Competishun

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

Date: 13/05/2024

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

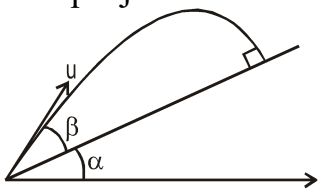
PRAVEEN-2 (24-25)_ACT-1_PAPER-2

Physics

MTC-SCQ

Q1 **Match the listing.**

The projectile collides perpendicularly with the inclined plane. (Refer the figure)



List-I	List-II
(P) Maximum height attained by the projectile from the ground	(1) zero
(Q) Maximum height attained by the projectile from Inclined plane	(2) g
(R) Acceleration of the projectile before striking the inclined plane	(3) $\frac{u^2\sin^2\beta}{2g\cos\alpha}$
(S) Horizontal component of acceleration of the projectile.	(4) $\frac{u^2\sin^2(\alpha+\beta)}{2g}$

a) P→3 Q→1 R→2 S→4 **b)** P→4 Q→3 R→2 S→1 **c)** P→4 Q→2 R→1 S→3

d) P→4 Q→1 R→2 S→3

Q2 **Match the following :**

Two particles A and B moving in x-y plane are at origin at t = 0 sec. The initial velocity vectors of A and B are $\vec{u}_A = 8\hat{i}$ m/s and $\vec{u}_B = 8\hat{j}$ m/s. The acceleration of A and B are constant and are $\vec{a}_A = -2\hat{i}$ m/s^2 and $\vec{a}_B = -2\hat{j}$ m/s^2. Column I gives certain statements regarding particle A and B. Column I gives corresponding results. Match the statements in column I with corresponding results in Column II.

Column I	**Column I**
(P) The time (in seconds) at which velocity of A relative to B is zero	(1) $16\sqrt{2}$
(Q) The distance (in metres) between A and B when their relative velocity is zero.	(2) $8\sqrt{2}$
(R) The time (in seconds) after t = 0 sec, at which A and B are at same position	(3) 8
(S) The magnitude of relative velocity of A and B at the instant they are at same position.	(4) 4

a) P→1 Q→2 R→3 S→4 **b)** P→4 Q→1 R→2 S→3 **c)** P→4 Q→1 R→3 S→2

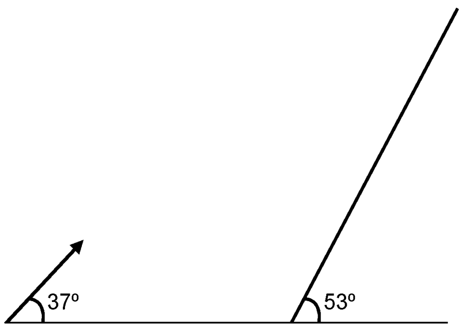
d) P→3 Q→2 R→1 S→4

Multiple Choice Question

Q3 A particle moving in a straight line has acceleration given by $a = -k\sqrt{v}$ where k is a positive constant and v is instantaneous velocity. Let v_0 be the initial velocity, t be the total time of motion and v_a be the average velocity in time t. Let s be total distance travelled. Choose the correct options.

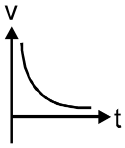
a) $t = \frac{2\sqrt{v_0}}{k}$ **b)** $v_a = \frac{v_0}{3}$ **c)** $s = \frac{2}{3}\frac{V_0^{3/2}}{k}$ **d)** $\frac{v_a}{v_0} = \frac{1}{2}$

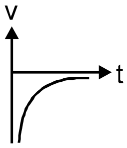
Q4 A particle is projected with speed u at angle 37° and its strikes an incline surface of angle 53° perpendicularly with speed v in time t. Correct options are

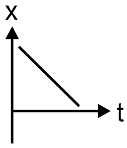


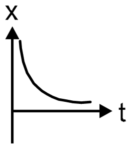
a) v = u **b)** $v = \frac{4}{3}u$ **c)** $t = \frac{8}{5}\frac{u}{g}$ **d)** $t = \frac{6}{5}\frac{u}{g}$

Q5 Which of the following graph(s) represent retardation ? [v:velocity, t : time ; x : position]

a)


b)


c)


d)


Q6 A particle is moving rectilinearly so that its acceleration is given as $a = 3t^2 + 1$ m/s^2.Its initial velocity is zero.

a) The velocity of the particle at t=1 sec will be 2m/s.

b) The displacement of the particle in 1 sec will be 2m.

c) The particle will continue to move in positive direction.

d) The particle will come back to its starting point after some time.

