carboxyl group

Answer (1)

Hints :

In Cannizzaro reaction, the transfer of hydride to the carbonyl group is the rate determining step.25. On the basis of the following thermochemical data : (fG^o H(aq) + = 0)

H2O(l) → H+(aq) + OH–(aq); ΔH = 57.32 kJ

H2(g) +

1

2 O2(g) → H2O(l); ΔH = –286.20 kJ

The value of enthalpy of formation of OH– ion at 25ºC is

(1) –228.88 kJ (2) +228.88 kJ

(3) –343.52 kJ (4) –22.88 kJ

Answer (1)

Hints:

I. H2O(l) → H+(aq) + OH–(aq); ΔH = 57.32 kJ

II. H2

(g) +

1

2 O2

(g) → H2

O(l); ΔH = –286.20 kJ

Adding I & II we get,

H2

(g) +

1

2 O2(g) → H+(aq) + OH–

(aq)

ΔH = 57.32 – 286.2

= –228.88 kJ

26. Copper crystallises in fcc with a unit cell length of 361 pm. What is the radius of copper atom?

(1) 127 pm (2) 157 pm (3) 181 pm (4) 108 pm

Answer (1)

Hints:

r =

a 361 127.6 pm 22 22 = =

27. In a fuel cell methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is

$CH_3OH(l) + \frac{3}{2} O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

At 298 K standard Gibb's energies of formation for $CH_3OH(l)$, $H_2O(l)$ and $CO_2(g)$ are –166.2, –237.2 and –394.4 kJ mol–1 respectively. If standard enthalpy of combustion of methanol is –726 kJ mol–1, efficiency of the fuel cell will be

(1) 87% (2) 90%

(3) 97% (4) 80%

Answer (3)

Hints:

$CH_3OH(l) + \frac{3}{2} O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

$\Delta G_{reaction} = \Delta G_{products} - \Delta G_{reactant}$

$= [-394.4 - 2 \times 237.2] - [-166.2]$

$= -702.6$ kJWe know, efficiency of a fuel cell,

$\eta = \frac{\Delta G}{\Delta H} \times 100$

$= \frac{-702.6}{-726} \times 100$

97%

28. Two liquids X and Y from an ideal solution. At 300 K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mmHg. At the same temperature, if 1 mol of Y is further added to this solution, vapour

pressure of the solution increases by 10 mmHg. Vapour pressure (in mmHg) of X and Y in their pure states

will be, respectively

(1) 300 and 400 (2) 400 and 600

(3) 500 and 600 (4) 200 and 300

Answer (2)

Hint :

Let V. P. of pure X = x

and V. P. of pure Y = y

Then,

1

4 x +

3

4 y = 550 ...(i)

and

1

5 x +

4

5 y = 560 ...(ii)

Solving (i) and (ii), we get

x = 400 mm

and y = 600 mm

29. Given 3

0

Fe

Fe

E + = – 0.036 V, 2

0

Fe

Fe

E + = – 0.439 V

The value of standard electrode potential for the change, 3 Fe(aq)

+ + e– → Fe2+ (aq) will be

(1) 0.385 V (2) 0.770 V

(3) – 0.270 V (4) – 0.072 V

Answer (2)

Hint :

Fe3+

(1)

E = ? 0

Fe2+

(2)

E = – 0.439 V 0

Fe

(3)

E = – 0.036 V 0

ΔG0

1 + ΔG0

2 = ΔG0

3

⇒ – n1E0

1 – n2E0

2 = – n3E0

3

⇒ – E0 + 2 × 0.439 = +3 × 0.036

⇒ E0 = +0.77 V30. The half life period of a first order chemical reaction is 6.93 minutes. The time required for the completion of

99% of the chemical reaction will be (log 2 = 0.301)

(1) 23.03 minutes (2) 46.06 minutes

(3) 460.6 minutes (4) 230.3 minutes

Answer (2)

Hint :

t

1/2 =

ln 2

k

⇒ k =

2.303 0.301

6.93

×

Also, t =

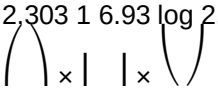
2.303 log – 0.99

a

k a a

⇒ t =

2.303 1 6.93 log 2.303 0.301 0.01



= 46.05 minutes

PART - B : MATHEMATICS

Directions : Questions number 31 to 35 are Assertion-Reason type questions. Each of these questions contains

two statements :

Statement -1 (Assertion) and Statement-2 (Reason)

Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select

the correct choice.

31. Statement-1 : ~ (p ↔ ~q) is equivalent to p ↔ q.

Statement-2 : ~ (p ↔ ~q) is a tautology.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

Answer (2)

Hint :

p q ~q p ↔ (~q) ~[p ↔ (~q)] p ↔ q

T T F F T T

T F T T F F

F T F T F F

F F T F T T

∴ Statement (1) is true and statement (2) is false.32. Let A be a 2 × 2 matrix

Statement-1 : adj (adj A) = A

Statement-2 : |adj A| = |A|

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

Answer (1)

Hint :

Let A =

a b

c d

⎡ ⎤

⎢ ⎥⎣ ⎦

Then adj (A) =

–

–

d b

c a

⎡ ⎤

⎢ ⎥⎣ ⎦

∴ |A| = |adj A| = ad – bc

Also adj[adj A] =

a b

c d

⎡ ⎤

⎢ ⎥⎣ ⎦ = A

∴ Both statements are true but (2) is not correct explanation of (1).

