JEE Main 2024 Solution April 5 Shift 2 (B.E./B.Tech)

JEE Main Mathematics Questions

Ques 1. The 50th word in the dictionary using the letters B, B, H, J, O is:

A. OBBJH
B. OBBHJ
C. JHBBO
D. BBHOJ

Ans. A
Solu. Number of words staring with 'B' = 4! = 24
Number of words staring with 'H' = 4! /2! = 12
Number of words staring with 'J' = 12
49th word = OBBHJ
50th word = OBBJH

Ques 2.

$\left(\frac{3^{\frac{1}{5}}}{x}+\frac{2x}{5^{\frac{1}{3}}}\right)^{12}$ **. Find which term is constant.**

A. 4th
B. 5th
C. 6th
D. 7th

Ans. D

Solu.

$$\left(\frac{3^{\frac{1}{5}}}{x}+\frac{2x}{5^{\frac{1}{3}}}\right)^{12}$$

$$T_{r+1}={}^{n}C_{r}\left(\frac{3^{\frac{1}{5}}}{x}\right)^{n-r}\left(\frac{2x}{5^{\frac{1}{3}}}\right)$$

$$\left(3^{\frac{1}{5}}\right)^{n-r}x^{r-n}\frac{2^{r}.x^{r}}{5^{\frac{r}{3}}}$$

For constant term r – n + r = 0 ⇒ 2r – n = 0
We have n = 12 ⇒ 2r – 12 = 0
r = 6
So 7th term is constant

Ques 3. Let $4^{1+x} + 4^{1-x}$, k/2 , $16^{x} + 16^{-x}$ are in A. P. then least value of k is____

Ans. 10
Solu. Let $4^{1+x} + 4^{1-x}$, k/2 , $16^{x} + 16^{-x}$
2 * K/2 = 4 ^ (1 + x) + 4 ^ (1 - x) + 16 ^ x + 16 ^ (- x)
K = 4.4 ^ x + 4/(4 ^ x) + (4 ^ (2x) + 4 ^ (- 2x))
=> K>=10
=>K = 10

Ques 4. The number of real solution x|x + 5| + 2|x + 7| - 2 = 0 is

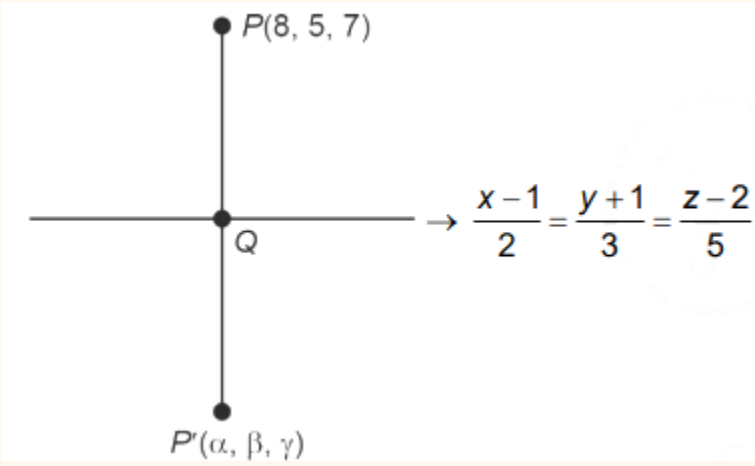
Ans. 3
Solu. x|x + 5| + 2 |x + 7| – 2 = 0
(i) d x>=-5 ⇒ x(x + 5) + 2(x + 7) - 2 = 0
x ^ 2 + 7x + 12 =0 ⇒ x=-3,-4
(ii) x \in (- 7, - 5)
x(- x - 5) + 2(x + 7) - 2 = 0

- x ^ 2 - 3x + 12 = 0
⇒ x ^ 2 + 3x - 12 = 0
⇒ x = (- 3 - sqrt(57))/2 satisfy
(iii) x <= - 7
⇒ x(- x - 5) + 2(- x - 7) - 2 = 0
-x^ 2 -7x-16=0
⇒ x ^ 2 + 7x + 16 = 0
No solution

Ques 5. Let image of point (8,5,7) with respect to line $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{5}$ is (α,β,γ). Then, α + β + y is equal to_____.

