22/01/2025
Morning

Memory Based
Answers & Solutions
for
JEE (Main)-2025 (Online) Phase-1

(Physics, Chemistry and Mathematics)

Time : 3 hrs. **M.M. : 300**

IMPORTANT INSTRUCTIONS:

(1) The test is of **3 hours** duration.

(2) This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.

(3) This question paper contains **Three Parts**. **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is **Mathematics**. Each part has only two sections: **Section-A** and **Section-B**.

(4) **Section - A :** Attempt all questions.

(5) **Section - B :** Attempt all questions.

(6) **Section - A (01 – 20)** contains 20 multiple choice questions which have **only one correct answer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

(7) **Section - B (21 – 25) contains** 5 **Numerical value** based questions. The answer to each question should be rounded off to the **nearest integer**. Each question carries **+4 marks** for correct answer and **–1 mark** for wrong answer.

PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. Find the dimensions of $\frac{B}{\mu_0}$

(1) [AL] (2) $[AL^{-1}]$

(3) [MAL] (4) $[MALT^{-1}]$

Answer (2)

Sol. $\oint B \cdot dl = \mu_0 i \Rightarrow \frac{B}{\mu_0} = \frac{i}{l} \equiv [AL^{-1}]$

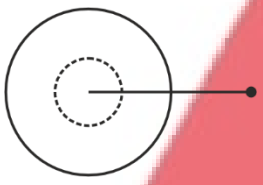
2. Solid sphere of mass M, radius R exerts force F on a point mass. Now a concentric spherical mass $\frac{M}{7}$ is removed. What is new force?

(1) $\frac{F}{7}$ (2) $\frac{6}{7}F$

(3) $\frac{5F}{7}$ (4) $\frac{3F}{7}$

Answer (2)

Sol.

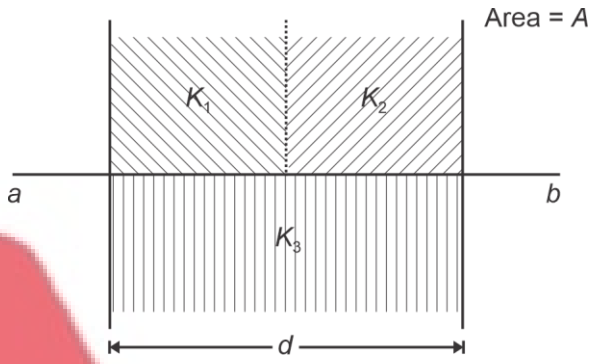


$$F = \frac{GMm}{r^2}$$

$$F' = \frac{G\left(M - \frac{M}{7}\right)m}{r^2}$$

$$\Rightarrow \quad F' = \frac{6}{7}F$$

3. Find out equivalent capacitance for the situation show in figure.



(1) $C_{eq} = \frac{A\varepsilon_0}{d}\left(\frac{K_1K_2 + K_2K_3 + K_3K_1}{K_1 + K_2}\right)$

(2) $C_{eq} = \frac{A\varepsilon_0}{d}\left(\frac{2K_1K_2 + K_2K_3 + K_3K_1}{2(K_1 + K_2)}\right)$

(3) $C_{eq} = \frac{A\varepsilon_0}{d}\left(\frac{K_1K_2 + K_2K_3 + K_3K_1}{2(K_1 + K_2)}\right)$

(4) $C_{eq} = \frac{A\varepsilon_0}{2d}\left(\frac{K_1K_2 + K_2K_3 + K_3K_1}{(K_1 + K_2)}\right)$

Answer (2)

Sol. Here,

$$C_1 = \frac{2 \times A\varepsilon_0 K_1}{2d} = \frac{A\varepsilon_0 K_1}{d}$$

$$C_2 = \frac{A\varepsilon_0 K_2}{d}$$

$$C_3 = \frac{A\varepsilon_0 K_3}{2d}$$

Now C_1 and C_2 are in series

So, $\frac{1}{C_1'} = \frac{1}{C_1} + \frac{1}{C_2}$

$$\Rightarrow \frac{1}{C_1'} = \frac{d}{A\varepsilon_0 K}\left[\frac{1}{K_1} + \frac{1}{K_2}\right] = \frac{d(K_1 + K_2)}{A\varepsilon_0 K_1 K_2}$$

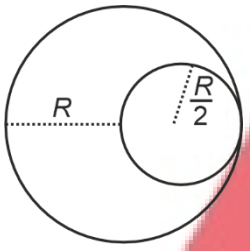
$$\Rightarrow C_1' = \frac{A\varepsilon_0 K_1 K_2}{d(K_1 + K_2)}$$

Now C_1' is parallel to C_3

$$\Rightarrow C_{eq} = \frac{A\varepsilon_0}{d}\left[\frac{K_1 K_2}{K_1 + K_2} + \frac{K_3}{2}\right]$$

$$\Rightarrow C_{eq} = \frac{A\varepsilon_0}{d}\left[\frac{2K_1K_2 + K_2K_3 + K_3K_1}{2(K_1 + K_2)}\right]$$

4. From a sphere of mass M and radius R, a cavity of radius $\frac{R}{2}$ is created. Find the moment of inertia about an axis passing through the centre of sphere and cavity.



(1) $\frac{31}{48} MR^2$

(2) $\frac{31}{80} MR^2$

(3) $\frac{13}{32} MR^2$

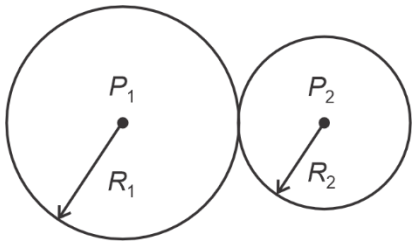
(4) $\frac{21}{32} MR^2$

Answer (2)

Sol. $I = \frac{2}{5} MR^2 - \frac{2}{5}\left(\frac{M}{8}\right)\left(\frac{R}{2}\right)^2$

$= \frac{31}{80} MR^2$

5. Find the radius of curvature of the common surface of two bubbles ($R_1 > R_2$)



(1) $R = \frac{R_1 R_2}{R_1 + R_2}$

(2) $R = \frac{2R_1 R_2}{R_1 - R_2}$

(3) $R = \frac{R_1 R_2}{R_1 - R_2}$

(4) $R = \frac{R_1 R_2}{(R_1 - R_2)}$

Answer (3)

Sol. $P_1 - P_0 = \frac{4S}{R_1}; P_2 - P_0 = \frac{4S}{R_2}$

So, $P_2 - P_1 = \Delta P = \frac{4S}{R} = 4S\left[\frac{1}{R_2} - \frac{1}{R_1}\right]$

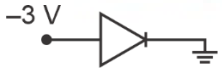
or $\frac{1}{R} = \frac{R_1 - R_2}{R_1 R_2}$

6. From the given option, identify the diode connected in forward bias.

(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. Only in option (1), the p-side is connected at higher potential than the n-side of the diode.