33. Let f(x) = (x + 1)2 – 1, x ≥ – 1.

Statement-1 : The set {x : f(x) = f –1(x)} = {0, –1}.

Statement-2 : f is a bijection.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

Answer (2)

Hint :

We have, f(x) = (x + 1)2 – 1, x ≥ – 1

⇒ f′(x) = 2 (x + 1) ≥ 0 for x ≥ – 1

⇒ f(x) is one-one

Since co-domain of the given function is not given, hence it can be considered as R, the set of reals and consequently R is not onto.

Hence f is not bijective statement-2 is false.

Also f(x) = (x + 1)2 – 1 ≥ –1 for x ≥ – 1

⇒ Rf

= [–1, ∞)

Clearly f(x) = f –1(x) at x = 0 and x = – 1.

Statement-1 is true.34. Statement-1 : The variance of first n even natural numbers is

2 – 1

4

n .

Statement-2 : The sum of first n natural numbers is (1)

2

n n +

and the sum of squares of first n natural

numbers is (1) (2 1)

6

nn n + + .

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

Answer (3)

Hint :

Statement (2) is true.

var x =

2 2

– i i x x

n n

∑ ∑

=

4 (1) (2 1)

6

nn n

n

+ +

– (n + 1)2

=

2

3 (n + 1) (2n + 1) – (n + 1)2

=

(1)

3

n +

{4n + 2 – 3n – 3)

=

(1) (– 1)

3

n n +

=

2 – 1

3

n

∴ Statement (1) is false.

Statement (2) is true.

35. Let f(x) = x |x| and g(x) = sin x.

Statement-1 : gof is differentiable at x = 0 and its derivative is continuous at that point.

Statement-2 : gof is twice differentiable at x = 0.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not a correct explanation for Statement-1

(2) Statement-1 is true, Statement-2 is false

(3) Statement-1 is false, Statement-2 is true

(4) Statement-1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement-1

Answer (2)Hint :

f(x) = x |x| and g(x) = sin x

(gof) (x) =

2

2

– sin 0

0 0

sin 0

x x

x

x x

⎧ <

⎩

⎨ =

⎪

⎪⎩ >

For first derivative

LHD =

2

0

– sin lim

x

x

→ x

= –

2

2 0

– sin lim 0 x

x x

→ x =

= 0

RHD =

2

0

sin lim

x

x x

x x → + × = 0

∴ gof is differentiable at x = 0.

(gof)′ (x) =

2

2

– 2 cos 0

0 0

2 cos 0

x xx

x

xxx

$\begin{cases} < \\ = \\ > \end{cases}$

For second derivative,

LHD = –

2

0

– 2 cos lim

x

x x

→ x

= – 2

RHD =

2

0

2 cos lim

x

x x

x → + = 2

∴ (gof) is not twice differentiable at x = 2.

36. The area of the region bounded by the parabola (y – 2)2 = x – 1, the tangent to the parabola at the point

(2, 3) and the x-axis is

(1) 6 (2) 9

(3) 12 (4) 3

Answer (2)

Hints : The equation of tangent at (2, 3) to the given parabola is x = 2y – 4

Required area =

3 2

0 {(y yd − +− + 2) 1 2 4 } y ∫

=

3 3

2

0

(2) 5

3

y y y

⌈ ⌉ – ⎪ ⎪ – +

⌊ ⌋

(2, 3)

(–4, 0)

(– 2) = (– 1) y x = 2

1 8 9 15

3 3

− + +

= 9 sq. units.37. Given P(x) = x4 + ax3 + bx2 + cx + d such that x = 0 is the only real root of P'(x) = 0. If P(–1) < P(1), then

in the interval [–1, 1]

(1) P(–1) is not minimum but P(1) is the maximum of P

(2) P(–1) is minimum but P(1) is not the maximum of P

(3) Neither P(–1) is the minimum nor P(1) is the maximum of P

(4) P(–1) is the minimum and P(1) is the maximum of P

Answer (1)

Hints : We have P(x) = x4 + ax3 + bx2 + cx + d

–1 O 1

P (0,) d ′ (x) = 4x3 + 3ax2 + 2bx + c

P′ (0) = 0 ⇒ c = 0

Also P′ (x) = 0 only at x = 0

P′ (x) is a cubic polynomial changing its sign from (–)ve to (+)ve and passing through O.

∴ P′ (x) < 0 ∀ x < 0

P′ (x) > 0 ∀ x > 0

Hence the graph of P(x) is upward concave, where P′ (x) = 0

Now P(–1) < P(1)

⇒ P(–1) cannot be minimum in [–1, 1] as minima in this interval is at x = 0.

Hence in [–1, 1] maxima is at x = 1

Hence P(–1) is not minimum but P(1) is the maximum of P.