A. 10
B. 12
C. 9
D. 14

Ans. D
Solu. Given point (8, 5, 7)



Let Q be general point.
(x, y, z) = (2λ + 1, 3λ - 1, 5λ + 2)
Now D.R. of P.Q
PQ ⇒ (2λ + 1 - 8, 3λ - 1 - 5, 5λ + 2 - 7)

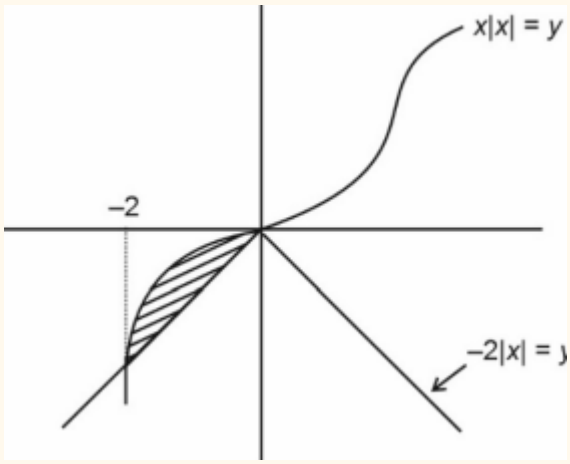
= (2λ - 7, 3λ - 6, 5λ - 5) ...(1)
D.R. of line <2,3,5>.... (2)
From (1) and (2)
2(2λ - 7) + 3(3λ - 6) + 5(5λ - 5) = 0
4λ - 14 + 9λ - 18 + 25λ - 25 = 0
38λ - 57 = 0

Ques 6. Area bounded by y = -2|x| and y = x|x| is:

A. ⅔
B. ⅓
C. ½
D. 4/3

Ans. D

Solu.



Area= $\left|\int_{-2}^{0}(-x^2-(2x))dx\right|$

= $\left|\frac{-x^3}{3}-x^2\right|_{-2}^{0}$

= |8/3 - 4| =4/3 sq. unit

Ques 7. If |a| = 2, |b| = 3 and a = b × 2, then minimum value of |ĉ – al² is:

A. 13
B. 5
C. 40/9
D. 20/9

Ans. C
Solu. $|\rightarrow a|=2$
$|\rightarrow b|=3$
Also, $\rightarrow a = \rightarrow b * \rightarrow c$
$\Rightarrow \rightarrow a * \rightarrow b = 0$
and $\rightarrow a * \rightarrow c = 0$
$|\rightarrow a - \rightarrow c|^2 = |\rightarrow a|^2 + |\rightarrow c|^2 - 2 \rightarrow a * \rightarrow c$
$= 4 + |\rightarrow c|^2$
$|\rightarrow a| = |\rightarrow b * \rightarrow c| = |\rightarrow b|\sin\theta| \rightarrow c|$
$\Rightarrow (\sin\theta)|\rightarrow c| = 2/3$
$\Rightarrow \sin^2\theta = 4/9|\rightarrow c|^2$
$\Rightarrow|\rightarrow c|^2 = 4/(9\sin^2\theta)$
$|\rightarrow a - \rightarrow c|^2 = 4 + 4/(9\sin\hat{}2\theta)$
For $|\rightarrow a - \rightarrow c|^2$ to be minimum
$\Rightarrow \sin\theta = 1$
$\Rightarrow 4 + 4/9 = (40/9)$

Ques 8. A = $\begin{bmatrix} \alpha & \alpha & \alpha \\ \beta & \alpha & -\beta \\ -\alpha & \alpha & \alpha \end{bmatrix}$
B is formed by co-factor of A matrix, then find out determinant of AB.

A. 4α3(2α + β)5
B. 12α4(α + β)2
C. 8α6(α + β)3
D. 18α8(α + β)3

Ans. C

Solu. A= $\begin{bmatrix} \alpha & \alpha & \alpha \\ \beta & \alpha & -\beta \\ -\alpha & \alpha & \alpha \end{bmatrix}$

|A| = $\begin{bmatrix} 2\alpha & 0 & 0 \\ \beta & \alpha & -\beta \\ -\alpha & \alpha & \alpha \end{bmatrix}$

= 2α(α ^ 2 + α*β)

= 2α ^ 2 * (α +β)

lations

Now, β = (adjA)

Determinant of A-B = |A-B = |A-(adjA)7

AB = 1 = |A|-|A|2 = |A|3

|A| ^ 3 = 8α ^ 6 * (α + β) ^ 3

Ques 9. Consider a equation $P(x)= ax^2 + bx + c =0$. If a,b,c ∈ A, were A = {1, 2, 3, 4, 5, 6} . Then the probability that P(x) has real and distinct roots?

