Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 15/07/2024

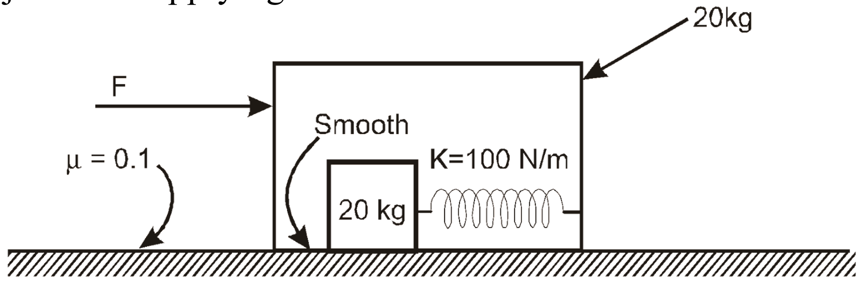
Time: 3 hours **Max. Marks:** 180

PRAVEEN-2_(24-25)-ACT-2_PAPER-1

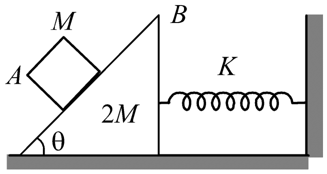
Physics

Numerical

Q1 A box of mass 20 kg is kept on a rough horizontal surface ($\mu = 0.1$). There is a spring mass system having block of mass 20 kg and spring of spring constant 100 N/m in the box. There is no friction between block and box and spring is initially relaxed. Now an external force of 120 N is applied on the box, find acceleration of the box (in m/s^2) just after applying the force.



Q2 A block 'A' of mass M rests on a wedge 'B' of mass 2M of inclination θ. There is sufficient friction between A and B so that A does not slip on B and there is no friction between B and ground. Initially the spring is in its natural length and system is at rest. Find the maximum compression in spring if the system is released from rest (Given data M= 10 kg, $\theta = 30^\circ$, $k = 100\frac{N}{m}$)

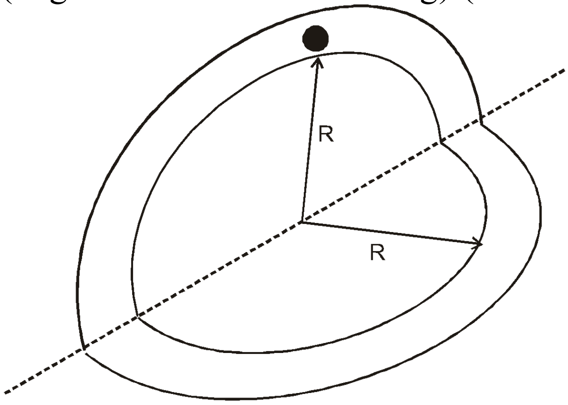


Q3 Two particles are projected in opposite direction horizontally from same position at sufficient height above the ground with velocities $v_1 = 3$ m/s and $v_2 = 4$ m/s. The time (in seconds) at which their velocity vectors become mutually perpendicular is $\frac{\sqrt{3}}{p}$ then the value of p is. ($g = 10\ m/s^2$)

Q4 A small block a placed on the top of a smooth fixed sphere of radius 60 cm. Block slightly pushed so that it starts sliding of the sphere. Find the speed (in m/s) of the block when it leaves the sphere ? ($g = 10\ m/s^2$)

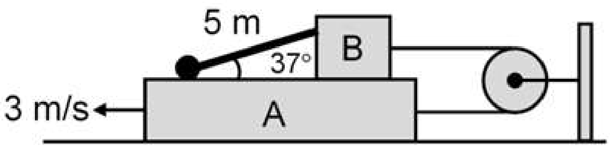
For More Material Join: @JEEAdvanced_2025