38. The shortest distance between the line y – x = 1 and the curve x = y2 is

(1)

2 3

8 (2)

3 2

5

(3) 3

4 (4)

3 2

8

Answer (4)

Hints : Let there be a point P(t

2, t) on x = y2

Its distance from x – y + 1 = 0 is

2 1

2

t t − +

Min (t

2 – t + 1) is

3

4

Shortest distance =

3 3 2

4 2 8 =39. Let the line

2 1 2

3 5 2

x yz − −+ = = − lie in the plane x + 3y – αz + β = 0. Then (α, β) equals

(1) (–6, 7) (2) (5, –15)

(3) (–5, 5) (4) (6, –17)

Answer (1)

Hints : The point (2, 1, –2) is on the plane x + 3y – αz + β = 0

Hence 2 + 3 + 2α + β = 0

2α + β = –5 ... (i)

Also 1(3) + 3(–5) + –α(2) = 0

3 – 15 – 2α = 0

2α = –12

α = –6

Put α = –6 in (i)

β = 12 – 5 = 7

∴ (α, β) ≡ (–6, 7)

40. From 6 different novels and 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged

in a row on a shelf so that the dictionary is always in the middle. Then the number of such arrangements is

(1) At least 500 but less than 750 (2) At least 750 but less than 1000

(3) At least 1000 (4) Less than 500

Answer (3)

Hints : The number of ways in which 4 novels can be selected = 6C4 = 15

The number of ways in which 1 dictionary can be selected = 3C1 = 3

4 novels can be arranged in 4! ways.

∴ The total number of ways = 15 × 4! × 3 = 15 × 24 × 3 = 1080.

41. In a binomial distribution $1, 4 B np \left(\quad\right) = \left|\quad\right| \left(\quad\right)$, if the probability of at least one success is greater than or equal to

9

10 , then n is greater than

(1)

10 10

1

log 4 log 3 + (2)

10 10

9

log 4 log 3 −

(3)

10 10

4

log 4 log 3 − (4)

10 10

1

log 4 log 3 −

Answer (4)Hints :

3 9 1

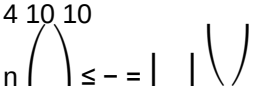
4 10

$n \left(\quad\right) - \geq \left|\quad\right| \left(\quad\right)$

⇒

3 9 1 1

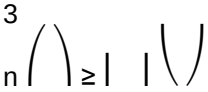
4 10 10



⇒

4 10

3



⇒ n[log4 – log3] ≥ log10 10 = 1

⇒

1

log 4 log3

n ≥ –

42. The lines p(p2 + 1)x – y + q = 0 and (p2 + 1)2x + (p2 + 1)y + 2q = 0 are perpendicular to a common line for

(1) Exactly one value of p (2) Exactly two values of p

(3) More than two values of p (4) No value of p

Answer (1)

Hints : Lines perpendicular to same line are parallel to each other.

∴ –p(p2 + 1) = p2 + 1

⇒ p = –1

∴ There is exactly one value of p.

43. If A, B and C are three sets such that A ∩ B = A ∩ C and A ∪ B = A ∪ C, then

(1) A = C (2) B = C

(3) A ∩ B = φ (4) A = B

Answer (2)

Hints : A ∩ B = A ∩ C and A ∪ B = A ∪ C

⇒ B = C

44. For real x, let f(x) = x3 + 5x + 1, then

(1) f is onto R but not one-one (2) f is one-one and onto R

(3) f is neither one-one nor onto R (4) f is one-one but not onto R

Answer (2)

Hints : f(x) = x3 + 5x + 1

f′ (x) = 3x2 + 5 > 0 ∀ x ∈ R

Hence f(x) is monotonic increasing. Therefore it is one-one.

Also it onto on R

Hence it one-one and onto R.45. The differential equation which represents the family of curves 2

1

c x y c = e , where c1 and c2 are arbitrary constants,

is

(1) y" = y′ y (2) yy" = y′

(3) yy" = (y′)

2 (4) y′ = y2

Answer (3)

Hints : Put 2 c e k =

Then y = c1.kx

⇒ loge y = loge c1 + x loge k

⇒

1 loge y k

y

′ =

⇒

2

2

1 1

y y( ) 0

y y ″ − ′ =

⇒ yy″ = (y′)2

46. Let a, b, c be such that b(a + c) ≠ 0. If

2 1

1 1 1 1 1

1 1 1 1 10

1 1 (1) (1) (1) n n n

a a a a b c

bb b a b c

cc c a bc + +

+ − + + −

− + −+ − − + =

− + − −−

, then the value

of n is

(1) Any even integer (2) Any odd integer

(3) Any integer (4) Zero

Answer (2)

Hints : Applying D' = D is first determinant and R2 ↔ R3 and R1 ↔ R2 in second determinant

2 1 (1) (1) (1)

1 1 1 1 1 10

111 1 1 1

n n n a b c a b c

abc a b c

abc a b c

+ + − − − −

+ + −+ + + − =

−−+ − − +

Then

2 1 (1) (1) (1)

1 1 10

1 11

n n n a a b bc c

a bc

a bc

+ + + − − +− +−

+ + −=

− −+

if n is an odd integer.