7. Radius of electron in ground state for hydrogen is a_0, then radius of electron in He^+ ion in 3rd excited state is a. Then $\frac{a_0}{a}$ is

(1) $\frac{1}{2}$

(2) $\frac{1}{4}$

(3) $\frac{1}{16}$

(4) $\frac{1}{8}$

Answer (4)

Sol. $\boxed{r = \frac{n^2}{z} r_0} \Rightarrow$ for H

$a_0 = \frac{1}{1} r_0$

$a = \frac{4^2}{2} r_0$

$\frac{a_0}{a} = \frac{1}{8}$

8. Ice at –10°C is to be converted into steam at 110°C. Mass of ice is 10^{-3} kg. What amount of heat is required?

(1) ΔQ = 730 cal (2) ΔQ = 900 cal

(3) ΔQ = 1210 cal (4) ΔQ = 870 cal

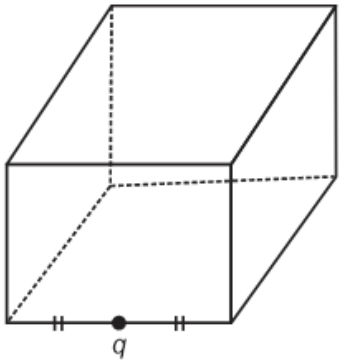
Answer (1)

Sol. –10°C ice to 0°C ice $\rightarrow$ 0°C ice to 0°C water + 0°C water to 100°C water + 100°C water to 100°C steam + 110°C steam.

$$\Rightarrow \Delta Q = \left(1 \times \frac{1}{2} \times 10\right) + (1 \times 80) + (1 \times 1 \times 100)$$

$$+(1 \times 540) + \left(1 \times \frac{1}{2} \times 10\right) = 730 \text{ cal}$$

9. A charge of value q is placed at the edge of a imaginary cube of side a as shown in figure. Find the net flux through the cube



(1) $\frac{q}{6\varepsilon_0}$ (2) $\frac{q}{4\varepsilon_0}$

(3) $\frac{q}{8\varepsilon_0}$ (4) $\frac{q}{2\varepsilon_0}$

Answer (2)

Sol. ϕ_4 such cubes $= \frac{q}{\varepsilon_0}$

ϕ_1 cube $= \frac{q}{4\varepsilon_0}$

10. A closed organ pipe in 9th harmonic resonates with 4th harmonic of open organ pipe [l_{closed} = 10 cm]. Find length of open organ pipe.

(1) $L_0 = 15$ cm

(2) $L_0 = \frac{100}{9}$ cm

(3) $L_0 = \frac{110}{7}$ cm

(4) $L_0 = \frac{80}{9}$ cm

Answer (4)

Sol. $\frac{9v}{4L_c} = \frac{4v}{2L_0} \Rightarrow L_0 = \frac{8L_c}{9}$

11. A capacitor is charged by battery to charge Q_1. Now the battery is disconnected and dielectric slab of dielectric constant K is inserted between the gaps of the plates. Now charge on capacitor is Q_2. Find $\frac{Q_1}{Q_2}$.

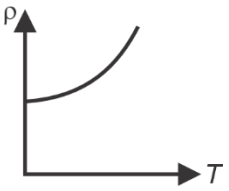
(1) 1 (2) $\frac{1}{2}$

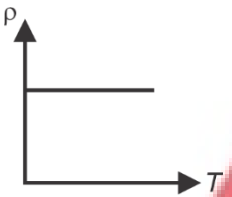
(3) 2 (4) $\frac{2}{3}$

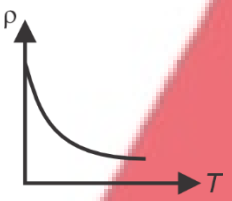
Answer (1)

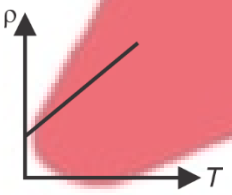
Sol. $\frac{Q_1}{Q_2} = 1$ (No further charge is supplied)

12. Which of the following graphs correctly represents the variation of resistivity (ρ) with temperature (T).

(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. The resistivity of conductors increases with increase in temperature non-linearly.

13. If whole YDSE apparatus is immersed in a liquid of refractive index μ, then what is the effect on fringe width?

(1) Fringe width increases

(2) Fringe width decreases

(3) Fringe width remains unchanged

(4) It may increase on one side and decrease on other side

Answer (2)

Sol. $\Delta\omega = \frac{\lambda D}{\lambda}$

So, for RI of μ

$\Delta\omega' = \frac{\lambda D}{\mu d}$

14. Two spherical black bodies of radius 0.8 m and 0.2 m are at temperatures of 400 K and 800 K respectively. Find ratio of rate of heat loss.

(1) 8

(2) 4

(3) 2

(4) 1

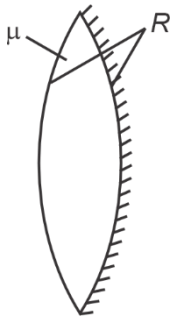
Answer (4)

Sol. $P_1 = \sigma 4\pi (0.8)^2 (400)^4$

$P_2 = \sigma 4\pi (0.2)^2 (800)^4$

$\frac{P_1}{P_2} = \frac{4 \times 4}{2^4} = 1$

15. The equiconvex lens shown in figure is silvered on one side. For what distance of object from the lens is the image formed on the object itself?



(1) μR (2) $\frac{R}{\mu}$

(3) $\frac{R}{2\mu-1}$ (4) $\frac{R}{2\mu-2}$

Answer (3)

Sol. Silvering of lens

$$\frac{1}{F_{eq}}=\frac{1}{f_m}-\frac{2}{f_\ell}$$

$$=\frac{-2}{R}-\frac{4(\mu-1)}{R}$$

$$=\frac{-2(1+2\mu-2)}{R}$$

$$F=\frac{-R}{2(2\mu-1)}$$

$$\frac{1}{f_\ell}=(\mu-1)\left(\frac{1}{R}-\left(\frac{1}{-R}\right)\right)$$

$$\frac{1}{f_\ell}=\frac{2(\mu-1)}{R}$$

For object-image to coincide distance should be $2f$

$|u| = 2|F|$

$$=\frac{R}{2\mu-1}$$

16. Light of wavelength 550 nm is incident an surfaces of cerium and lithium. Work function are respectively 1.9 eV and 2.5 eV. Then electron will be ejected from

(1) Cerium only (2) Lithium only

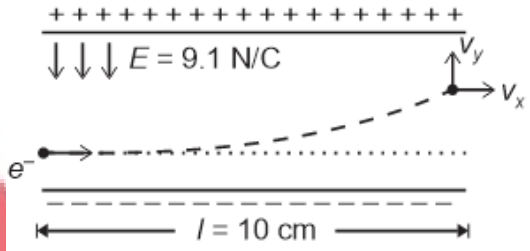
(3) From both of them (4) None of them

Answer (1)

Sol. $\mathrm{E(eV)}=\frac{1240}{\lambda(\mathrm{nm})}=\frac{1240}{550}\simeq 2.25$

2.25 > 1.9 for cerium only

17. The figure shows an electron entering the space between the plates of a parallel plate capacitor with an initial velocity, $v_x = 10^6$ m/s parallel to the plates. If the length of plates is $l = 10$ cm and the electric field in the region $E = 9.1$ N/C, then the value of v_y when the electron comes out of the plates is (Electronic mass = 9.1×10^{-31} kg)



(1) 1.6×10^4 m/s (2) 1.6×10^5 m/s

(3) 1.6×10^7 m/s (4) 1.6×10^3 m/s

Answer (2)

Sol. Time inside the electric field, $t = \frac{l}{v_x}$

Acceleration of electron along y-axis, $a = \frac{eE}{m}$

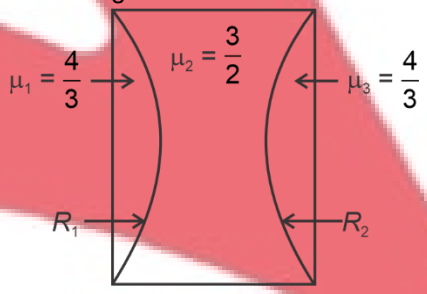
Velocity $v_y = at$

$$=\frac{eE}{m}\cdot\frac{l}{v_x}$$

$$=\frac{1.6\times10^{-19}\times9.1\times10\times10^{-2}}{9.1\times10^{-31}\times10^{6}}\ \text{m/s}$$