Q5 A vertical narrow smooth tube is bend from it's diameter such that one semi–circular part of tube is horizontal and other part is vertical. A smooth ball is released from the highest point of the tube. If maximum speed of ball is 'x' m/s then, value of 'x' is : (neglect collision at bending) (take R = 2.5 m and g = 9.8 m/s^2)

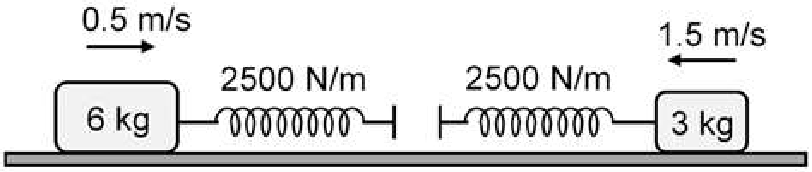


Q6 The dispersive power of the material of a lens is 0.04 and the focal length of the lens is 10 cm. Find the magnitude of difference in the focal length (in mm) of the lens for violet and red colour.

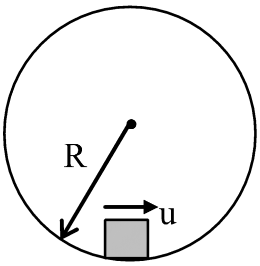
Q7 One end of a rod of length 5 m is hinged at a point of block A and other end is always in contact with block B as shown below. Block A is pulled towards left with velocity 3 m/s. Then angular velocity of rod in rad/s when rod makes an angle 37° from horizontal is:



Q8 Two blocks having mass 6 kg and 3 kg respectively are moving on a smooth horizontal surface towards each other with velocities 0.5 m/s and 1.5 m/s respectively massless spring of spring constant 2500 N/m are connected to both blocks as shown. The springs are at same horizontal level. Then maximum compression on each spring in (cm) is:

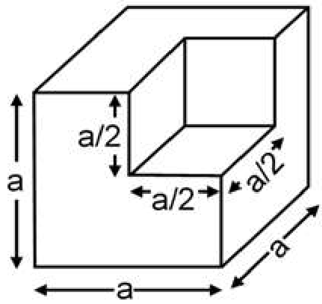


Q9 A particle is given an initial speed u inside a smooth spherical shell of radius R = 1 m that it is just able to complete the circle. Acceleration of the particle when its velocity is vertical is $g\sqrt{2N}$, the value of N -



For More Material Join: @JEEAdvanced_2025

Q10 From a uniform cube of side $a = \frac{28}{\sqrt{3}} m$, a cube of side $\frac{a}{2}$ is removed from a corner as shown. Then distance of centre of mass of remaining part from the centre of the cube in meter is:

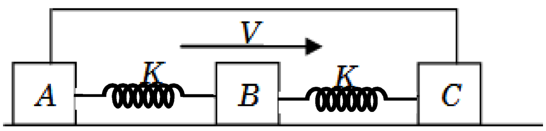


Single Choice Question

Q11 A lens of focal length 20.0 cm and aperture radius 2.0 cm is placed at a distance 30.0 cm from a point source of light. On the other side a screen is placed at a distance 50.0 cm from the lens. The radius of spot of light formed on screen is. (Neglect spherical abberation through lens)

a) 0.5 cm **b)** 0.3 cm **c)** 0.2 cm **d)** 1.0 cm

Q12 The diagram shows three blocks and two springs. A massless rigid rod connects the end blocks. The middle block is given a velocity 'v'. The maximum deformation of the spring is (mass of A = 2M; mass of B = M; mass of C = M). (All surfaces are smooth)



a) $\sqrt{\frac{3Mv^2}{5k}}$ **b)** $\sqrt{\frac{3Mv^2}{8k}}$ **c)** $\sqrt{\frac{Mv^2}{8k}}$ **d)** $\sqrt{\frac{3Mv^2}{4k}}$

Q13 Two masses m_1 and m_2 are attached to a massless string which pass over a frictionless fixed pulley. Given that m_1 = 10 kg and m_2 = 6 kg and g = 10 ms^{-2}, What is the acceleration of the masses ?