47. The remainder left out when 82n – (62)2n + 1 is divided by 9 is

(1) 2 (2) 7

(3) 8 (4) 0

Answer (1)

Hints : Put n = 0

Then when 1 – 62 is divided by 9 then remainder is same as when 63–61 is divided by 9 which is 2.48. Let y be an implict function of x defined by x2x – 2xx cot y – 1 = 0. Then y′(1) equals

(1) 1 (2) log 2

(3) –log 2 (4) –1

Answer (4)

Hints : ∵

2 () 2. cot 1 x x x xy − = , ∴ when x = 1, y = 2

π

Differentiating, 2 2. . (1 log) 2 cosec cot . (1 log) 0 x x x x

e

dy xx x x y yx x dx

⎡ ⎤ + −− + + = ⎢ ⎥⎣ ⎦

Put x = 1 and y = 2

π

2 2. 20 0 dy

dx

+ −x=

1 dy

dx = −

49. If the roots of the equation bx2 + cx + a = 0 be imaginary, then for all real values of x, the expression

3b2x2 + 6bcx + 2c2 is

(1) Less than 4ab (2) Greater than –4ab

(3) Less than –4ab (4) Greater than 4ab

Answer (2)

Hints : bx2 + cx + a = 0

Roots are imaginary c2 – 4ab < 0

f(x) = 3b2x2 + 6bcx + 2c2

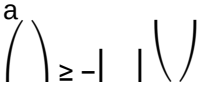
D = 36b2c2 – 24b2c2 = 12b2c2

∵ 3b2 > 0

∴ ( ) 4

D f x

a



2 f x( ) ≥ −c

Now c2 – 4ab < 0

c2 < 4ab

–c2 > – 4ab

∴ f(x) > – 4ab.

50. The sum to infinity of the series 2 3 4

2 6 10 14 1 ..... 33 3 3

++ + + + is

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

Answer (1)Hints : Let 234

2 6 10 14 1 ..... 3 333

S =+ + + + +

234

2 6 10 14 1 ..... 33 3 3

S −= + + + +

234 5

1 2 6 10 14 ..... 3 3333

S − =++++

⇒ 234

2 2 4 4 4 (1) 3 33 3 3

S −=+ + + +

⇒ 2 3

2 2 2 1 1 ..... 3 3 3

S −=+ + + +

⇒

2

3 2 1 1

3

S = +

−

= 2 + 1

= 3

51. The projections of a vector on the three coordinate axis are 6, –3, 2 respectively. The direction cosines of the

vector are

(1)

6 32 , ,

5 5 5

− (2)

6 32 , ,

7 7 7

−

(3)

6 3 2 , , 7 7 7

− − (4) 6, –3, 2

Answer (2)

Hints : Direction ratios are a = 6, b = –3 and c = 2

Then direction cosines are

6 3 2 , , 36 9 4 36 9 4 36 9 4

−

++ ++ ++

=

6 32 , ,

7 7 7

−

52. Let A and B denote the statements :

A : cosα + cosβ + cosγ = 0

B : sinα + sinβ + sinγ = 0

If cos(β – γ) + cos(γ – α) + cos(α – β) =

3

2 − , then

(1) A is false and B is true

(2) Both A and B are true

(3) Both A and B are false

(4) A is true and B is false

Answer (2)Hints : $2(\cos\beta\cos\gamma + \sin\beta\sin\gamma) + 2(\cos\gamma\cos\alpha + \sin\gamma\sin\alpha) + 2(\cos\alpha\cos\beta + \sin\alpha\sin\beta)$

$+ \sin2\alpha + \cos2\alpha + \sin2\beta + \cos2\beta + \sin2\gamma + \cos2\gamma = 0$

$\Rightarrow (\sin\alpha + \sin\beta + \sin\gamma)2 + (\cos\alpha + \cos\beta + \cos\gamma)2 = 0$

$\Rightarrow \sin\alpha + \sin\beta + \sin\gamma = 0 = \cos\alpha + \cos\beta + \cos\gamma$

$\therefore$ Both A and B are true.

53. One ticket is selected at random from 50 tickets numbered 00, 01, 02, ... , 49. Then the probability that the

sum of the digits on the selected ticket is 8, given that the product of these digits is zero, equals

(1)

1

7 (2)

5

14 (3)

1

50 (4)

1

14

Answer (4)

Hints : Restricting sample space as S = {00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 20, 30, 40}.

$\therefore$ P(sum of digits is 8) =

1

14 .

54. Three distinct points A, B and C are given in the 2 - dimensional coordinate plane such that the ratio of the

distance of any one of them from the point (1, 0) to the distance from the point (–1, 0) is equal to

1

3 . Then

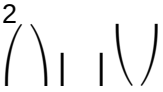
the circumcentre of the triangle ABC is at the point

(1)

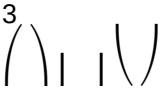
5 , 0

4
 (2)

5 , 0

2
 (3)

5 , 0

3
 (4) (0, 0)

Answer (1)

Hints : Let (x, y) denote the coordinates of A, B and C.

Then,

2 2

2 2

(1) 1

(1) 9

x y

x y

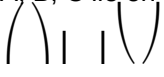
− + = + +

⇒ 9x2 + 9y2 – 18x + 9 = x2 + y2 + 2x + 1

⇒ 8x2 + 8y2 – 20x + 8 = 0

2 2 5 1 0

2 xy x + − + =

∴ A, B, C lie on a circle with 5 , 0 . 4
C 

55. If the mean deviation of the numbers 1, 1 + d, 1 + 2d, ..., 1 + 100d from their mean is 255, then the d is

equal to

(1) 20.0 (2) 10.1 (3) 20.2 (4) 10.0

Answer (2)

Hints : 1 (1) (1 2) .....(1 100)

101

dd d

x

++ ++ + + =

101 (1 2 3 .....100)