$= 1.6 \times 10^5$ m/s

18. Find the equivalent power of the thin lens combination shown in the figure.



(1) $+\left(\frac{R_1+R_2}{R_1+R_2}\right)$ (2) $-\left(\frac{R_1+R_2}{R_1R_2}\right)$

(3) $-\left(\frac{R_1+R_2}{6R_1R_2}\right)$ (4) $+\left(\frac{R_1+R_2}{6R_1R_2}\right)$

Answer (3)

Sol. Net power = $P_1 + P_2 + P_3$

$$= \frac{(\mu_1 - 1)}{R_1} + (\mu_2 - 1)\left(\frac{1}{-R_1} + \frac{1}{-R_2}\right) + \frac{(\mu_3 - 1)}{R_2}$$

$$= \frac{(\mu_1 - \mu_2)}{R_1} + \frac{(\mu_3 - \mu_2)}{R_2}$$

$$= \left(\frac{4}{3} - \frac{3}{2}\right)\frac{1}{R_1} + \left(\frac{4}{3} - \frac{3}{2}\right)\frac{1}{R_2}$$

$$= -\frac{1}{6}\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$$= -\left(\frac{R_1 + R_2}{6R_1R_2}\right)$$

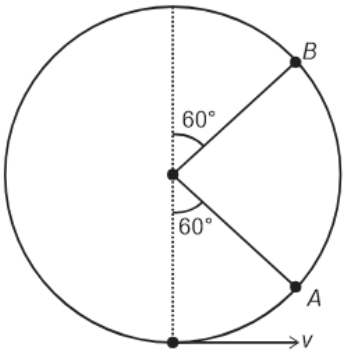
19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. The particle shown in figure is just able to complete the vertical circular motion. Find the ratio of kinetic energy at *A* to the kinetic energy at *B*.



Answer (2)

Sol. $v = \sqrt{5gR}$

$$KE_A = \frac{1}{2}mv^2 - mg\frac{R}{2}$$

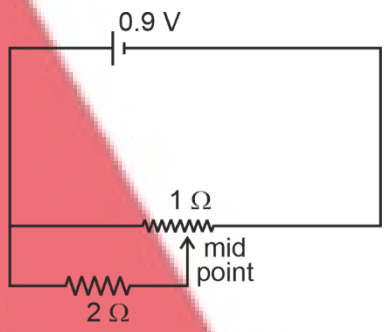
$$KE_A = 2mgR$$

$$KE_B = \frac{1}{2}mv^2 - mg\left(\frac{3R}{2}\right)$$

$$= mgR$$

$$\frac{KE_A}{KE_B} = 2$$

22. The current drawn from battery in the circuit shown below is _____ *A*



Answer (1)

Sol. $\frac{1}{R_1'} = \frac{1}{2} + 2 = \frac{5}{2}$

$$\Rightarrow \quad R_1' = \frac{2}{5}\Omega$$

Now, $R = \frac{2}{5} + \frac{1}{2} = \frac{9}{10}\Omega$

So, $I = \frac{9 \times 10}{10 \times 9} = 1\text{A}$

23.

24.

25.

CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. For complex ion $[NiCl_4]^{2-}$ what is the charge on metal and shape of complex respectively?

   (1) +2, Tetrahedral (2) +2, Square planar

   (3) +4, Tetrahedral (4) +4, Square Planar

Answer (1)

Sol. $[NiCl_4]^{2-} \Rightarrow Ni^{2+} \rightarrow 3d^8$

Cl^- ligand is weak field ligand and hybridisation is sp^3. Shape of complex is tetrahedral.

2. Compare boiling point of given solutions

   (i) 10^{-4} M NaCl (ii) 10^{-3} M NaCl

   (iii) 10^{-2} M NaCl (iv) 10^{-4} M urea

   (1) I > II > III > IV (2) III > II > I > IV

   (3) II > I > III > IV (4) III > I > II > IV

Answer (2)

Sol. Higher the elevation in boiling point, higher will be the boiling point

$\Delta Tb \propto i \times m$

For urea i = 1

For NaCl i = 2

Boiling point order III > II > I > IV

3. The correct decreasing order of electronegativity is

   (1) F > Cl > I > Br (2) Cl > F > Br > I

   (3) F > Cl > Br > I (4) Br > F > I > Cl

Answer (3)

Sol. The correct order is

F > Cl > Br > I

4. Which of the following has maximum size out of Al^{3+}, Mg^{2+}, F^-, Na^+?

   (1) Al^{3+} (2) Mg^{2+}

   (3) F^- (4) Na^+

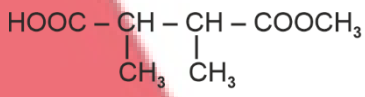
Answer (3)

Sol. For isoelectronic species, more the negative charge more will be the size, also more the positive charge smaller will be the size.

The correct order of ionic size is :

$Al^{3+} < Mg^{2+} < Na^+ < F^-$

5. The IUPAC name of given specie is



   (1) 2, 3-dimethyl methyl carboxy butanoic acid

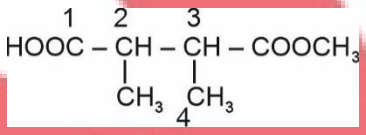
   (2) 4-methoxy carbonyl-2, 3-dimethyl propanoic acid

   (3) 3-methoxycarbonyl-2-methyl butanoic acid

   (4) 1-carboxy-2, 3-dimethyl methyl butanoate

Answer (3)

Sol.



3-methoxycarbonyl-2-methyl butanoic acid

6. Compare crystal field splitting energy(Δ) for given complexes

   (i) $K_4[Fe(CN)_6]$ (ii) $[Cu(NH_3)_4]^{+2}$ s

   (iii) $K_4[Fe(SCN)_6]$ (iv) $[Fe(en)_3]Cl_3$

   (1) I > II > III > IV (2) II > I > IV > III

   (3) IV > I > III > II (4) IV > III > I > II

Answer (2)

Sol. $K_4[Fe(CN)_6] \Rightarrow d^6 \Rightarrow$ SFL,

$K_2[Cu(NH_3)_4] \Rightarrow d^9 \Rightarrow dsp^2$

$K_4[Fe(SCN)_6] \Rightarrow d^6 \Rightarrow$ WFL

$[Fe(en)_3]Cl_3 \Rightarrow d^5 \Rightarrow$ SFL

Splitting energy $\propto$ Strength of ligand $\propto$ Charge of CA.

$\Delta_{sp} > \Delta_o$

II > I > IV > III

7. Consider the given equilibrium reaction

$$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$$

If initial pressure of CO_2 is 0.6 atm and after equilibrium is established, total pressure is 0.8 atm. Then, find K_p.

