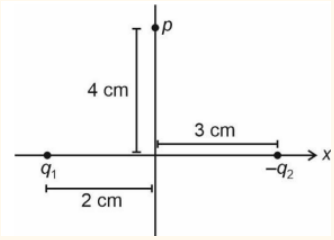
JEE Main 2024 Solution
April 8 Shift 2
(B.E./B.Tech)

JEE Main Physics Questions

Ques 1. Figure shows two charges q1 and –q2 placed on the x-axis as shown. If electric field at p is along x-direction, find q1/q2



A. 4√5 / 25
B. 8√5 / 25
C. 12/25
D. 16√5 / 25

Ans. B
Solu. $E_1 \sin 0_1 = E2 \sin 02$

$$\frac{k_{q_1}}{(20)} \times \frac{4}{\sqrt{20}} = \frac{k_{q_2}}{(25)} \frac{4}{5}$$

$$\frac{q_1}{q_2} = \frac{8\sqrt{5}}{25}$$

Ques 2. A disk of mass M, radius R is rotating about an axis passing through its centre and perpendicular to its plane with angular speed

ω. If another disk of mass M/2 and radius R is gently placed over it what will be their common angular velocity after some time?

A. ω/5
B. ω/2
C. 2ω/3
D. ω/4

Ans. C

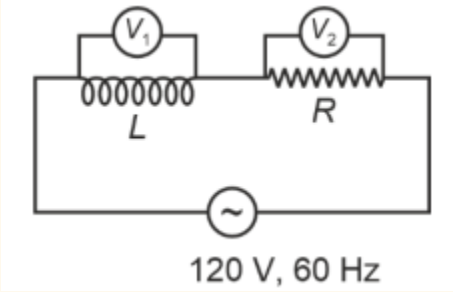
Solu.

$$I_1\omega = (I_1 + I_2)\omega'$$

$$\frac{MR^2}{2}\omega = \frac{3}{2}\left(\frac{MR^2}{2}\right)\omega'$$

$$\omega' = \frac{2\omega}{3}$$

Ques 3. In a given AC circuit consisting of a resistor R and an inductor L and source emf, two voltmeter V1 & V2 are connected as shown. If V2 = 36 volts then inductance of inductor is (Resistance R is √91Ω.)



A. 0.08 H
B. 0.8 H
C. 8 H
D. 80 H

Ans. A

Solu.

$$i\sqrt{R^2 + X_L^2} = 120 \ \& \ iR = 36$$

$$\Rightarrow \quad \frac{R^2 + X_L^2}{R^2} = \frac{120 \times 120}{36 \times 36} = \frac{100}{9}$$

$$9R^2 + 9X_L^2 = 100R^2$$

$$9X_L^2 = 91R^2$$

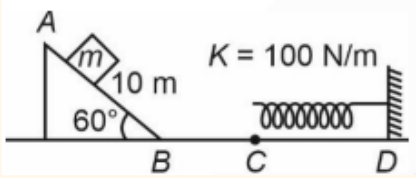
$$X_L = \frac{\sqrt{91}}{3}R$$

$$X_L = \frac{\sqrt{91}}{3} \times \sqrt{91} = \frac{91}{3}$$

$$L_\Omega = \frac{91}{3}$$

$$L = \frac{91}{3 \times 2 \times \pi \times 60}$$

Ques 4. A block of mass 5 kg is released as shown in the figure. Surface CD is rough with = 0.5, rest of all the surfaces are smooth. Find the maximum compression in the spring (initially spring is in its natural length.)



A. 1.5 m
B. 2.0 m
C. 3.5 m
D. 2.5 m

Ans. B

Solu. $W = E_1 - E$

$+ \quad (0.5 * 50) * x = (50 * 10)/2 - 1/2 * 100x \wedge 2$

$x = 2m$

Ques 5. A physical quantity P depends on electric field (E) and permittivity of free space (ε_0) as $P \propto E \varepsilon_0^2$, Find dimension of P

A. $[ML^{-5}T^5]^3]$
B. $[M^{-1}L^{-5}T^5I^3]$
C. $[M^2L^{-5}T^5I^2]$
D. [MLTI]

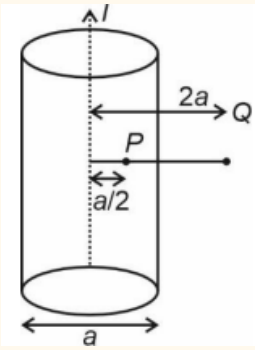
Ans. B
Solu. $[P] = [ML * T^{-3} \ I^{-1}] * [M^{-1} * L^{-3} * T^4 * I^2]^2 = [M^{-1}L^{-5}T^5I^3]$

Ques 6. An electron and a proton has same de Broglie wavelength. If Ke and Kp are their respective kinetic energies, then

A. kp > ke
B. kp<ke
C. kp = ke
D. None of these

Ans. B
Solu. lambda = h/p
$K_e = (p \wedge 2)/(2m)$
$K_e \propto 1/m$

Ques 7. Find ratio of magnetic field at point P to that at point Q. Point P is inside the solid cylinder and Q is outside the cylinder. Current is uniform through the crosssection of cylinder.