101

d

x

+ +++ =

100 101 101

2

101

d

x

× + ×

=

x = +1 50dMean deviation = |1 50 1| | 1 50 1 | ..... | 1 50 1 100 |

101

+ − + + −− + + −− d dd d d

=

50 49 48 ..... 0 2 50

101

d d d d dd d + + + ++ + +

=

50 51 2

2

101

⇒

50 51 255

101

× × d =

⇒ d = 10.1

56. The ellipse x2 + 4y2 = 4 is inscribed in a rectangle aligned with the coordinate axes, which in turn is inscribed

in another ellipse that passes through the point (4, 0). Then the equation of the ellipse is

(1) x2

+ 12y2

= 16 (2) 4x2

+ 48y2

= 48

(3) 4x2

+ 64y2

= 48 (4) x2

+ 16y2

= 16

Answer (1)

Hints : Let the equation of the required ellipse is

2 2

2 1

16

x y

b

+ =

(0, 1)

(2, 0) (4, 0)

x

2

4 + y 2

1 = 1

A(2, 1)

But the ellipse passes through (2, 1)

⇒ 2

1 1 1

4 b

+ =

⇒ 2

1 3

b 4 =

⇒ 2 4

3

b =

Hence equation is

2 2 3 1

16 4

x y × + =

⇒ x2 + 12y2 = 16

57. If 4 Z 2

Z − = , then the maximum value of |Z| is equal to

(1) 5 1 + (2) 2

(3) 2 2 + (4) 3 1+

Answer (1)Hints : 4 Z 2

Z − =

⇒

4 4 | | | |

Z Z

Z Z

− ≥ −

⇒

4 | | 2

| |

Z

z

− ≤

⇒ |Z|

2 – 4 – 2|Z| ≤ 0

⇒ |Z|

2 – 2|Z| – 4 ≤ 0

1 5| − ≤ ≤+ Z |1 5

Hence maximum value = 1 5 +

58. If P and Q are the points of intersection of the circles x2 + y2 + 3x + 7y + 2p – 5 = 0 and

x2 + y2 + 2x + 2y – p2 = 0, then there is a circle passing through P, Q and (1, 1) for

(1) All except one value of p

(2) All except two values of p

(3) Exactly one value of p

(4) All values of p

Answer (1)

Hints : x2 + y2 + 3x + 7y + 2p – 5 + λ(x2 + y2 + 2x + 2y – p2) = 0, λ ≠ –1 passes through point of intersection

of given circles.

Since it passes through (1, 1), hence

7 – 2p + λ(6 – p2) = 0

⇒ 7 – 2p + 6λ – λp2 = 0

If λ = –1, then 7 – 2p – 6 + p2 = 0

p2 – 2p + 1 = 0

p = 1

∵ λ ≠ –1 hence p ≠ 1

∴ All values of p are possible except p = 1

59. If u v, , w JG JG JJG

are non-coplanar vectors and p, q are real numbers, then the equality

[3u pv pw pv w qu w qv qu , ,] [, ,] [2 , ,] 0 −− = JG JG JJG JG JJG JG JJG JG JG holds for

(1) Exactly two values of (p, q)

(2) More than two but not all values of (p, q)

(3) All values of (p, q)

(4) Exactly one value of (p, q)

Answer (4)Hints : [3u pv pw pv w qu w qv qu] − − [ ] [2] JG JG JJG JG JJG JG JJG JG JG

= 2 2 3 [p u v.( )] [.( )] 2 [.( )] × − ×− × w pq v w u q w v u JG JG JJG JG JJG JG JJG JG JG

⇒ 2 2 (3p pq q u v w −+ × = 2)[.( )] 0

JG JG JJG

But uv w .( ) × ≠ 0 JG JG JJG

⇒ 3p2 – pq + 2q2 = 0

⇒ p = q = 0

60. 0

[cot] x dx

π

∫ , where [.] denotes the greatest integer function, is equal to

(1) 1 (2) –1 (3) 2

π − (4) 2

π

Answer (3)

Hints : 0

I x dx [cot]

π

= ∫

0

I xd [cot( )] x

π

= π − ∫

0

2 (I x x dx [cot] [cot])

π

= + − ∫

0

2 (I dx 1)

π

= − = −π ∫

2

I π = −

PART - C : PHYSICS

61. Consider a rubber ball freely falling from a height h = 4.9 m onto a horizontal elastic plate. Assume that the

duration of collision is negligible and the collision with the plate is totally elastic.

Then the velocity as a function of time and the height as a function of time will be

(1)

+v1

–v1

O

v

t

h

y

t

(2)

+v1

–v1

O

v

t

h

y

t

t1 2t1 4t1

(3) t

h

y

t

t1 2t1 4t1

(4) t

h

y

t

v

v1

O

Answer (2)Hints :

From v = u + at

v = 0 – g × t

⇒ v = –gt

And just after collision velocity is upwarded then after some time it becomes zero and then negative. Same

process repeats.

From 1 2

2

S u = +t at 4.9 m

1 2 4.9

2 h g = − t

So, graph will be downward parabola.

62. The height at which the acceleration due to gravity becomes 9

g (where g = the acceleration due to gravity

on the surface of the earth) in terms of R, the radius of the earth, is

(1) 2

R

(2) 2

R

(3) 2R (4) 2R

Answer (4)

Hints :

As,

2 ( )

1

g g h

h

R

=

⇒ 2 9

1

g g

h

R

=

⇒ 1 3 h

R

⇒ 2 2 h h R

R

= ⇒ =

63. A long metallic bar is carrying heat from one of its ends to the other end under steady state. The variation of

temperature θ along the length x of the bar from its hot end is best described by which of the following figures?