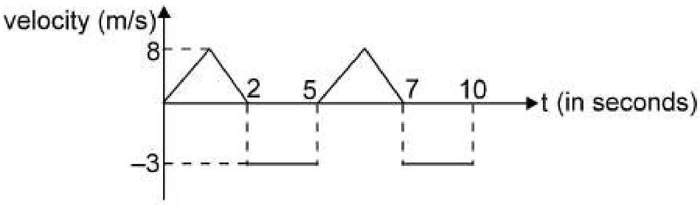
Numerical

Q7 A ball is thrown from the roof of a building of height 44m with speed v_0 at an angle θ below the horizontal. It lands 2 seconds later at a point 30m from the base of the building. If $\tan\theta = \frac{X}{10}$ then, find the value of X. (Take $g = 10\ m/s^2$)

Q8 An astronaut is on the surface of a planet whose air resistance is negligible. To measure the acceleration due to gravity (g), he throws a stone upwards. He observer that the stone reaches to a maximum height of 10m and reaches the surface 4 second after it was thrown. Find the acceleration due to gravity (g) on the surface of that planet in m/s^2 .

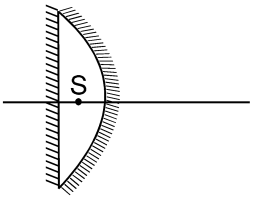
Q9 A stone is dropped from a certain height of 5x meter (height from the surface of lake) into a lake 100m deep. The stone reaches the bed of the lake 7 seconds after it was dropped. Assume that both the velocity and the acceleration of the stone are halved on entering the water. Then value of x is. ($g = 10\ m/s^2$)

Q10 A particle moves along X axis. At t = 0 it was at x = – 1. It's velocity varies with time as shown in the figure. Find the number of times the particle passes through the origin.



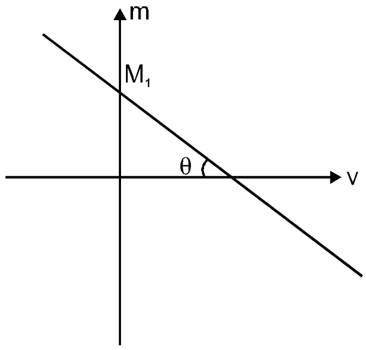
Q11 A particle is projected from ground with an initial speed $u = 4\sqrt{2}$ m/sec at an angle $\theta = \tan^{-1}\sqrt{2}$ with horizontal. Find the magnitude of average velocity of particle between its point of projection and the highest point. ($g = 10\ m/s^2$)

Q12 In the figure shown a thick plano convex lens is silvered at both the surfaces. A point source of light 'S' is inside the lens. The radius of curvature of the curved surface is 8/3 cm and the distance of 'S' from the curved surface is 2 cm. If the images formed due to direct reflections from the plane and curved surface coincide then find the thickness of the lens.



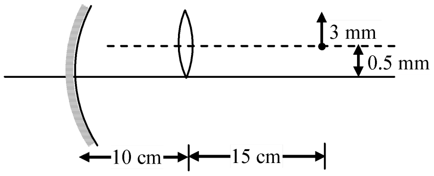
Q13 The position of a particle moving along X-axis is given by $x = 2t^3 - 9t^2 + 12t + 7$, where x is in meter and t in seconds. If the distance covered by the particle in 3s is (6 + y) m, find the value of y.

Q14 Lateral magnification m is plotted against the image distance v for a converging lens of focal length f as shown in figure. Find the value of $\frac{f\tan\theta}{M_1}$?