A. 2:1
B. 1:1
C. 1:2
D. 4:1

Ans. B
Solu. For P:

$$B_P 2\pi\left(\frac{a}{2}\right) = \mu_0 j \pi \frac{a^2}{4}$$

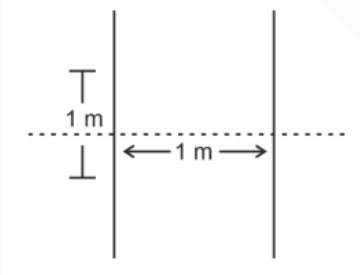
$$B_P = \frac{\mu_0 j a}{4}$$

For Q :

$$B_Q 2\pi(2a) = \mu_0 j \pi a^2$$

$$B_Q = \frac{\mu_0 \hat{j} a}{4}$$

Ques 8. In a YDSE shown a monochromatic light of wavelength 500 nm is incident. At point P, 10th maxima is formed. Now the two slits are replaced with a single slit of width w placed at the centre. If first diffraction minima is observed at P, find w.



A. 0.5 mm
B. 1 mm
C. 0.1 mm
D. 0.2 mm

Ans. C
Solu. 10 * (λ*D)/d = (λ*D)/w
w = d/10 = 0.1mm

Ques 9. An object is projected such that its horizontal range and maximum height are same, then angle of projection is

A. $\tan^{-1}2$
B. $\tan^{-1}1$
C. $\tan^{-1}3$
D. $\tan^{-1}4$

Ans. D
Solu.

$$R = \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin^2 \theta}{2g}$$

$$2\sin\theta\cdot\cos\theta = \frac{\sin\theta\cdot\sin\theta}{2}$$

$$\tan\theta = 4$$

Ques 10. A wave is given by the equation y= Asin{ π(330t-x) },then frequency of the wave is

A. 330 Hz
B. 660 Hz
C. 165 Hz
D. 1/330 Hz

Ans. C
Solu. y = A * sin(wt - kn)

- $\omega = 330\pi = 2\pi * t$
$v = 165Hz$

Ques 11. A vernier caliper having least count 1 /20 N cm and one main scale division is 1 mm, then value of one vernier scale division is

A. (N+1)mm /2N
B. (2N+1)mm /2N
C. (2N-1)mm /2N
D. (2N+2)mm /2N

Ans. C
Solu. L.C. 1 MSD - 1 VSD
1/20N cm=1mm- 1 VSD
VSD = 1 mm - 1/2N mm
=2N-1 mm / 2 N

Ques 12. A screw gauge with a pitch of 1 mm and a circular scale with 100 divisions is used to measure the thickness of the aluminium sheet. Negative zero error of 0.05 mm is there. What is the thickness of the sheet when main scale reading is 4 mm and 60th division coincides with the main scale line

A. 10.05 mm
B. 10.10 mm
C. 10.15 mm
D. 10.20 mm

Ans. A
Solu. Reading = MSR + CSR × LC – Zero error = 4 mm + 60 × 0.01 mm – (–0.05 mm) = 10.05 mm

JEE Main Chemistry Questions

Ques 1. Molecular orbital σ^* represents:

A. $\psi_A + \psi_B$
B. $\psi_A - \psi_B$
C. $\psi_A - 2\psi_B$
D. $\psi_A + 2\psi_B$

Ans. B
Solu. σ* is antibonding molecular orbital which is represented by (ΨA –ΨB)

Ques 2. Consider the given reaction:

$Cr_2O_7^{2-} \rightleftharpoons CrO_4^{2-}$

Above reaction shifts in forward direction in

A. Acidic Medium
B. Basic Medium
C. Neutral Medium
D. Slightly acidic medium

Ans. B
Solu. $H_20 + Cr_2O_7^{2-} \rightleftharpoons CrO_4^{2-} + H_2$
As per Le-Chatelier's principle, reaction will shift in forward direction in basic medium.