(1)

θ

x

(2)

θ

x

(3)

θ

x

(4)

θ

x

Answer (1)Hints :

As rate of heat flow through the rod is constant through each section.

1 2

0 0

T T

x x

k A k A

−θ θ− = A −

T1

(> T T 1 2)

T2

x

θ

⇒ 1 2

1

( ) T T x T − θ = − +

A

So, graph is

θ

x

64. Two point P and Q are maintained at the potentials of 10 V and –4 V respectively. The work done in moving

100 electrons from P to Q is

(1) 9.60 × 10–17 J (2) –2.24 × 10–16 J (3) 2.24 × 10–16 J (4) – 9.60 × 10–17 J

Answer (3)

Hints :

Q = 100e = –100 × 1.6 × 10–19 = –1.6 × 10–17C

ΔV = –14 V

∴ W = QΔ V = 14 × 1.6 × 10–17 = 2.24 × 10–16 J

Directions : Question numbers 65 and 66 are based on the following paragraph.

A current loop ABCD is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and

DA (radius = a) of the loop are joined by two straight wires AB and CD. A steady current I is flowing in the loop.

Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I

1 flowing out of

the plane of the paper is kept at the origin.

30°

O

I1

a A

B

C

D

I

b

65. The magnitude of the magnetic field (B) due to the loop ABCD at the origin (O) is

(1) 0 ( )

24

I b a

ab

μ − (2) 0

4

I b a

ab

μ ⌈ ⌉ –

⎪ ⎪π ⌊ ⌋

(3) 0 2( ) ( ) 4 3

I ba ab μ ⌈ ⌉ π

−+ + ⎪ ⎪π ⌊ ⌋ (4) Zero

Answer (1)Hints :

Magnetic field due to AB and CD is zero

∴ 0 0

net ˆ ˆ ( ) 4 6 4 6

I I Bkk

a b

μ μ π π

= ×× + ×× −

π π

G

0 1 1 ˆ

24

I k

a b

μ ⎛ ⎞ = × ⎫ ⎫ – ⎩ ⎭

0 ( ) ˆ

24

I b a k

ab

μ − =

66. Due to the presence of the current I

1 at the origin

(1) The forces on AD and BC are zero

(2) The magnitude of the net force on the loop is given by 1

0 2( ) ( ) 4 3

I I ba ab ⎡ ⎤ π

μ −+ + ⎢ ⎥ π ⎣ ⎦

(3) The magnitude of the net force on the loop is given by 0 1 ( ) 24

II b a

ab

μ −

(4) The forces on AB and DC are zero

Answer (1)

Hints :

In wire DA

I1

A

B

C

D

b

a

B

B d ↑↑ G G

A

∴ FDA = 0

In wire AB, d B×

G G A is upwards

In wire BC, B d ↑↓ ∴ = FBC 0 G G

A

In wire CD, d B×

G G A is downwards.

Since, AB and CD are symmetrical to I

1

So, 0. F F AB + = CD

JJJG JJJK

Directions : Question numbers 67, 68 and 69 are based on the following paragraph

Two moles of helium gas are taken over the cycle ABCDA, as shown in the P-T diagram

A B

D C

T

300 K 500 K

1 × 105

2 × 105

P(Pa)

T67. Assuming the gas to be ideal the work done on the gas in taking it form A to B is

(1) 300 R (2) 400 R (3) 500 R (4) 200 R

Answer (2)

Hints :

Since process is isobaric

WAB = 2 × R × 200 = 400R

68. The work done on the gas in taking it from D to A is

(1) +414R (2) –690R (3) +690R (4) –414R

Answer (1)

Hints :

Since process is isothermal

$\therefore W_{DA} = 2.303 \times 2 \times R \times 300 \log_{10} 2$

$= -415.8R \text{ J}$

So, work done on the gas = 415.8R J

Remarks : The exact answer is 415.8R J but the option given in the question is approximate.

69. The net work done on the gas in the cycle ABCDA is

(1) 276R (2) 1076R (3) 1904R (4) Zero

Answer (1)

Hints :

$W_{total} = W_{DA} + W_{BC}$, since $W_{AB} + W_{CD} = 0$

$= 2.303 \times 2 \times R \times 300 \log_{10} 2 + 2.303 \times 2 \times R \times 500 \log(2)$

$= 2.303 \times 2R \times 200 \log(2)$

$= 277.2R$

Remarks : The exact answer is 277.2R but the option given in the question is approximate.

70. In an experiment the angles are required to be measured using an instrument. 29 divisions of the main scale

exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is

half-a-degree (= 0.5°), then the least count of the instrument is

(1) Half minute (2) One degree (3) Half degree (4) One minute

Answer (4)

Hints :

29 Div of M.S = 30 Div of V.S

1 Div of V.S =

29

30 Div of M.S

Least count = 1 Div of M.S – 1 Div V.S

=

1

30 Div. of M.S

=

1 1 1 1 minute

30 2 60 ×= = °71. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other

two corners. If the net electrical force on Q is zero, then

Q

q equals.

(1) –1 (2) 1 (3)

1 – 2 (4) –2 2

Answer (4)

Hints :

Either of Q or q must be negative for equilibrium.