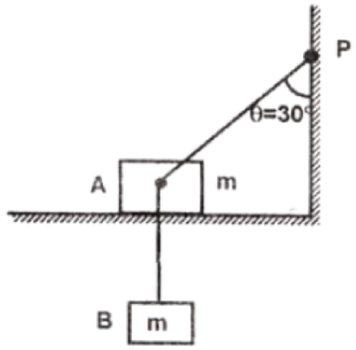


Q15 Cross section of a glass prism has the form of an equilateral triangle. A ray is incident onto one of the faces perpendicular to it. Angle ϕ between the incident ray and the ray that leaves the prism in degree is ......× 60°. The refraction index of glass is 1.5.

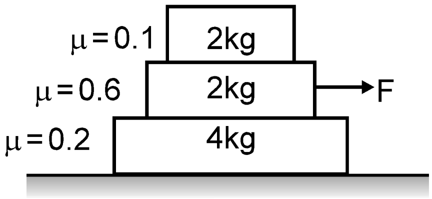
Q16 A concave mirror of focal length 20 cm and a convex lens of focal length 10 cm are kept with their optic axes parallel but separated by 0.5 cm as shown in figure. The distance between lens and mirror is 10 cm. An object of height 3 mm is placed on the optic axis of lens at a distance 15 cm from the lens. Find length of image formed by mirror in mm.



Q17 Block A is on a frictionless horizontal table. A massless inextensible string fixed at one end passes over a smooth nail fixed with the block A. The other end of the string is connected to block B of mass m. Initially the block B is held at rest so that θ = 30°. What will be the magnitude of acceleration of block B just after it is released (in m/s^2 take $g = 10\ m/s^2$).



Q18 In the situation shown in figure, for what value of minimum horizontal force F (in Newton), sliding between middle and lower block will start ? (Take g = 10 m/s^2) Then find F/10



Chemistry

MTC-SCQ

Q19

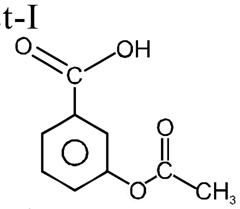
Column I Configuration	Column-II Ionisation energy in k J/ mol
(P) ns^2	(1) 2100
(Q) ns^2np^1	(2) 1400
(R) ns^2np^3	(3) 800
(S) $ns^2\ np^6$	(4) 900

a) P→1 Q→2 R→3 S→4 **b)** P→2 Q→3 R→4 S→1 **c)** P→4 Q→3 R→2 S→1

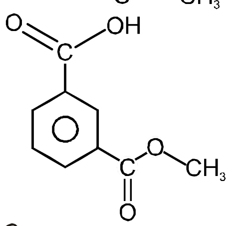
d) P→3 Q→2 R→1 S→4

Q20 Match the compounds of List I with the appropriate subtituent (prefix name) in List II and select the correct answer using the code given below the lists :

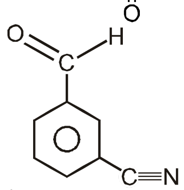
List-I List-II

(P) 

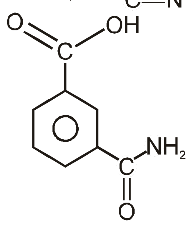
(1) Methoxycarbonyl

(Q) 

(2) Ethanoyloxy.

(R) 

(3) Cyano

(S) 

(4) Carbamoyl

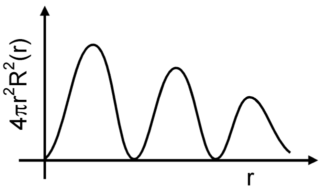
a) P→2 Q→1 R→3 S→4 **b)** P→3 Q→1 R→2 S→4 **c)** P→2 Q→3 R→4 S→1

d) P→3 Q→2 R→4 S→1

Multiple Choice Question

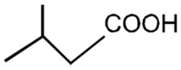
Q21 Given for H-atom $R_{n,\ell} = \frac{1}{9\sqrt{3}}\left(\frac{1}{a_o}\right)^{3/2}$
$(6 - 6\sigma + \sigma^2)e^{-\sigma/2}$
where $\sigma = \frac{2Zr}{na_o}$, $a_o = 0.53$ Å
Select the incorrect statement(s) for the given orbital?

a) Orbital is 3s

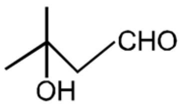
b) Graph for the given orbital is : 