Ques 3. If de- Broglie wavelength of electron is equal to de- Broglie wavelength of proton, then what is the relation between their kinetic energy

A. $KE_e > KE_p$
B. $KE_p > KE_e$

C. $KE_p = KEe$
D. $2KE_e = KE_p$

Ans. A
Solu. $\lambda_e = \lambda_p$
$\Rightarrow (m\square KE)_e = (m\ \square KE)_p$
$\Rightarrow m_e < m_p$
(KE)e > (KE)p

Ques 4. Select the correct options:

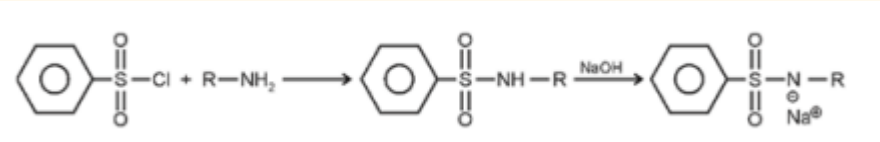
Statement 1: Benzene sulphonyl chloride reacts with 1°, 2° and 3° amines.

Statement 2: All products of the reaction above are soluble in NaOH.

A. Statement 1 is true and statement 2 is false.
B. Statement 1 is false and statement 2 is true.
C. Statement 1 and statement 2, both are true.
D. Statement 1 and statement 2, both are false.

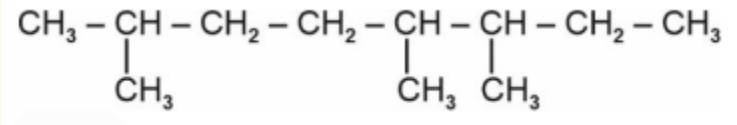
Ans. D

Solu.



1° and 2° amines reacts with benzene sulphonyl chloride. Product of 10 amine only is soluble in NaOH

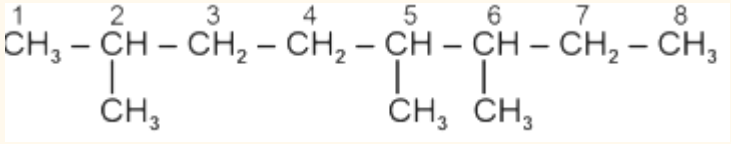
Ques 5. Consider the following compound:
What is the IUPAC nomenclature of the compound?



A. 2,5,6-trimethyl octane
B. 3,4,7-trimethyl octane
C. 2,4-ethyl, 3-methyl octane
D. Isopropyl hexane

Ans. A

Solu.



2, 5, 6-trimethyloctane

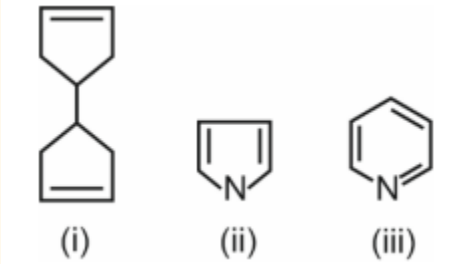
Ques 6. The total number of compounds having Bond order 2 among the following are: F_2, N_2, Ne_2, O_2, Li_2, Be_2, C_2

Ans. 2

Solu.

Molecule	Bond order
F_2	1
N_2	3
Ne_2	0
O_2	2
Li_2	1
Be_2	0

Ques 7. Which of the following are aromatic compounds?



A. Only (i) and (ii)
B. Only (ii) and (iii)
C. Only (i) and (iii)

D. All are aromatic

Ans. B
Solu. (ii) and (iii) are aromatic because they have 4n + 2 π electrons in cyclic resonance or say follow Huckel's rule while in case of (i) resonance is absent. (ii) and (iii) both are having 6π electrons in cyclic resonance.

Ques 8. Which of the following is correct?

A. Non-metals are generally more electronegative than metals
B. Non-metallic oxides are generally basic
C. Metallic oxides are generally acidic or neutral
D. Non-metallic have always lower ionisation enthalpy than metals

Ans. A
Solu. EN order: (Non-metals) > metals Non-metallic oxides are generally acidic Metallic oxides are generally basic

Ques 9.
Assertion: Kjeldahl method is not used for pyridine.
Reason: Nitrogen of pyridine does not change to ammonium sulphate under these conditions.