2

2 2 2

2

kQq kQ

l l =

q

q

Q

Q | | 2 2

| |

Q

q =

72. One kg of diatomic gas is at a pressure of 8 × 104 N/m2. The density of the gas is 4 kg/m3. What is the

energy of the gas due to its thermal motion?

(1) 5 × 104 J (2) 6 × 104 J

(3) 7 × 104 J (4) 3 × 104 J

Answer (1)

Hints :

2

f E P = V

5

2

E P = V

5

2

m = ×× P

ρ

4 5 8 10 1 4 5 10 J

2 4

×× × = = × ×

73. An inductor of inductance L = 400 mH and resistors of resistances R1 = 2 Ω and R2 = 2 Ω are connected to

a battery of emf 12 V as shown in the figure. The internal resistance of the battery is negligible. The switch

S is closed at t = 0. The potential drop across L as a function of time is

E

R2

R1 L

S

(1)

12 –3 Vt e

t (2) 6(1 – e–t/0.2) V

(3) 12e–5t

V (4) 6e–5t

VAnswer (3)

Hints :

Given circuit is

E

R2

L

R1

I through inductor as a function of time is

{ }2

– /

2

1–

t

L R E I e R =

2 – R t

L

L

dI V L Ee

dt = =

= 12 e–5t

74. Statement 1: The temperature dependence of resistance is usually given as R = R0(1 + αΔt). The resistance

of a wire changes from 100 Ω to 150 Ω when its temperature is increased from 27°C to 227°C. This implies

that α = 2.5 × 10–3/°C.

Statement 2: R = R0(1 + αΔt) is valid only when the change in the temperature ΔT is small and

ΔR = (R – R0) < < R0.

(1) Statement 1 is true, statement 2 is true; Statement 2 is the correct explanation of Statement 1

(2) Statement 1 is true, Statement 2 is true; Statement 2 is not the correct explanation of Statement 1

(3) Statement 1 is false, Statement 2 is true

(4) Statement 1 is true, Statement 2 is false

Answer (3)

Hints :

As relation $R = R0(1 + \alpha\Delta t)$ is valid only when $\Delta R << R0$.

Hence statement 1 is false and statement 2 is true.

75. The transition from the state n = 4 to n = 3 in a hydrogen like atom results in ultraviolet radiation. Infrared

radiation will be obtained in the transition from

(1) $3 \rightarrow 2$ (2) $4 \rightarrow 2$

(3) $5 \rightarrow 4$ (4) $2 \rightarrow 1$

Answer (3)

Hints :

Energy gap between 4th and 3rd state is more than the gap between 5th and 4th state,

And $hc \Delta = E$

λ

$\lambda 5 - 4 > \lambda 4 - 3$76. A mixture of light, consisting of wavelength 590 nm and an unknown wavelength, illuminates Young's double

slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights

coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe

of the unknown light. From this data, the wavelength of the unknown light is

(1) 885.0 nm (2) 442.5 nm

(3) 776.8 nm (4) 393.4 nm

Answer (2)

Hints :

As 4th bright fringe of unknown wavelength coincides with 3rd bright fringe of known wavelength

⇒

4 (590 nm) 3 D D

d d

λ =

⇒

3 590 442.5 nm

4

× λ= =

77. A particle has an initial velocity of ˆ ˆ 3 4 i j + and an acceleration of ˆ ˆ 0.4i j + 0.3 . Its speed after 10 s is

(1) 7 2 units (2) 7 units

(3) 8.5 units (4) 10 units

Answer (1)

Hints :

v ua = + t G GG

ˆ ˆ ˆ ˆ =++ + (3 4) 10(0.4 0.3) ij i j

ˆ ˆ ˆ ˆ =+++ (3 4) (4 3) ij ij

ˆ ˆ = + 7 7 i j

| | v = 7 2 units G

78. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons

was found to be 1.68 eV. The work function of the metal is

(1) 1.41 eV (2) 1.51 eV

(3) 1.68 eV (4) 3.09 eV

Answer (1)

Hints :

According to enstein photo electric equation

– Kmax

hc φ = λ

⇒ (3.10 eV – 1.68 eV) = Kmax

⇒ Kmax = 1.42 ev79. Three sound waves of equal amplitudes have frequencies (v – 1), v, (v + 1). They superpose to give beats.

The number of beats produced per second will be

(1) 3 (2) 2 (3) 1 (4) 4

Answer (3)

If we assume that all the three waves are in same phase at t = 0 they will be again in same phase at t = 1

80. A motor cycle starts from rest and accelerates along a straight path at 2 m/s2. At the starting point of the motor

cycle there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency

of the siren at 94% of its value when the motor cycle was at rest ? (Speed of sound = 330 ms–1)

(1) 98 m

(2) 147 m

(3) 196 m

(4) 49 m

Answer (1)

Hints :

f′ = – 0 v v f

v

speed of sound

speed of observer

v

v

⇒ 0.94 = 0 1 – v

v

⇒ 0 v

v

= 0.06

⇒ v0 = 19.8 m/s

⇒ Distance covered =

2

0

2

v

a

= 98 m

81. Eb

A

B C D E

F

M

The above is a plot of binding energy per nucleon Eb, against the nuclear mass M; A, B, C, D, E, F correspond

to different nuclei. Consider four reactions :

(i) A + B → C + ε (ii) C → A + B + ε (iii) D + E → F + ε (iv) F → D + E + ε

where ε is the energy released? In which reactions is ε positive?