- **A. ¼**
- **B. 1/16**
- **C. 25/108**
- **D. 19/108**

Ans. D

Solu. b ^ 2 - 4ac > 0

⇒ b < 2

not possible

⇒ b=3 → ac < 9/4 (a, c) ∈ {(1, 1), (1, 2), (2, 1)) ⇒ 3 cases

⇒ b=4 → ac<4 ⇒ ac = \{1, 2, 3\}

(a, c) ∈ {(1, 1), (1, 2), (2, 1), (3, 1), (1, 3)} = 5way

⇒ b=5 → ac< 25 4 ⇒ ac = {1, 2, 3, 4, 5, 6}

(a,c) ∈ (1, 1), (1, 2), (2, 1), (3, 1), (1, 3), (2, 2) , (4, 1), (1, 4), (3, 2), (2, 3), (5, 1), (1, 5), (1,6), (6, 1) \ →14 ways
⇒ b=6⇒ ac<9 ⇒ ac in {1, 2, 3, 4, 5, 6, 7, 8}
(a, c) ∈ {(1, 1), (1, 2), (2, 1), (3, 1), (1, 3), (2, 2), (4, 1), (1, 4), (3, 2), (2, 3), (5, 1), (1, 5), (1, 6), (6, 1), (2, 4), (4, 2)} 16 ways
⇒ 3 + 5 + 14 + 16 = 38 cases
⇒ Probability = $38/6^3$=19/108

Ques 10. A line L is perpendicular to y = 2x + 10 such that it touches the parabola y2 = 4(x – g). Then the distance between point of contact and origin is equal to (

A. 165
B. 175
C. 185
D. 190

Ans. C
Solu. L: 2y + x = c y2 = 4(x – 9)
Now
$((c-x)/2)^2 =4(x-9)$
x2 – 2(c + 8)x + c2 + 144 = 0
D = 0 ⇒ c = 5
∴ L: 2y + x = 5
Parabola and L meets at (13, –4)
Now, distance = √185

Ques 11. If S = {2, 4, 8, 16, …, 512}. If S is broken in 3 equal subsets A, B and C such that A∩B = B∩C = C∩A = φ and A ∪ B ∪ C = S then maximum number of ways to break is

A. $^9C_3$
B. 9!/(3!)3
C. 9!/(3!)4

D. $9!/(3!)^2$

Ans. B

Solu. S = {21, 22, 23, ..., 29)
A∩B = BOC = AC =
and = AUBUC = S
A, B, C are disjoint mutually exhaustive and
exclusive
9! 6! X 3!3! -x(1)
9! 3!3!3! = = 1680

Ques 12. If y= $\frac{2\cos 2\theta + \cos\theta}{\cos 3\theta + \cos^2\theta + \cos\theta}$ **, Then value of y"+ y' +y is**

A. secθ(1 – tan3θ)
B. tanθ(sec3θ + 2tan2θ)
C. secθ(2sec2θ + tanθ)
D. cotθ(sec3θ + 2tanθ)

Ans. C

Solu. y = (2cos 2θ + cos θ)/(cos 3θ + cos^2 θ + cos θ)
y = (2cos 2θ + cos θ)/(2cos 2θ * cos θ + cos^2 θ)
y = (2cos 2θ + cos θ)/(cos θ * (2cos 2θ + cos θ))
y = 1/(cos θ)
y = sec
y' = sec tan
y" = $\sec^3$ θ + tan θ * (sec(θ) * tan θ)
= sec^3 θ + sec(tan^2 θ)
y^ prime prime + y' + y = sec^3 θ + sec(θ) * tan^2 θ + sec(θ) * tan θ + sec(θ) = sec(θ) * (sec^2 θ + 1) + sec(θ) * tan θ * (tan θ + 1) = sec(θ) * (sec^2 θ + 1 + tan^2 θ + tan θ) = sec(θ) * (2sec^2 θ + tan θ)