A. Both Assertion and Reason are true and Reason is a correct explanation for assertion
B. Both Assertion and reason are true but Reason is not a correct explanation for assertion
C. Assertion is true but Reason is false
D. Assertion is false but Reason is true

Ans. A
Solu. Kjeldahl method is not applicable to compounds containing nitrogen in the ring (pyridine) as nitrogen of these compounds does not change to ammonium sulphate under these conditions

Ques 10.
S-I: Blood is a buffer solution, whose pH is maintained at 7.4 by an acidic buffer.
S-II: pH is maintained by $HCO3^-$ and H_2CO_3

A. S-I and S-II both are correct
B. S-I and S-II both in correct
C. S-I is correct and S-II are incorrect
D. S-I is incorrect and S-II is correct

Ans. A
Solu. H CO /HCO 23 3 buffer system helps to maintain pH of blood between 7.26 to 7.42.

JEE Main Mathematics Questions

Ques 1. Number of 5 letters words made from the word "MATHEMATICS" is equal to

A. 13540
B. 13560
C. 14210
D. 17310

Ans, B
Solu. 2M
2A
2T
H, E, I, C, S
Case-I
2 Alike 2 Alike 1 Diff

$${}^3C_2 \cdot {}^6C_1 \cdot \frac{5!}{2!2!} = 18 \times 30 = 540$$

Case-II 2 Alike + 3 Diff

$${}^3C_1 \cdot {}^7C_3 \times \frac{5!}{2!} = 105 \times 60 = 6300$$

Case-III All different

${}^8C_5 \cdot = 5!$ 6720

Total words = 13560

Ques 2. 

,Then the sum of elements of 10th row.

- **A. 1505**
- **B. 1438**
- **C. 1981**
- **D. 1745**

Ans. A

Solu. The given sequence is 2, (5, 8), (11, 14, 17), (20, 21, 24, 27) …

Before 10th term total number of numbers would be 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 = 9 × 5 = 45

It is an A.P. with a = 2 and d = 3

T_{46} = 2 + 45 × 3 = 137

Sum of 10th terms = 10/2 (2 × 137 + (10 – 1)3) = 1505

Ques 3. Two points (5, 2) and (2, a). Line passes through these points makes an angle of π/4 at origin. The product of all values of a is equal to

- **A. 8**
- **B. –4**
- **C. –2**
- **D. 1**

Ans. B

Solu.

$$m_1 = \frac{2}{5},\ m_2 = \frac{a}{2}$$

$$1 = \left[\frac{\frac{2}{5} - \frac{a}{2}}{1 + \frac{2}{5}\cdot\frac{a}{2}}\right] \qquad \left(\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right|\right)$$

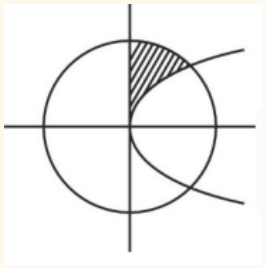
$$\pm 1 = \frac{4 - 5a}{10 + 2a}$$

Ques 4. A circle $x^2 + y^2 = 8$ and a parabola $y^2 = 2x$ are given. Find area bounded by these two curves in first quadrant which lie inside the circle and outside the parabola.

A. π-⅔
B. π-⅓
C. π +⅓
D. π- 4/3

Ans. A

Solu.



$$\text{Area} = \int_0^2 \left(\sqrt{8 - x^2} - \sqrt{2x}\right) dx$$

$$= \left[\frac{x}{2}\sqrt{8 - x^2} + \frac{8}{2}\sin^{-1}\left(\frac{x}{2\sqrt{2}}\right)\right]_0^2 - \sqrt{2} \times \frac{2}{3}\left[x^{3/2}\right]_0^2$$

$$= 2 + 4\sin^{-1}\left(\frac{1}{\sqrt{2}}\right) - \frac{2\sqrt{2}}{3}(2\sqrt{2})$$

$$= \left(\pi - \frac{2}{3}\right) \text{ sq. units.}$$

Ques 5. Bag X contains five one-rupee coins, four fiverupee coins. Bag Y contains 4 one rupee and 5 five rupees. Bag Z contains 3 one-rupee coin and 6 five rupee coins. If 1 rupee coin is selected at random, what is the probability it is drown from bag Y?