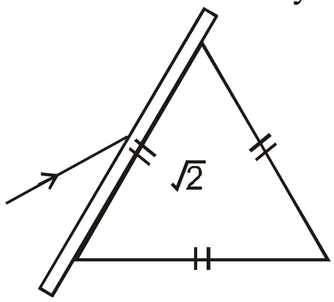
a) 2.5 ms^{-2} **b)** 5 ms^{-2} **c)** 20 ms^{-2} **d)** 40 ms^{-2}

Q14 A particle moves from position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under the action of force $4\hat{i} + \hat{j} + 3\hat{k}N$. The work done by this force will be

a) 100 J **b)** 50 J **c)** 200 J **d)** 75 J

For More Material Join: @JEEAdvanced_2025

Q15 A parallel glass slab of refractive index $\sqrt{3}$ is placed in contact with an equilateral prism of refractive index $\sqrt{2}$. A ray is incident on left surface of slab as shown. The slab and prism combination is surrounded by air. The magnitude of minimum possible deviation of this ray by slab-prism combination is



a) $30°$ **b)** $45°$ **c)** $60°$ **d)** $60° - \sin^{-1}\sqrt{\frac{2}{3}}$

Q16 A ball suspended by a thread swings in a vertical plane so that its acceleration in the extreme position and lowest position are equal in magnitude. Angle θ of thread deflection with the vertical in the extreme position will be:

a) $2\tan^{-1}\frac{1}{2}$ **b)** $\tan^{-1}\frac{1}{2}$ **c)** $\tan^{-1}\sqrt{2}$ **d)** $\tan^{-1} 2$

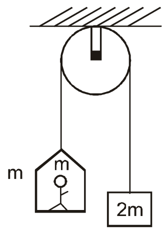
Q17 In a closed room, a ball is projected vertically upward from ground with 20 m/s and height of ceiling is 10 m. It strikes the ground vertically with a velocity of $10\sqrt{3}$ m/s. The coefficient of restitution for the collision between ball & ceiling is :

a) $\frac{1}{2}$ **b)** $\frac{1}{\sqrt{3}}$ **c)** $\frac{1}{\sqrt{2}}$ **d)** 1

Q18 There is layer of medium of variable refractive index $\mu = \sqrt{2} - \frac{1}{\sqrt{2}}y$ (where $0 \le y < 1$) sandwiched between the layer of glass and air. A beam of light travelling in air at an angle 45° has a width $\Delta\omega$. When the beam enters the layer of glass its width becomes : ($\mu_{glass} = \sqrt{2}$)

a) $\sqrt{\frac{3}{2}}\Delta\omega$ **b)** $\sqrt{\frac{2}{3}}\Delta\omega$ **c)** $\sqrt{2}\,\Delta\omega$ **d)** $\sqrt{\frac{1}{2}}\Delta\omega$

Q19 A man of mass ‘m’ is standing in a lift of the same mass ‘m’ which is balanced on a pulley by a block of mass 2m. If the man jumps suddenly with a velocity V_0 upwards with respect to ground, then the speed of the man relative to lift the just after it jumps would be :



a) V_o **b)** $\frac{V_o}{3}$ **c)** $\frac{2V_o}{3}$ **d)** $\frac{4V_o}{3}$

For More Material Join: @JEEAdvanced_2025

Q20 Two particle A & B are moving with velocity $(\hat{i}+\hat{j}-2\sqrt{3}\hat{k})$ m/s and $(-2\hat{i}+\hat{j}+\sqrt{3}\hat{k})$ m/s respectively. At an instant A is crossing the point $(1,3,\sqrt{3})$ m & at the same instant B is crossing the point $(-2,1,2\sqrt{3})$ then the rate at which separation between them decreases at the given instant is :