JEE Main Chemistry Questions

Ques 1. Find out E cell of the given cell M | M^{2+} | | x^{2-}|x.
$E^{o}_{M^{2+}|M}$ = 0.34 V
$E^{\circ}_{x|x^{2-}}$ = 0.46 V

A. 0.80 V
B. 0.12 V
C. -0.12 V
D. -0.80 V

Ans. B
Solu. M - M ^ 2+ +2e^ - (Anode) X +2e^ - → X^ 2-
M+X → M^ 2+ +X^ 2- E cell ^ =(E M|M^ 2+ ^)+(E X|X^ 2- ^) -0.34 +0.46 = 0.12V

Ques 2. Which of the following is true regarding coagulation of egg:

A. 1° structure does not change
B. 2° structure does not change
C. 3º structure does not change
D. Denaturation of protein does not occur.

Ans. A
Solu. Coagulation of egg white on boiling is a common example of denaturation in which primary structure only remains intact.

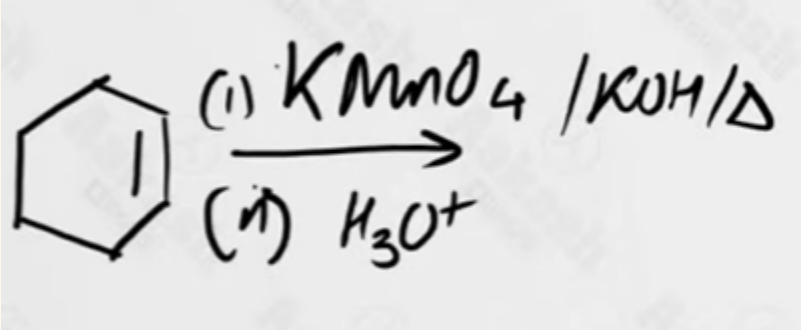
Ques 3. Find out value of C_p/C_y for an ideal gas undergoing reversible adiabatic process for which $P \propto T^3$ is given

A. 4/3
B. 3/2

C. 5/4
D. 5/3

Ans. B
Solu. PT3 = Constant (C)
P * (PV) ^ - 3 = C
P ^ 1 * P ^ - 3 * V ^ - 3 = C
P ^ - 2 * V ^ - 3 = C
P ^ 2 * V ^ 3 = C
P * V ^ (3/2) = C

Ques 4. Consider the following reaction:

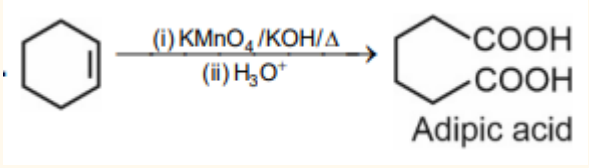


The product is

A. Adipic Acid
B. Oxalic Acid
C. Succinic acid
D. Benzoic Acid

Ans. A

Solu.

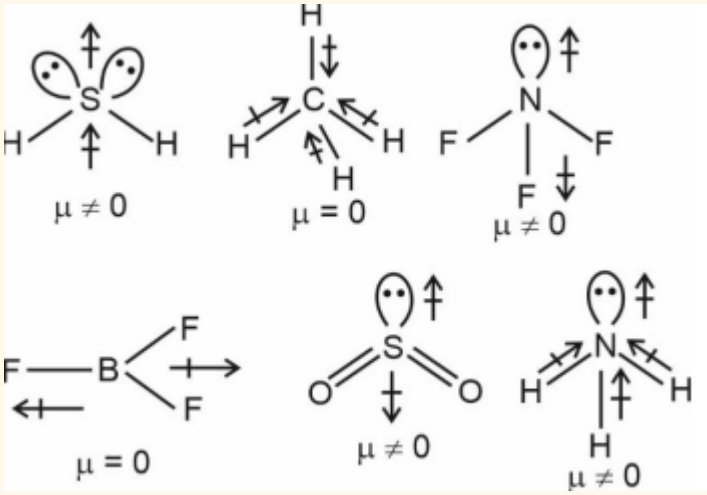


Ques 5. How many of the following have zero dipole moment

H_2S, CH_4, NH_3, BF_3, SO_2, NF_3

Ans. 2

Solu.