(1) 0.4 (2) 0.2

(3) 0.6 (4) 0.8

Answer (1)

Sol. $CO_2(g) + C(s) \rightleftharpoons 2CO(g)$

t = 0 0.6

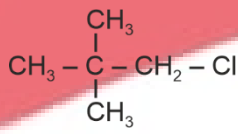
$t = t_{eq}$ 0.6 – p 2p

P_t at equilibrium = 0.8 = 0.6 + p

0.2 = p

$$K_p = \frac{(p_{CO})^2}{(p_{CO_2})} = \frac{(2p)^2}{0.6-p} = \frac{4\times0.04}{0.6-0.2} = \frac{4\times0.04}{0.4} = 0.4$$

8. Statement-I: $CH_3 - O - CH_2 - Cl$ will show nucleophilic substitution by S_N1 mechanism in protic medium.

Statement-II:  will not undergo nucleophilic substitution via S_N2 mechanism easily.

(1) Statement-I and statement-II both are correct

(2) Statement-I and statement-II both are incorrect

(3) Statement-I is correct but statement-II is incorrect

(4) Statement-I is incorrect but statement-II is correct

Answer (1)

Sol. $CH_3 - O - \overset{\oplus}{C}H_2$ stabilised by resonance.

9. Which of the following acids is also known as vitamin C?

(1) Adipic acid (2) Ascorbic acid

(3) Saccharic acid (4) Aspartic acid

Answer (2)

Sol. Ascorbic acid is also known as vitamin C.

10. An electron of He^+ is present in 3rd excited state. Find its de-Broglie wavelength.

(1) 6.64 Å (2) 1.66 Å

(3) 3.32 Å (4) 13.28 Å

Answer (1)

Sol. $n\lambda = 2\pi r$

For 3rd excited state, n = 4

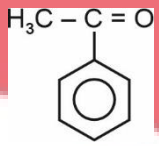
$$4\lambda = 2 \times \pi \times a_\circ \frac{n^2}{z}$$

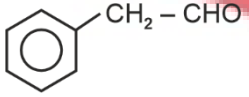
$$4\lambda = 2 \times \pi \times 0{\cdot}529 \frac{16}{2} \text{ Å}$$

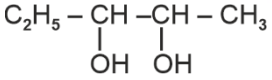
$\lambda = 2 \times 3{\cdot}14 \times 0{\cdot}529 \times 2$ Å = 6·64 Å

11. Which of the following will show positive Fehling test?

(1) 

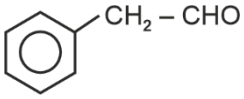
(2) 

(3) 

(4) 

Answer (3)

Sol. Fehling test is given by Aldehydes except benzaldehyde



will give +ve Fehling test

12. $4f^7$ configuration is possible for

(a) Eu^{3+}, (b) Eu^{2+}, (c) Gd^{3+}, (d) Tb^{3+}, (e) Sm^{2+}

(1) (a) and (c)

(2) (b) and (c)

(3) (d) and (e)

(4) Only (c)

Answer (2)

Sol. Electronic configuration of:

$Eu^{3+} \Rightarrow 4f^6$ $\quad$ $Tb^{3+} \Rightarrow 4f^8$

$Eu^{2+} \Rightarrow 4f^7$ $\quad$ $Sn^{2+} \Rightarrow 4f^5$

$Gd^{3+} \Rightarrow 4f^7$

13. Given : $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

If the partial pressure of CO_2 gas at equilibrium is 0.4 atm and the total pressure is 1 atm, then the value of K_p at the same temperature is

(1) 0.027 atm^3

(2) 0.064 atm^3

(3) 0.144 atm^3

(4) 0.216 atm^3

Answer (3)

Sol. $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

Total pressure at equilibrium = 1.0 atm

Partial pressure of CO_2 at equilibrium = 0.4 atm

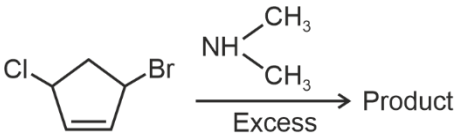
$\therefore$ Partial pressure of NH_3 at equilibrium = 0.6 atm

$K_p = (p_{NH_3})^2 (p_{CO_2})$

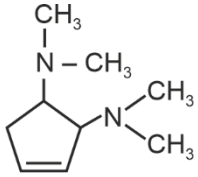
$= (0.6)^2(0.4)$

$= 0.144\ atm^3$

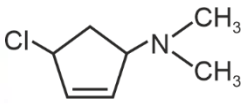
14.



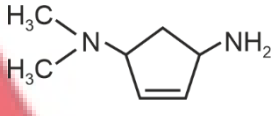
(1)



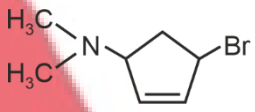
(2)



(3)

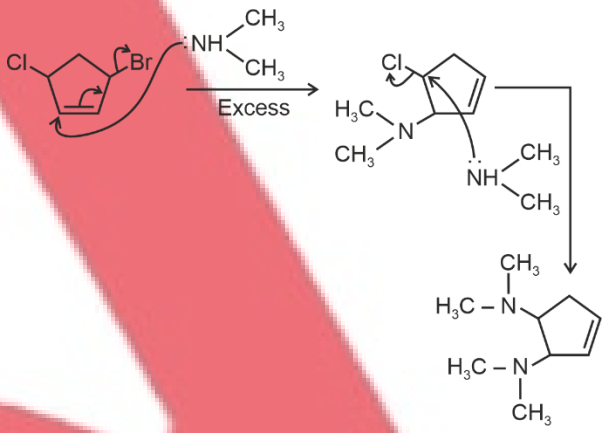


(4)



Answer (1)

Sol.



15. CO_2 gas is taken at 1 atm, 273K. Now it is allowed to pass through 0.1 M $Ca(OH)_2$ aq. solution. Excess amount of $Ca(OH)_2$ is neutralised with 40 mL of 0.1 M HCl. Then find volume of $Ca(OH)_2$ initially taken if 50% $Ca(OH)_2$ is react with CO_2

(1) 40 mL

(2) 20 mL

(3) 80 mL

(4) 50 mL

Answer (1)

Sol. g meq of $Ca(OH)_2$ = 2 × gm eq of HCl

$$0.1\times\frac{V_{mL}}{1000}\times 2 = 2\times 0.1\times\frac{40}{1000}\times 1$$

V_{mL} = 40 mL

16. In a closed insulated container, a liquid is stirred with a paddle to increase the temperature, which of the following is true?

(1) $w = 0, \Delta E = q \neq 0$ (2) $\Delta E = w \neq 0, q = 0$

(3) $\Delta E = w = 0, q \neq 0$ (4) $\Delta E = 0, w = q \neq 0$

Answer (2)

Sol. In closed insulated container a liquid stirred with a paddle to increase the temperature, it behaves as an adiabatic container, q = 0

From FLOT

$\Delta U = q + w; q = 0$

$\Delta E = w$ (but not zero)

17. Match the column and choose the correct option

	Column-I (Properties)		**Column-II (Order)**
(A)	Electronegativity	(1)	B < C < N < O
(B)	Cationic size	(2)	Li > Mg > Be
(C)	Metallic Character	(3)	K > Mg > Al
(D)	Electron affinity	(4)	Cl > F > Br > I

(1) A–1, B–2, C–3, D–4

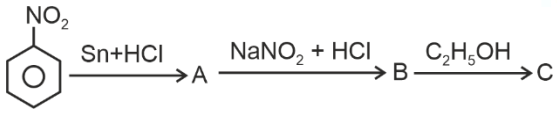
(2) A–4, B–3, C–2, D–1

(3) A–2, B–3, C–4, D–1

(4) A–3, B–2, C–4, D–1

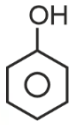
Answer (1)

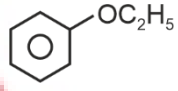
Sol. Li^{+} (76 pm) $> Mg^{2+}$ (72 pm) $> Be^{2+}$ (31 pm)

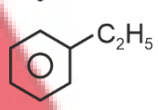
18. 