a) –2.5 m/s **b)** 2.5 m/s **c)** –4.5 m/s **d)** 4.5 m/s

For More Material Join: @JEEAdvanced_2025

Chemistry

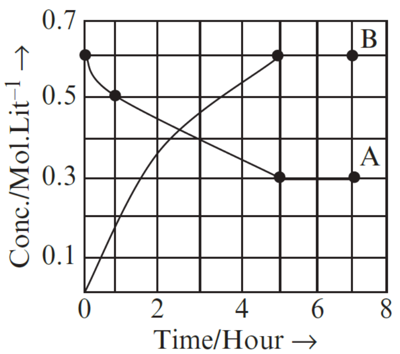
Numerical

Q21 For the reaction A + B $\rightleftharpoons$ C + D, the initial concentration of A and B is equal, but the equilibrium concentration of C is twice that of equilibrium concentration of A. The equilibrium constant is

Q22 In an atom, the total number of electrons having quantum number $n = 4$, $|m_\ell| = 1$ and $m_s = -\frac{1}{2}$ is:

Q23 A person takes 6.1 g of an antacid tablet comprising of bicarbonate ions 20 % w/w. The volume of CO_2 evolved $(HCO_3^{-} \rightarrow CO_2)$ at 1 atm and 25°C in the stomach on neutralization, multiplied by a factor of 10 is x L. Determine the value of x. Give your answer to the nearest single digit integer. $(R = \frac{1}{12} \frac{atmL}{molK})$
(Answer to be round off to nearest integer).

Q24 The progress of the reaction A $\rightleftharpoons$ nB with time is represented by the graph given below.
The value of n is



Q25 Flask A contains a mixture of O_2, SO_2 and He in the molar ratio of 8: 16: 1. Flask B contains a mixture of the same gases in the mass ratio 8: 16: 1. Each flask is at 1.0 atm and 0ºC. Predict how many statement(s) is/are true ?
(A) Partial pressures of three gases are different in flask A.
(B) Partial pressures of three gases are same in flask B.
(C) Partial pressure of O_2 in flask A is greater than that in flask B.
(D) Partial pressure of S O_2 in flask A is greater than that in flask B.
(E) Partial pressure of He in flask A is smaller than that in flask B.
(F) If we remove O_2 from flask A then partial pressure of He will increase in it.

Q26 What is the pH of solution made by mixing equal volumes of 0.1 N-H_2SO_4, 0.1 N-HNO_3, 0.1 N-HCl ?

Q27 A compound which contains one atom of X and two atoms of Y for each three atoms of Z is made by mixing 5.0 g of X, 1.15 × 10^{23} atoms of Y and 0.03 g-atoms of Z. If only 4.40 g of the compound results, then the value of atomic mass of Y divided by 10 is (The atomic masses of X and Z are 60 and 80, respectively.)

For More Material Join: @JEEAdvanced_2025

Q28 A 1.174 g sample of special grade steel was treated appropriately with Chugaev's reagent by which nickel was precipitated as nickel dimethylglyoxime, $NiC_8H_{14}O_4N_4$. The dried precipitate weighed 0.2887 g. The percentage of nickel in the steel being analysed is (Ni = 58.7)

Q29 Gaseous nitrosyl chloride and nitrogen are taken in a flask, sealed and heated to some temperature where the total pressure would have been 1 atm if the following reaction had not been occurred.

$2NOCl(g) \xrightleftharpoons{K_p} 2NO(g) + Cl_2(g)$

But the actual pressure was found to be 1.2 atm due to above equilibrium. Now into the above equilibrium mixture, some Cl_2 gas was introduced at constant V & T so that the total pressure would have been 8.3 atm, if no further reaction had occurred but the actual pressure was found to be 8.2 atm.

Determine the value of K_p (in atm). Give your answer after multiplying by 2.5.