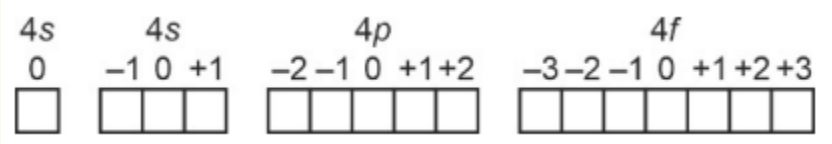


CH4 and BF3 have zero dipole moment

Ques 6. In an atom, how many electrons can have
(i) n = 4 (ii) m1 =1 (iii) ms = ½

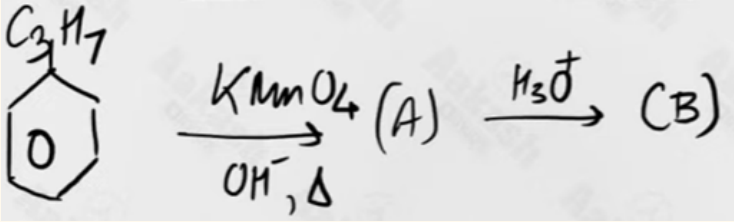
Ans. 3

Solu. In n = 4 shell,

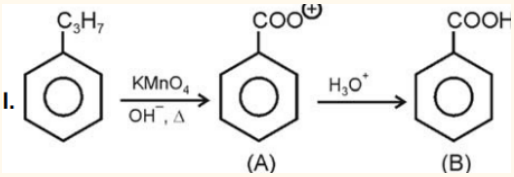


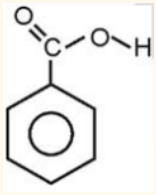
Total orbitals with ml = 1→ 3
Total e– with m_s = ½ → 3

Ques 7. Number of π bonds present in product B is:



Ans. 4

Solu. I. 

Number of bonds in B:  are : 4

Ques 8. From the given information, calculate enthalpy of formation of 2 moles of C6H6(l) at 25°C. Given: CH(C6H6(l)) = –3264.6 kJ/mol CH(C(s)) = –393.5 kJ/mol fH(H2O(l)) = –285.83 kJ/mol

A. –124.5 kJ/mol
B. –46.11 kJ/mol
C. 46.11 kJ/mol
D. 124.5 kJ/mol

Ans. C
Solu. Formation reaction
6C(s) + 3H_{2}(g) -> C_{6}*H_{6}(l)
Δ_{t}*H(C_{6}*H_{6}) = 6Δ_{C}*H(C(s)) + 3Δ_{C}*H(H_{2}(g)) - Δ_{C}*H(C_{6}*H_{6}(l))
= 6(- 393.5) + 3(- 285.83) - (- 3264.6)
[: Δ_{f}*H(H_{2}*O(l)) = Δ_{C}*H(H_{2}(g))]
= 3264.6-2361-857.49
= 46.11kJ / mol

Ques 9. Which of the following molecule is an acidic oxide?

A. N2O3
B. NO
C. CO
D. CaO

Ans. A
Sol. N_2O_3 → Acidic oxide
NO and CO → Neutral oxide
CaO →Basic oxide

Ques 10. Equanil drug is used for which disease?

- **A. Infertility**
- **B. Hypertension and depression**
- **C. Acidity**
- **D. Eye-itching**

Ans. B

Solu. Equanil is a mild tranquilizer used to treat hypertension and depression.

JEE Main Physics Questions

Ques 1. Angular momentum of an electron in an orbit of radius R of a hydrogen atom is directly proportional to

- **A. R**
- **B. 1/R**
- **C. $1/\sqrt{R}$**
- **D. $\sqrt{R}$**

Ans. D
Solu. $L = nh/2\pi$ (i) $r = n^2/2\ r_0$ (ii)
=> $L \propto \sqrt{R}$

Ques 2. Shortest wavelength in Lyman series has wavelength of 915 À. Longest wavelength of Balmer series has a value of ?