Identify C.

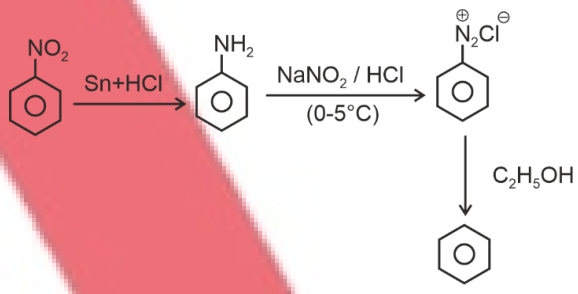
(1) 

(2) 

(3) 

(4) 

Answer (1)

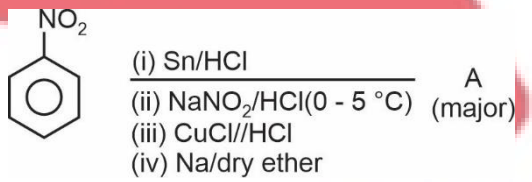
Sol. 

19.

20.

SECTION - B

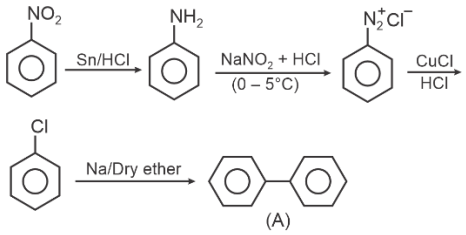
Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. 

Find molecular weight of (A) in g mol^{-1}

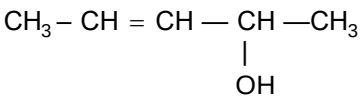
Answer (154)

Sol.



Molecular weight of (A) = 154 g mol^{-1}

22. Calculate Number of stereoisomers of



Answer (4)

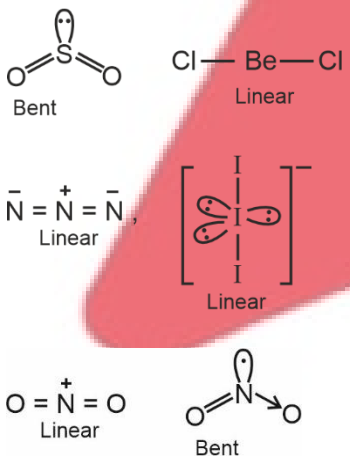
Sol. Number of centres which can show stereoisomerism in molecule = 2

Number of isomers = $2^2 = 4$

23. How many compounds have linear shape SO_2, $BeCl_2$, N_3^-, I_3^-, NO_2^+, NO_2 ?

Answer (4)

Sol.



24. In Carius method 180 mg of organic compound gives 143.5 mg of AgCl. Find the percentage of Cl in the organic compound. (Nearest integer)

Answer (20)

Sol. Mass of organic compound = 180 mg

Mass of AgCl = 143.5 mg

$$\text{Mass of Cl} = \frac{143.5}{143.5} \times 35.5 \text{ mg}$$

$$= 35.5 \text{ mg}$$

Percentage of Cl in the organic compound

$$= \frac{35.5 \times 100}{180}$$

$$= 19.72\% \simeq 20\%$$

25. Two ampere current is allowed to pass through molten $AlCl_3$ for 30 min. Find the mass (in mg) of aluminium deposited at cathode. (Nearest integer)

Answer (336)

Sol. Total charge passed = 2 × 30 × 60 C

$$\text{Number of Faradays passed} = \frac{2 \times 30 \times 60}{96500} \text{ F}$$

$$\text{Equivalents of Al deposited} = \frac{36}{965}$$

$$\text{Mass of Al deposited} = \frac{36 \times 9}{965} \text{ g}$$

$$= \frac{36 \times 9 \times 1000}{965} \text{ mg}$$

$$= 335.75 \text{ mg}$$

$$\simeq 336 \text{ mg}$$

MATHEMATICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. The shortest distance between the lines

$\frac{x-1}{2}=\frac{y-2}{3}=\frac{z-1}{4}$ and

$\frac{x+2}{7}=\frac{y-2}{8}=\frac{z+1}{2}$ is

(1) $\frac{88}{\sqrt{1277}}$ (2) $\frac{78}{\sqrt{1277}}$

(3) $\frac{66}{\sqrt{1277}}$ (4) $\frac{55}{\sqrt{1277}}$

Answer (1)

Sol. $d=\frac{|(a_2-a_1)\cdot(b_1\times b_2)|}{|b_1\times b_2|}$

$b_1\times b_2=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 3 & 4\\ 7 & 8 & 2\end{vmatrix}$

$=-26\hat{i}+24\hat{j}-5\hat{k}$, $a_2-a_1=3\hat{i}+2\hat{k}$

$d=\left|\frac{(3\hat{i}+2\hat{k})\cdot(-26\hat{i}+24\hat{j}-5\hat{k})}{\sqrt{26^2+24^2+5^2}}\right|$

$=\left|\frac{-78-10}{\sqrt{1277}}\right|=\frac{88}{\sqrt{1277}}$

2. In a bag there are 6 white and 4 black balls two balls are drawn at random, then the probability that both ball are white are

(1) $\frac{1}{2}$ (2) $\frac{1}{3}$

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

Answer (2)

Sol. $P(E)=\frac{{}^6C_2}{{}^{10}C_2}$

$=\frac{15}{45}=\frac{1}{3}$

3. Let $A=\{1, 2, 3\}$ number of non-empty equivalence relations from A to A are

(1) 4 (2) 5

(3) 6 (4) 8

Answer (2)

Sol. The partitions far a set with 3 elements, {1, 2, 3}

$\{\{1\},\{2\},\{3\}\}$ – Every element is in its own subset

$\{\{1,2\},\{3\}\}$ – Two elements are together, one separate

$\{\{1,3\},\{2\}\}$ – Two elements are together, one separate

$\{\{2,3\},\{1\}\}$ – Two elements are together, one separate

$\{\{1,2,3\}\}$ – All elements are together in one subset

$\therefore$ Therefore, total possible equivalence relation = 5

4. If $f(x)=16(\sec^{-1}x)^2+(\text{cosec}^{-1}x)^2$. Then the maximum and minimum value of $f(x)$ is

(1) $\frac{1001\pi^2}{33}$ and $\frac{2\pi^2}{9}$ (2) $\frac{1105\pi^2}{68}$ and $\frac{4\pi^2}{17}$

(3) $\frac{1117\pi^2}{59}$ and $\frac{6\pi^2}{19}$ (4) $\frac{1268\pi^2}{27}$ and $\frac{3\pi^2}{16}$

Answer (2)

Sol. $f(x)=(4\sec^{-1}x)^2+(\text{cosec}^{-1}x)^2$

$=(4\sec^{-1}x+\text{cosec}^{-1}x)^2-8\sec^{-1}x\,\text{cosec}^{-1}x$

$=\left(3\sec^{-1}x+\frac{\pi}{2}\right)^2-8\sec^{-1}x\left[\frac{\pi}{2}-\sec^{-1}x\right]$

$$= 9(\sec^{-1}x)^2 + \frac{\pi^2}{4} + 3\pi\sec^{-1}x - 4\pi\sec^{-1}x + 8(\sec^{-1}x)^2$$

$$= 17(\sec^{-1}x)^2 - \pi(\sec^{-1}x) + \frac{\pi^2}{4}$$

$$= 17\left[\left(\sec^{-1}x\right)^2 - \frac{\pi}{17}(\sec^{-1}x) + \frac{\pi^2}{34^2}\right] + \frac{\pi^2}{4} - \frac{17\pi^2}{34^2}$$

$$= 17\left[\left(\sec^{-1}x - \frac{\pi}{34}\right)^2\right] + \frac{\pi^2}{4} - \frac{\pi^2}{68}$$

$$= 17\left[\left(\sec^{-1}x - \frac{\pi}{34}\right)^2\right] + \frac{4\pi^2}{17}$$