Q30 Consider the following orders :

(i) $N_3H < CH_3N_3$ (Boiling point)
(ii) $CH_4 > SiH_4 > GeH_4 > SnH_4$ (Bond angle)
(iii) $NH_3 > PH_3 > AsH_3 > SbH_3$ (Lewis base character)
(iv) HF > HCl > HBr > HI (Bond dissociation energy)
(v) $H_2O > H_2S > H_2Se > H_2Te$ (Thermal stability)
(vi) $O_2 > KO_2 > K_2O_2$ (Spin only magnetic moment order)
(vii) $SiCl_4 < SnCl_4 < PbCl_4$ (Oxidising power order)
(viii)$Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2\ Sr(OH)_2 < Ba(OH)_2$ (Solubility in water)
(ix) $CH_3Cl > CH_3F > CH_3Br > CH_3I$ (Dipole moment)
(x) $P_4S_5 > P_4S_3$ (Number of P–P bond)

Calculate the value of (x – y) where x and y are total number of correct and incorrect orders respectively.

Single Choice Question

Q31 A sample of an ethanol–water solution has a volume of 55.0 cm^3 and a mass of 50.0 g. What is the percentage of ethanol (by mass) in the solution? Assume that there is no change in volume when the pure compounds are mixed. The density of ethanol is 0.80 g/cm^3 and that of water is 1.00 g/cm^3.

a) 20% **b)** 40% **c)** 60% **d)** 45.45%

Q32 A volume V of a gaseous hydrocarbon was exploded with an excess of oxygen. The observed contraction was $2.5V$, and on treatment with potash, there was a further contraction of $2V$. What is the molecular formula of the hydrocarbon?

a) C_2H_6 **b)** C_3H_6 **c)** C_4H_{12} **d)** C_2H_4

Q33 Air is compressed in a vertical cylinder by weight of piston. When a weight is added to the Piston, the volume of the gas decreases from 500 mL to 400 mL. If another weight of same magnitude is added, the volume of the gas will decreases (2^{nd} decrease) by (Assume ideal behaviour) :

a) another 100 mL **b)** less than 100 mL **c)** more than 100 mL

d) Insufficient Information

For More Material Join: @JEEAdvanced_2025

Q34 The value of $\frac{K_c}{K_p}$ the below for reaction is.

$$CO\,(g) + \tfrac{1}{2}O_2\,(g) \rightleftharpoons CO_2\,(g)$$

a) $\frac{1}{\sqrt{RT}}$ **b)** $\sqrt{RT}$ **c)** $1/RT$ **d)** 1

Q35 Which of the following is correct increasing order of oxidation number of chlorine in the given compounds ?
I – Sodium chlorite
II – Sodium hypochlorite
III – Sodium perchlorate
IV – Sodium chlorate

a) I < II < III < IV **b)** I < II < IV < III **c)** II < I < III < IV **d)** II < I < IV < III

Q36 The average charge on each O atom and average bond order of I–O bond in IO_6^{5-} is :

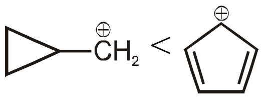
a) –1 and 1.67 **b)** – 5/6 and 1.67 **c)** –5/6 and 1.33 **d)** –5/6 and 1.167

Q37 Which is correct order of stability for the following intermediates ?

(a) $(CH_3)_3\overset{\oplus}{C} < Ph-\overset{\oplus}{C}(Ph)-CH_3$

(b) $(CH_3)_3\dot{C} < Ph-\dot{C}H-Ph$

(c) $\bar{C}H_3 < (CH_3)_3\bar{C}$

(d) 

a) a & b **b)** b & c **c)** b & d **d)** a & d

Q38 Which is the correct option:

(p) CH3–CH2–NH–CH(CH3)–CH3

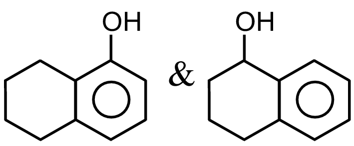
(q) CH3–NH–CH2–CH(CH3)–CH3

(r) CH3–CH2–N(CH3)–CH2–CH3

(s) CH3–CH2–NH–CH2–CH2–CH3

a) (q) & (s) are chain isomers **b)** (q) & (s) are position isomers
c) (p) & (r) are metamers **d)** (p) & (r) are functional isomers