A. 5296 Å
B. 3647 Å
C. 6588 Å
D. 7294 Å

Ans. C
Solu. Lyman: 1/915 = R * Z ^ 2 * (1/1 - 1/(∞))
R * Z ^ 2 = 1/915
Balmer: Transition from n = 3 to n = 2

Ques 3. A solid sphere is rolling without slipping. Find the ratio of rotational kinetic energy to total kinetic energy of sphere.

A. 4/7
B. 3/7
C. 2/7
D. 5/7

Ans. C

Solu.

$$K_{rot} = \frac{1}{2}\left(\frac{2}{5}MR^2\right)\omega^2$$

$$K_{total} = \frac{1}{2}Mv^2 + \frac{1}{2}\left(\frac{2}{5}MR^2\right)\omega^2$$

$$v = R\omega$$

$$\therefore \quad K_{total} = \frac{1}{2}\left(\frac{7}{5}MR^2\right)\omega^2$$

$$\frac{K_{rot}}{K_{total}} = \frac{2}{7}$$

Ques 4. A truck is moving from rest with constant power P. if the displacement of the truck is proportional to t", where t is time, find n.

A. 2
B. 3/2
C. ½
D. 5/2

Ans. B
Solu. $Pt = 1/2mv^2$
$v = \sqrt{((2Pt)/m)}$
$v = ds/dt$
$s = \int \sqrt{((2Pt)/m)}\, dt$
$s \propto t \wedge (3/2)$

Ques 5. A block of mass 50 kg is moving with speed of 10 m/s on a rough horizontal surface (friction coefficient of 0.3). Find the kinetic friction acting on the object.

A. 500 N
B. 150 N
C. 167 N
D. 16 N

Ans. B
Solu. $f = \mu N = 0.3 \times 500 = 150$ N

Ques 6. In thermodynamics adiabatic process, pressure is directly proportional to cube of absolute temperature. Find C_P/C_V for the gas

A. 4/3
B. 7/5
C. 3/2
D. 8/7

Ans. C
Solu. $P \propto T^3 \Rightarrow P^3V^3 / P \propto P^2V^3\ PV^{3/2} = PV^Y$

Ques 7. In a hydraulic lift force F is applied to balance 10 N load, diameter of effort arm is 14 cm and load arm is 1.4 cm. The F is equal to

A. 500 N
B. 100 N
C. 2000 N
D. 1000 N

Ans. 4
Solu. $P_1 = P_2$

$$\frac{10}{\frac{\pi}{4}(1.4)^2} = \frac{F}{\frac{\pi}{4}(14)^2}$$

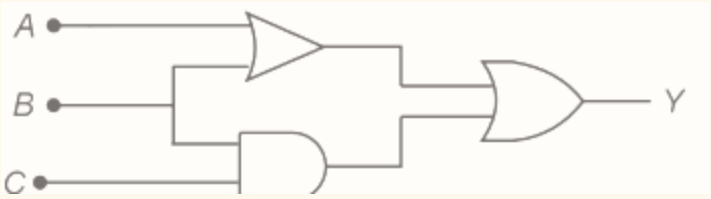
F= 1000N

Ques 8. In sonometer, fundamental frequency changes from 400 Hz to 500 Hz keeping same tension. Find percentage change in length.

A. 5%
B. 10%
C. 20%
D. 40%

Ans. C
Solu. $f = v/(2l_1) = 400$
$v/(2l_2) = 500$
$(l_2 - l_1)/l_1 * 100 = (V/1000 - V/800)/(V/800) * 100 = (8/10 - 1) * 100 = -20\ \%$

Ques 9. For what boolean values of A, B & C the given logic gate gives output of zero?



A. A = 1, B = 0, C = 1
B. A = 0, B = 0, C = 1
C. A = 0, B = 1, C = 1
D. A = 1, B = 1, C = 1

Ans. B
Solu. Putting values gives option (2).

Ques 10. 20R resistance wire is cut into 10 equal parts. Now each part first is connected in series and then in parallel. Find ratio of equivalent resistance in both cases (Rseries : Rparallel)

A. 100 : 1
B. 50 : 1
C. 25 : 1
D. 5 : 1

Ans. A
Solu. Series: R^{eq} = 20R
Parallel: R'_{eq} -= R/5
Ratio: R_{eq}: R'_{eq} = 20R: 20R/100 =1:1/100= 100:1