Min $= \frac{4\pi^2}{17}$

Max if $\sec^{-1}x = \pi$

$$17\left[\left(\pi - \frac{\pi}{34}\right)^2\right] + \frac{4\pi^2}{17}$$

$$\frac{1089}{68}\pi^2 + \frac{4\pi^2}{17} = \frac{1105\pi^2}{68}$$

5. If $8 = 3 + \frac{1}{4}(3+p) + \frac{1}{4^2}\left(3+p^2\right) + \ldots\infty$ then the value of p is

(1) $\frac{14}{5}$ (2) $\frac{16}{5}$

(3) $\frac{3}{5}$ (4) $\frac{4}{5}$

Answer (2)

Sol. $8 = \left(3 + \frac{3}{4} + \frac{3}{4^2} + \ldots + \infty\right) + \left(\frac{p}{4} + \frac{p^2}{4^2} + \ldots + \infty\right)$

$$8 = 3\left(1 + \frac{1}{4} + \frac{1}{4^2} + \ldots + \infty\right) + \left(\frac{p}{4} + \frac{p^2}{4^2} + \ldots + \infty\right)$$

$$8 = 3\left(\frac{1}{1-\frac{1}{4}}\right) + \frac{\frac{p}{4}}{1-\frac{p}{4}}$$

$$8 = 3\left(\frac{4}{3}\right) + \frac{p}{4-p}$$

$$4 = \frac{p}{4-p}$$

$\Rightarrow$ $16 - 4p = p$

$\Rightarrow$ $5p = 16$

$\Rightarrow$ $p = \frac{16}{5}$

6. If $\frac{dx}{dy} + \frac{x}{y^2} = \frac{1}{y^3}$, $x(1) = 1$. Then $x\left(\frac{1}{2}\right)$ equals to

(1) $2 - e$ (2) $3 - e$

(3) $5 - e$ (4) $7 - e$

Answer (2)

Sol. I.F $= e^{\int\frac{1}{y^2}}$

I.F $= e^{-\frac{1}{y}}$

$$\therefore \quad x \cdot e^{-\frac{1}{y}} = \int e^{-\left(\frac{1}{y}\right)} \cdot \left(\frac{1}{y^3}\right) dy$$

$$x \cdot e^{-\frac{1}{y}} = \int e^{-\left(\frac{1}{y}\right)} \cdot \left(\frac{1}{y}\right)\left(\frac{1}{y^2}\right) dy$$

Put $\frac{1}{y} = t$

$$-\frac{1}{y^2}dy = dt$$

$$\therefore \quad xe^{-t} = -\int e^{-t} \cdot t \; dt$$

$$xe^{-t} = -\left[t\,e^{-t} - \int\left(\frac{d(t)}{dt} \cdot \int e^{-t} \cdot dt\right)dt\right]$$

$$xe^{-t} = -\left[-t\,e^{-t} - e^{-t}\right] + c$$

$$xe^{-t} = te^{-t} + e^{-t} + c \qquad \ldots(1)$$

Given $x(1) = 1$

$e^{-1} = e^{-1} + e^{-1} + c$

$\boxed{-e^{-1} = c}$

$\therefore$ from (1)

$x = t + 1 - (e^{-t} \cdot e^{t})$

Put $y = \frac{1}{2}$

$\boxed{x = 3 - e}$

7. Let $T_r = \frac{(2r-1)(2r+1)(2r+3)(2r+5)}{64}$, then

$\lim\limits_{n\to\infty}\sum\limits_{r=1}^{n}\frac{1}{T_r}$ is equal to

(1) $\frac{22}{45}$ (2) $\frac{32}{35}$

(3) $\frac{27}{45}$ (4) $\frac{32}{45}$

Answer (4)

Sol. $T_r = \frac{(2r-1)(2r+1)(2r+3)(2r+5)}{64}$

$\Rightarrow \frac{1}{T_r} = \frac{64}{16\left(r-\frac{1}{2}\right)\left(r+\frac{1}{2}\right)\left(r+\frac{3}{2}\right)\left(r+\frac{5}{2}\right)}$

$\Rightarrow \frac{1}{T_r} = \frac{\frac{4}{3}\left[\left(r+\frac{5}{2}\right)-\left(r-\frac{1}{2}\right)\right]}{\left(r-\frac{1}{2}\right)\left(r+\frac{1}{2}\right)\left(r+\frac{3}{2}\right)\left(r+\frac{5}{2}\right)}$

$\Rightarrow \frac{1}{T_r} = \frac{4}{3}\left[\frac{1}{\left(r-\frac{1}{2}\right)\left(r+\frac{1}{2}\right)\left(r+\frac{3}{2}\right)} - \frac{1}{\left(r+\frac{1}{2}\right)\left(r+\frac{3}{2}\right)\left(r+\frac{5}{2}\right)}\right]$

$\lim\limits_{n\to\infty}\sum\limits_{r=1}^{n}\frac{1}{T_r} = \frac{4}{3}\left[\frac{1}{\frac{1}{2}\cdot\frac{3}{2}\cdot\frac{5}{2}} - \frac{1}{\frac{3}{2}\cdot\frac{5}{2}\cdot\frac{7}{2}}\right]$

$\frac{1}{\frac{3}{2}\cdot\frac{5}{2}\cdot\frac{7}{2}} - \frac{1}{\frac{5}{2}\cdot\frac{7}{2}\cdot\frac{9}{2}}$

$= \frac{4}{3}\left[\frac{8}{15}\right] = \frac{32}{45}$

8. Coefficient of x^{2012} in $(1-x)^{2008}(1+x+x^2)^{2007}$

(1) 0 (2) 1

(3) 2 (4) 3

Answer (1)

Sol. $(1-x)[(1-x)(1+x+x^2)]^{2007}$

$= (1-x)(1-x^3)^{2007}$

$= (1-x^3)^{2007} - x(1-x^3)^{2007}$

[$(1-x^3)^{2007}$ contains 3λ types of exponents while $x(1-x^3)^{2007}$ will have $(3\lambda+1)$ type while 2012 is $(3\lambda+2)$ type] that is not possible $\Rightarrow 0$

Coefficient of x^{2012} in $(1-x^3)^{2007} = 0$

Coefficient of x^{2011} in $(1-x^3)^{2007} = 0$

$\Rightarrow$ Coefficient of x^{2012} in $(1-x)^{2008}(1+x+x^2)^{2007} = 0$

9. If the images of the points $A(1, 3)$, $B(3, 1)$ and $C(2, 4)$ in the line $x + 2y = 4$ are D, E and F respectively, then the centroid of the triangle DEF is

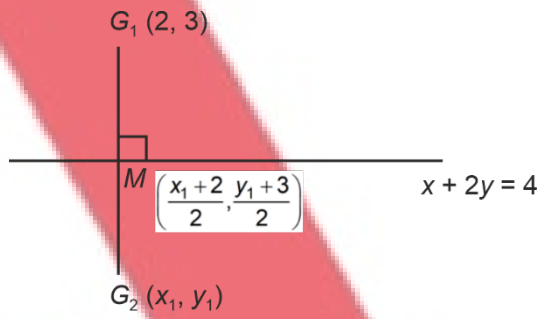
(1) $(3, -1)$ (2) $\left(-\frac{3}{5}, -\frac{2}{5}\right)$

(3) $\left(\frac{2}{5}, -\frac{1}{5}\right)$ (4) $\left(\frac{1}{5}, -\frac{2}{5}\right)$

Answer (3)

Sol. Centroid of the ΔDEF is the mirror image of the centroid of the ΔABC about the line $x + 2y = 4$.