Q39 Select the incorrect statement:

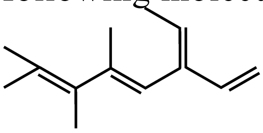
a) 

are functional isomers

b) $C_2H_4Cl_2$ has two structural isomers.
c) Cyclobutane on dichlorination will give 3 structural isomers.
d) Cyclohexa-1,3-diene on reductive ozonolysis gives only one product.

For More Material Join: @JEEAdvanced_2025

Q40 Which of the following is not produced on reductive ozonolysis (O_3/Zn) of the following molecule.



a) Acetone **b)** Formaldehyde **c)** Butane-2,3-dione **d)** Propane-1,2,3-trial

For More Material Join: @JEEAdvanced_2025

Mathematics

Numerical

Q41 The period of the function $f(x) = \left(\sec^2\left(\frac{\pi x}{10}\right) - \tan^2\left(\frac{\pi x}{10}\right)\right)^{\cos^4 4\pi x + 100\{x\}}$ (where $\{\cdot\}$ denotes fractional part function) is λ, then $(\lambda/2)$ is equal to

Q42 If $\tan^{-1}\left(x + \frac{2}{x}\right) - \tan^{-1}\left(x - \frac{2}{x}\right) = \tan^{-1}\frac{4}{x}$ then value of $2x^4 - 3x^2$ is equal to

Q43 If $\lim_{x\to 0} \frac{(2^{\sin x} - 1)\,(\ell n(1+\sin 2x))}{x \tan^{-1} x} = \ell$, then the value of e^{ℓ} is...............

Q44 Let A be the set of all positive integers greater than or equal to 8 and let $f : A \to A$ be a function such that $f(x + y) = f(xy)\ \forall\ x \geq 4, y \geq 4$, if $f(16) = 9$ then $f(9)$

Q45 A circle passing through the points A (1, –1) and B(3, 1) but not passing through origin is touching the line $3x + y = 0$. The equation of this circle is $x^2 + y^2 + ax + by + c = 0$ then $a + b + c$.

Q46 Coefficient of "–x" in $f(x) = \begin{vmatrix} x & (1+\sin x)^3 & \cos x \\ 1 & log(1+x) & 2 \\ x^2 & 1+x^2 & 0 \end{vmatrix}$ is -

Q47 The line $2x + 3y = 6$ cuts x-axis at A and y-axis at B. The line $Kx + 8y = 11$ cuts x-axis at A' and y-axis at B'. If K_1 and K_2 are the values of K for which points A, B, A', B' are concyclic $(K_1 > K_2)$, then the value of $3K_2 - \frac{K_1}{4}$ is

Q48 Let S be the region consistiting of points (x, y) satisfying the inequality $x^2 + y^2 - 6x - 8y + 21 \leq 0$ and $x, y \in R$. Let minimum and maximum value of $\frac{y}{x}$ be m & M respectively, where $(x, y) \in S$. Then value of $\frac{5}{4}Mm$ is.

Q49 Let three matrices $A = \begin{bmatrix} 2 & 1 \\ 4 & 1 \end{bmatrix}$; $B = \begin{bmatrix} 3 & 4 \\ 2 & 3 \end{bmatrix}$ and $C = \begin{bmatrix} 3 & -4 \\ -2 & 3 \end{bmatrix}$ then $tr(A) + t_r\left(\frac{ABC}{2}\right) + t_r\left(\frac{A(BC)^2}{4}\right) + t_r\left(\frac{A(BC)^3}{8}\right) + ... + \infty =$

Q50 If $A = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ and $\det(A^n - I) = 1 - \lambda^n$, $n \in N$, then λ is equal to