(1) (i) and (iii) (2) (ii) and (iv)

(3) (ii) and (iii) (4) (i) and (iv)

Answer (4)

Hints : In reactions (i) & (iv), The B.E per nucleon increases. This makes nuclei more stable so energy will be

released in these reactions.82. A transparent solid cylindrical rod has a refractive index of

2

3 . It is surrounded by air. A light ray is incident

at the mid-point of one end of the rod as shown in the figure.

The incident angle θ for which the light ray grazes along the wall of the rod is

(1)

–1 3 sin

2

(2)

–1 2 sin

3

(3)

–1 1 sin

3

(4) –1 1 sin

2

Answer (3)

Hints :

f + θC = 90° θC = sin– 1

μ

Using snell's law

sin

sin

θ

φ = μ

⇒ sinθ = μ cos θC

⇒ sinθ = 2

1

μ 1 –

μ

= 2 μ – 1

⇒ θ =

–1 1 sin

3

83. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area

A and wire 2 has cross-sectional area 3A. If the length of wire 1 increases by Δx on applying force F, how much force

is needed to stretch wire 2 by the same amount ?

(1) 4F (2) 6F (3) 9F (4) F

Answer (3)

Hints :

F l Y

A l

Δ =

⇒ F =

2 lA Y

Al

Δ

=

2 lA Y

V

Δ

⇒ F ∝ A2

⇒

F

F′

=

1

9

⇒ F′ = 9FThis question contains Statement-1 and statement-2. Of the four choices given after the statements, choose the

one that best describes the two statements.

84. Statement 1 : For a charged particle moving from point P to point Q, the net work done by an electrostatic

field on the particle is independent of the path connecting point P to point Q.

Statement 2 : The net work done by a conservative force on an object moving along a closed loop is zero.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statment-1.

(2) Statment-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.

(3) Statement-1 is false, Statement-2 is true.

(4) Statement-1 is true, Statement-2 is false.

Answer (1)

Hints :

We = – q (Vf

– Vi

) It depends on initial and final point only, because electrostatic field is a conservative field.

85. The logic circuit shown below has the input waveforms 'A' and 'B' as shown. Pick out the correct output

waveform.

A

B

Y

Input A

Input B

Output is :

(1)

(2)

(3)

(4)

Answer (4)Hint

y = ( ) A B + = A . B

The combination represents AND Gate Truth table.

A B Y

0 0 0

010

100

111

86. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic

motion of time period T, then, which of the following does not change with time ?

(1) aT/ x (2) aT + 2πv

(3) aT/v (4) a2T2 + 4π 2v 2

Answer (1)

Hint

x = A sin(ωt + φ)

a = – Aω2 sin (ωt + φ)

So

aT

x

= – ω2T (which is constant)

87. A thin uniform rod of length l and mass m is swinging freely about a horizontal axis passing through its end.

Its maximum angular speed is ω. Its centre of mass rises to a maximum height of

(1)

1

6

I

g

ω

(2)

2 2 1

2

I

g

ω

(3)

2 2 1

6

I

g

ω

(4)

2 2 1

3

I

g

ω

Answer (3)

Hints :

Loss in kinetic energy = Gain in potential energy

1 2

2

I m ω = gh

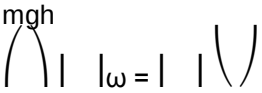
⇒

2 1 2

2 3

m

mgh



A

⇒

2 2

6

h

g

ω = A

88. In an optics experiment, with the position of the object fixed, a student varies the position of a convex lens

and for each position, the screen is adjusted to get a clear image of the object. A graph between the object

distance u and the image distance v, from the lens, is plotted using the same scale for the two axes. A straight

line passing through the origin and making an angle of 45° with the x-axis meets the experimental curve at

P. The coordinates of P will be:

(1) ,

2 2

f f

(2) (f, f) (3) (4f, 4f) (4) (2f, 2f)

Answer (4)Hints :

At point P

|u| = |v| = x

Since

111

v u f − = P

45°

| | u

⇒ u = 2f | | v

89. A p-n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in

the circuit.

R

v

D

The current (I) in the resistor (R) can be shown by:

(1)

I

t

(2)

I

t

(3)

I

t

(4)

I

t

Answer (2)

Hints :

Let input be

T

2

T

vi

t

From 0

2

T − Diode is in forward bias so there will be current

From 2

T −T Diodes is in reverse bias so current through resistor will be zero.90. Let 4 ( ) Q

r r

R ρ =

π

be the charge density distribution for a solid sphere of radius R and total charge Q. For a

point ‘p’ inside the sphere at distance r

1 from the centre of the sphere, the magnitude of electric field is:

(1) 2 4 0 1

Q

πε r (2)

2

1

4 4 0

Q r

πε R (3)

2

1

4 3 0

Q r

πε R (4) 0

Answer (2)

Hints :

Consider a gaussian surface of radius r

1

0

. Qen E dA = ∫ ε

G JJJG

v

2

1

0

1 E r 4π= ρ dV

ε ∫

1

2

4

0 0

1 4

r

Q r r dr

R

= π

ε ∫ π

r

R

4 2

1 1

4 2 4 4 4 0 1 0

Qr Qr E

R r R = = πε πε

‰‰‰