G_1 = Centroid of $\Delta ABC \equiv (2, 3)$, $G_2 \equiv$ Centroid of ΔDEF.



$\Rightarrow \frac{y_1-3}{x_1-2} = 2, \frac{x_1+2}{2} + (y_1+3) = 4$

$\Rightarrow x_1 = \frac{2}{5}, y_1 = -\frac{1}{5}$

$\Rightarrow G_2 = \left(\frac{2}{5}, -\frac{1}{5}\right)$

10. If $A = \{1, 2, 3, \ldots, 10\}$.

$B = \left\{\frac{m}{n}, m,n \in A \text{ and } m < n \text{ and gcd of } (m,n) = 1\right\}$.

Then number of elements in set B is

(1) 30 (2) 31

(3) 28 (4) 29

Answer (2)

Sol. $n = 1 \;\; m \in \phi$ …0

$n = 2 \;\; m = 1 \Rightarrow \frac{m}{n}$ can be $\frac{1}{2}$ …1

$n = 3 \;\; m = 1, 2 \Rightarrow \frac{m}{n}$ can be $\frac{1}{3}, \frac{2}{3}$ …2

$n = 4 \;\; m = 1,3 \Rightarrow \frac{m}{n}$ can be $\frac{1}{4}, \frac{3}{4}$ …2

$n = 5 \;\; m = 1, 2, 3, 4 \Rightarrow \frac{m}{n} = \frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}$ …4

$n = 6 \;\; m = 1, 5 \Rightarrow \frac{m}{n} = \frac{1}{6}, \frac{5}{6}$ …2

$n = 7 \;\; m = 1, 2, 3, 4, 5, 6 \Rightarrow \frac{m}{n} = \frac{1}{7}, \frac{2}{7}, \frac{3}{7}, \frac{4}{7}, \frac{5}{7}, \frac{6}{7}$ …6

$n = 8 \;\; m = 1, 3, 5, 7 \Rightarrow \frac{m}{n} = \frac{1}{8}, \frac{3}{8}, \frac{5}{8}, \frac{7}{8}$ …4

$n = 9 \;\; m = 1, 2, 4, 5, 7, 8 \Rightarrow \frac{m}{n} = \frac{1}{9}, \frac{2}{9}, \frac{3}{9}, \frac{4}{9}, \frac{5}{9}, \frac{7}{9}, \frac{8}{9}$ …6

$n = 10 \;\; m = 1, 3, 7, 9 \Rightarrow \frac{m}{n} = \frac{1}{10}, \frac{3}{10}, \frac{7}{10}, \frac{9}{10}$ …4

11. How many ways are there to pick 5 letters from English alphabets such that M is the middle of the letters (repetition not allowed).

(1) ${}^{26}C_5 . 5!$

(2) ${}^{25}C_4 . 4!$

(3) ${}^{26}C_4 . 4!$

(4) ${}^{25}C_5 . 5!$

Answer (2)

Sol. $\underline{A_1}\;\underline{A_2}\;\underset{\uparrow \text{fixed}}{\underline{M}}\;\underline{A_3}\;\underline{A_4}$

${}^{25}C_4 \times 4!$

12. Let $|Z_i| = 1$ for $i = 1, 2, 3$ satisfying $\left|\bar{Z}_1 Z_2 + \bar{Z}_2 Z_3 + \bar{Z}_3 Z_1\right|^2 = a + b\sqrt{2}$, where a, b an rational numbers such that $\arg(Z_1) = \frac{\pi}{4}$, $\arg(Z_2) = 0$ and $\arg(Z_3) = \frac{-\pi}{4}$, then find (a, b)

(1) (5, 2) (2) (–5, –2)

(3) (5, –2) (4) (–5, 2)

Answer (3)

Sol. $Z_1 = |1| e^{i\frac{\pi}{4}} = \frac{1}{\sqrt{2}} + i \cdot \frac{1}{\sqrt{2}}$

$Z_2 = |1| e^{-(0)} 1 + 0i$

$Z_3 = |1| e^{-i\frac{\pi}{4}} = \frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}$

$\bar{Z}_1 Z_2 = \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)(1)$

$\bar{Z}_2 Z_3 = 1\left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right)$

$\bar{Z}_3 Z_1 = \left(\frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}\right)\left(\frac{1}{\sqrt{2}} + \frac{i}{\sqrt{2}}\right)$

$\Rightarrow \bar{Z}_1 Z_2 + \bar{Z}_2 Z_3 + \bar{Z}_3 Z_1 = \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right) + \left(\frac{1}{\sqrt{2}} - \frac{i}{\sqrt{2}}\right) + \left(\frac{1}{2} - \frac{1}{2}\right) + 2i\left(\frac{1}{2}\right)$

$= \sqrt{2} - \sqrt{2}i + i$

$\Rightarrow \left|\bar{Z}_1 Z_2 + \bar{Z}_2 Z_3 + \bar{Z}_3 Z_1\right|^2 = \left|\sqrt{2} + i\left(-\sqrt{2} + 1\right)\right|^2$

$= \left(\sqrt{\left(\sqrt{2}\right)^2 + \left(1 - \sqrt{2}\right)^2}\right)^2$

$= 5 - 2\sqrt{2}$

$(a, b) = (5, -2)$

13. Let a coin is tossed thrice. Let the random variable x is tail follows head. Let the mean of x is μ and variance is σ^2. Find $64 (\mu + \sigma^2)$.

(1) 48 (2) 64

(3) 132 (4) 128

Answer (1)

Sol.

	x_i	P_i
HHH	0	$\frac{1}{8}$
TTT	0	$\frac{1}{8}$
HHT	1	$\frac{1}{8}$
HTH	1	$\frac{1}{8}$
THH	0	$\frac{1}{8}$
TTH	0	$\frac{1}{8}$
THT	1	$\frac{1}{8}$
HTT	1	$\frac{1}{8}$

$$\mu = \Sigma P_i\ x_i = \frac{1}{2}$$

$$\sigma^2 = \Sigma P_i x_i^2 - \mu^2$$

$$= \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$$

$$64\left(\frac{1}{2} + \frac{1}{4}\right) = 64 \times \frac{3}{4} = 48$$

14. Let $g(x) = 3f\left(\frac{x}{3}\right) + f(3-x) \forall x \in (0,3)$ and $f''(x) > 0 \forall x \in (0,3)$ then $g(x)$ decreases in interval $(0, \alpha)$, then α is

(1) $\frac{7}{4}$ (2) $\frac{2}{3}$

(3) $\frac{9}{4}$ (4) $\frac{7}{3}$

Answer (3)