For More Material Join: @JEEAdvanced_2025

Single Choice Question

Q51 If α, β, γ are the roots of the equation $y^3 - (\sin[\alpha + \beta + \gamma]\pi)\, y^2 - ky + 2014 = 0$ then $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix}$ equals (where [.] denotes greatest integer function)

a) 0 **b)** 1 **c)** 2 **d)** 5

Q52 If the line 3x – 4y – k = 0, (k > 0) touches the circle $x^2 + y^2 - 4x - 8y - 5 = 0$ at (a, b) then k + a + b is equal to-

a) 20 **b)** 22 **c)** –30 **d)** –28

Q53 If $f(x) = \cos^{-1}\left(\frac{\sqrt{2x^2+1}}{x^2+1}\right)$, then range of f(x) is

a) $[0, \pi]$ **b)** $\left(0, \frac{\pi}{4}\right]$ **c)** $\left(0, \frac{\pi}{3}\right]$ **d)** $\left[0, \frac{\pi}{2}\right)$

Q54 Set of all values of x satisfying the inequality $x - 3 < \sqrt{x^2 + 4x - 5}$

a) $(-\infty, -5] \cup [1, \infty)$ **b)** (–5, 3] **c)** [3, 5) **d)** (–5, 3)

Q55 Let 1, abc, $a^2b^2c^2$ are in A.P. (a, b, c > 0), then minimum value of 27a + 8b + 125c is

a) 30 **b)** 60 **c)** 90 **d)** 100

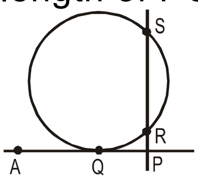
Q56 If $\sqrt{\alpha}$ and $\sqrt{\beta}$ are the roots of the equation $x^2 + qx + p = 0$ $(p \neq 0, p, q \in R)$ then the equation $x(x + q^3) + (p^3 - 3pqx) = 0$ has roots

a) $\alpha^{\frac{3}{2}}$ and $\beta^{\frac{3}{2}}$ **b)** $\alpha\beta^{\frac{1}{2}}$ and $\alpha^{\frac{1}{2}}\beta$ **c)** $\sqrt{\alpha\beta}$ and $\alpha\beta$ **d)** $(\alpha\beta)^{\frac{1}{4}}$ and $(\alpha\beta)^{\frac{5}{4}}$

Q57 If sinA . cosB = 1/4 and 3tanA = tanB, then sin(A + B) is

a) 1 **b)** –1 **c)** $\frac{1}{2}$ **d)** $-\frac{1}{2}$

Q58 In the adjoining figure, PR = 2, RS = 6, AP is tangent to the circle at Q, then length of PQ is



a) 16 **b)** 4 **c)** 8 **d)** 32

Q59 If n– arithmetic means are inserted between 1 and 31 such that the 7^{th} mean : the $(n-1)^{th}$ mean = 5 : 9, then 'n' is equal to -

a) 12 **b)** 13 **c)** 14 **d)** None of these

Q60 The solution set of inequality $\log_{10}(x^2 - 16) \leq \log_{10}(4x - 11)$ is

a) $(4, \infty)$ **b)** (4, 5] **c)** $\left(\frac{11}{4}, \infty\right)$ **d)** $\left(\frac{11}{4}, 5\right)$

For More Material Join: @JEEAdvanced_2025

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**4**	**0**	**5**	**2**	**7**	**4**	**2**	**4**	**5**	**1**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**B**	**B**	**A**	**A**	**A**	**A**	**C**	**A**	**D**	**C**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**4**	**6**	**5**	**2**	**4**	**1**	**7**	**5**	**8**	**4**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**B**	**A**	**B**	**B**	**D**	**D**	**A**	**D**	**D**	**D**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**5**	**2**	**4**	**9**	**6**	**2**	**8**	**3**	**6**	**2**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**A**	**A**	**D**	**A**	**C**	**A**	**A**	**A**	**C**	**B**

For More Material Join: @JEEAdvanced_2025