A. ⅓
B. ¼
C. ⅕
D. ⅙

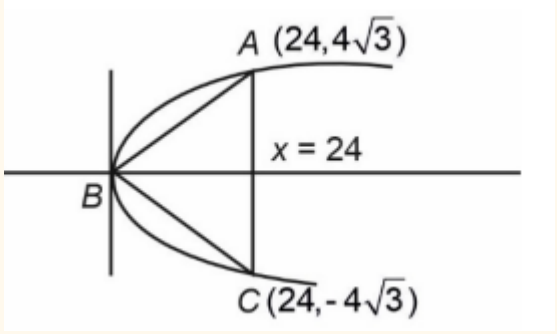
Ans. A
Solu. By Baye's theorem Probability (coin drawn from bag Y)

$$= \frac{\frac{1}{3}\cdot\frac{4}{9}}{\frac{1}{3}\cdot\frac{5}{9}+\frac{1}{3}\cdot\frac{4}{9}+\frac{1}{3}\cdot\frac{3}{9}} = \frac{4}{12} = \frac{1}{3}$$

Ques 6. A triangle is drawn inside bounded region of $y^2 = 2x$ and $x = 24$. Then maximum area of triangle is

A. $64\sqrt{3}$
B. $108\sqrt{3}$
C. $96\sqrt{3}$
D. $120\sqrt{3}$

Ans. C
Solu.



Base is constant i.e., AC = 8√3 Area of ΔABC will be maximum when height is maximum
∴ B is (0, 0)

∴ (Area)max = $= \frac{1}{2} \times 24 \times 8\sqrt{3} = 96\sqrt{3}$

Ques 7. A ray of light coming from (3, 1) incident on 2x + y = 6 and deflected ray passing through (7, 2). If equation of incident ray is ax + by + 1 = 0, then a2 + b2 + 3ab =

A. 11/25

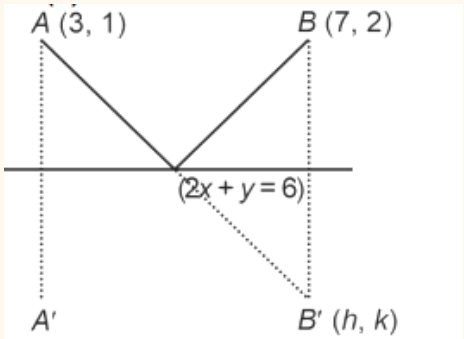
B. -11/25

C. -⅗

D. ⅗

Ans. B

Solu.



$$\frac{h-7}{2} = \frac{k-2}{1} = -2\frac{(14+2-6)}{5} = -4$$

$\therefore \quad h = -1, k = -2$

$\therefore \quad B'(-1, -2)$

$$\therefore \quad AB' \equiv \frac{4}{5}y - \frac{3}{5}x + 1 = 0$$

$$a = \frac{4}{5}, b = \frac{-3}{5}$$

$$a^2 + b^2 + 3ab = \frac{16}{25} + \frac{9}{25} - \frac{36}{25} = \frac{-11}{25}$$

Ques 9. If |x + 1||x + 3| – 4|x + 2| + 5 = 0, then sum of squares of solutions is

Ans. 16

Solu. . Let t = x + 2 ⇒ |t 2 – 1| –4|t| + 5 = 0

(1) t ∈ [1, ∞) t 2 – 4t + 4 = 0 ⇒ t = 2
(2) t ∈ [0, 1] ⇒ (t + 2)2 = 10 ⇒ t = − 10 2 or t =− − 10 2 No solution
(3) t ∈ [–1, 0] ⇒ (t + 2)2 = 10 ⇒ Again no solution
(4) t ∈ (–∞, –1), (t + 2)2 = 0, t = –2
⇒ x + 2 = 2 ⇒ x = 0
x + 2 = –2 ⇒ x = –4
⇒ Sum of squares = $0^2 + (-4)^2 = 16$

Ques 10. If solution of differential equation xdy – ydx = xy(xdy – ydx) and y(1) = 1 is α|y| = $|x|e^{(xy-\beta)}$ then (α + β) is equal to

Ans. 2

Solu.

$$(xdy - ydx) = xy(xdy + ydx)$$

$$\Rightarrow \frac{dy}{y} - \frac{dx}{x} = xdy + ydx = d(xy)$$

$$\Rightarrow \ln|y| - \ln|x| = xy + c$$

$$\Rightarrow \ln\left(\left|\frac{y}{x}\right|\right) = (xy + c) \quad \Rightarrow \quad \left|\frac{y}{x}\right| = Ae^{xy},\ A > 0$$

$$y(1) = 1$$

$$\Rightarrow 1 = Ae^1 \quad \Rightarrow \quad A = \frac{1}{e}$$

$$\Rightarrow \left|\frac{y}{x}\right| = e^{(xy-1)}$$

$$\Rightarrow |y| = |x|e^{(xy-1)}$$