Sol. $g(x) = 3f\left(\frac{x}{3}\right) + f(3-x)$

$$g'(x) = 3 \cdot \frac{1}{3} f'\left(\frac{3}{3}\right) - f'(3-x)$$

$$= f'\left(\frac{x}{3}\right) - f'(3-x)$$

$$g''(x) = \frac{f''(x)}{3} + f''(3-x)$$

$$\Rightarrow g'(x) > 0$$

$$f'\left(\frac{3}{3}\right) - f'(3-x) > 0$$

$f'(x) > 0 \Rightarrow f'(x)$ is increasing

15. Let $\vec{b} = \lambda\hat{i} + 4\hat{k}, \lambda > 0$ and the projection vector of $\vec{b}$ on $\vec{a} = 2\hat{i} + 2\hat{j} - \hat{k}$ is $\vec{c}$. If $|\vec{a} + \vec{c}| = 7$, then the area of the parallelogram formed by vector $\vec{b}$ and $\vec{c}$ is (in square units)

(1) 8

(2) 16

(3) 32

(4) 64

Answer (3)

Sol. $\vec{c} = (\vec{b} \cdot \hat{a})\hat{a} = \frac{2\lambda - 4}{6}\vec{a}$

$$\because\ |\vec{a} + \vec{c}| = 7 \ \Rightarrow \left|\vec{a}\left(1 + \frac{2\lambda - 4}{9}\right)\right| = 7$$

$$\left|\frac{5 + 2\lambda}{9}\right| \times 3 = 7 \Rightarrow |5 + 2\lambda| = 21$$

$$\because\ \lambda > 0 \ \Rightarrow\ \lambda = 8$$

$$\Rightarrow \vec{c} = \frac{4}{3}\vec{a} \text{ and } \vec{b} = 4(2\hat{i} - \hat{k})$$

$$\Rightarrow \vec{b} \times \vec{c} = \frac{16}{3}\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 0 & 1 \\ 2 & 2 & -1 \end{vmatrix} = \frac{16}{3}(-2\hat{i} + 4\hat{j} + 4\hat{k})$$

$$\Rightarrow |\vec{b} \times \vec{c}| = \frac{32}{3}|-\hat{i} + 2\hat{j} + 2\hat{k}| = 32$$

$\Rightarrow$ Area of parallelogram formed by $\vec{b}$ and $\vec{c}$

$$\Rightarrow |\vec{b} \times \vec{c}| = 32$$

16. Let the parabola $y = x^2 + px - 3$ cuts the coordinate axes at P, Q and R. A circle with centre $(-1, -1)$ passes through P, Q and R, then the area of triangle PQR.

(1) $\frac{5}{2}$ (2) $\frac{3}{2}$

(3) 3 (4) 5

Answer (2)

Sol. Since at $x = 0$, $y = -3$, parabola cuts the coordinate y-axe at $(0, -3)$

$\Rightarrow$ Equation of circle will be

$(x + 1)^2 + (y + 1)^2 = (-1 - 0)^2 + (-1 + 3)^2$

$= 1 + 4 = 5$

$x^2 + 2x + y^2 + 2y = -3 = 0$

Circle cuts x-axis at $y = 0$

$\Rightarrow x^2 + 2x - 3 = 0$, $(x + 3)(x - 1) = 0$

$\Rightarrow (-3, 0), (1, 0)$

$\Rightarrow$ Area of Δ

$$\Rightarrow \frac{1}{2}\begin{vmatrix} -3 & 0 & 1 \\ 0 & -3 & 0 \\ 1 & 0 & 0 \end{vmatrix} = \frac{1}{2}(3) = \frac{3}{2}$$

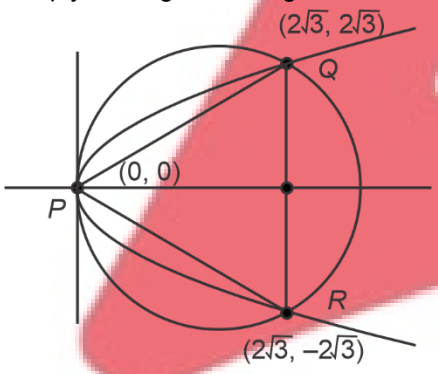
17. If the circle $\left(x - 2\sqrt{3}\right)^2 + y^2 = 12$ and parabola $y^2 = 2\sqrt{3}x$ intersects at P, Q and R. Then the area of triangle PQR is

(1) 10 sq. units (2) 12 sq. units

(3) 14 sq. units (4) 16 sq. units

Answer (2)

Sol. Simply solving both we get $x = 0,\ 2\sqrt{3}$



$$\Delta PQR = \frac{1}{2} \times (4\sqrt{3})(2\sqrt{3})$$

18. A hyperbola with foci (1, 14) and (1, –12) passes through the point (1, 6). The length of the latus rectum of the hyperbola is

(1) $\frac{144}{5}$

(2) 50

(3) $\frac{288}{5}$

(4) 100

Answer (3)

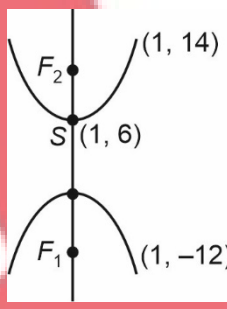
Sol. $|sp - s'p| = 2a$, $ss' = 2ae$

$s(1, 14)$, $s'(1, -12)$, $P(1, 6)$

$\Rightarrow 2a = |8 - 18|$

$\Rightarrow a = 5$; $2ae = 26$

$\Rightarrow ae = 13$



Length of latus rectum $1 = \frac{2b^2}{a} = \frac{2a^2(e^2 - 1)}{a}$

$= \frac{2(169 - 25)}{5} = \frac{288}{5}$

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. If A be a 3×3 square matrix such that $\det(A) = -2$. If $\det(3\ \text{adj}(-6\ \text{adj}(3A))) = 2^n \cdot 3^m$, where $m \geq n$, then $4m + 2n$ is equal to

Answer (104)

Sol. Concept: A. $\text{adj}(A) = |A|I$, $\det(\lambda A) = \lambda^n \det(A)$

$\Rightarrow$ $\det(A) = |A|^{n-1}$, where n is order

$\Rightarrow$ $\det(3\ \text{adj}(-6\ \text{adj}(3A)))$

$= 3^3 \cdot \det(\text{adj}(-6\ \text{adj}(3A)))$

$= 3^3 \cdot (-6\ \text{adj}(3A)))^2$

$= 3^3 \cdot (-6)^6\ |3A|^4$

$= 3^9 \cdot 2^6 \cdot 3^{12} \cdot (-2)^4$

$= 3^{21} \cdot 2^{10}$

$\therefore$ $n = 10$, $m = 21$

$\therefore$ $4m + 2n = 104$

22. If $a_1, a_2, a_3 \ldots, a_n$ are in geometric progression such that $a_1a_5 = 28$, $a_2 + a_4 = 29$, then the value of a_6 is

(1) 635 (2) 784

(3) 872 (4) 898

Answer (2)

Sol. $a_1a_5 = 28 \Rightarrow a^2r^4 = 28$

$a_2 + a_4 = 29 \Rightarrow ar + ar^3 = 29$

ar, ar^3 are roots of $k^2 - 29k + 28 = 0$

$\Rightarrow$ $k = 1, k = 28$

$\Rightarrow$ $ar = 1, ar^3 = 28$

$\Rightarrow$ $r^2 = 28,\ a^2 = \dfrac{1}{28}$

$a_6 = ar^5 \Rightarrow a_6^2 = a^2r^{10} = \dfrac{1}{28} \times (28)^5 = (28)^4$

$\Rightarrow$ $a_6 = (28)^2 = 784$

23.

24.

25.

❑ ❑ ❑