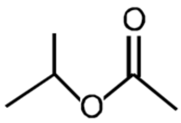
c) Distance between radial nodes is equal to $3\sqrt{3}\ a_o$

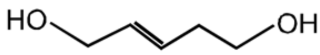
d) None of these

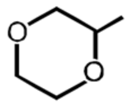
Q22 

have functional isomer relation with

a) 

b) 

c) 

d) 

Q23 Which is the correct relationship mentioned in bracket :

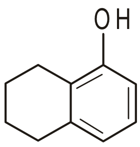
a) $CH_3–CN$ and CH_3NC (Functional isomers)

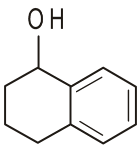
b) $CH_3 - O - N = O$ and $CH_3 - \underset{\underset{O}{\|}}{N} \rightarrow O$ (Functional isomers)

c) $CH_3–CH_2–CH_2–CHO$ and $H_3C - \underset{\underset{CHO}{|}}{CH} - CH_3$ (Chain isomer)

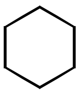
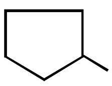
d) $H - \underset{\underset{O}{\|}}{C} - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{CH_3}{|}}{CH} - CH_3$ and $H - \underset{\underset{O}{\|}}{C} - O - \underset{\underset{O}{\|}}{C} - CH_2 - CH_2 - CH_3$ (Functional isomers)

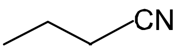
Q24 Select the correct relationship.

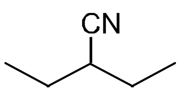
a) 

and 

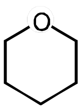
are functional isomers

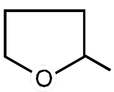
b)  and  are chain isomers

c) 

and 

are chain isomers

d) 

and 

are metamers

Numerical

Q25 Given is an equation of state for real gas, where A and B are constants. P : Pressure and V : Molar volume PV = RT – $\frac{A}{V} + \frac{2B}{V^2}$. Find $\frac{3}{Z}$ at critical point.

Q26 For real gases, PV v/s P diagram at constant temperature is not linear so $\frac{d}{P}$ or $\frac{W}{V.P}$ will not be independent of P. (W $\rightarrow$ Weight of gas, V $\rightarrow$ Volume, P $\rightarrow$ Pressure) y-intercept of the graph of $\frac{d}{P}$ (g/atm-L) v/s P (atm) at 360 K is : [Given : Molar mass of gas = 60 gm/mol, R = $\frac{1}{12}\frac{atm-L}{mol-K}$]

Q27 A sample of chlorine has only two isotopes, Cl^{35} and Cl^{37} and its average atomic weight is 35.82. the percentage abundance of isotope Cl^{37} in the given sample is.

Q28 For the gaseous reaction K + F → $K^+ + F^-$, ΔH was calculated to be 18.4 kcal/mol under conditions where the cations and anions were preverted from combining with each other. The ionisation enthalpy of K is 4.3 eV/atom. What is the electron gain enthalpy of F (in eV) ?
If your answer is x report it as –2x.

Q29 In the balanced chemical reaction (with lowest possible integers),
$IO_3^- + aI^- + bH^+ \longrightarrow cH_2O + dI_2$
Determine value of a – b + c ?

Q30 Consider the reaction
$2As_2O_3 + 3UO_2(NO_3)_2 \xrightarrow{\Delta} U_3O_8 + 6NO_2 + 2As_2O_5$
(U = 238, As = 75, N = 14, O = 16)
How many of the following conclusion(s) is/are incorrect based on this equation ?
(A) Mass ratio of As_2O_3 and $UO_2(NO_3)_2$ present is 2 : 3
(B) Mole ratio of As_2O_3 and $UO_2(NO_3)_2$ present is 2 : 3
(C) Mass ratio of As_2O_3 and $UO_2(NO_3)_2$ reacted is 2 : 3
(D) Mole ratio of $UO_2(NO_3)_2$ and U_3O_8 in reaction mixture is 3 : 1
(E) Mass ratio of $UO_2(NO_3)_2$ and U_3O_8 in reaction mixture is 3 : 1
(F) Mole ratio of NO_2 and U_3O_8 formed is 6 : 1
(G) Mole ratio of As_2O_5 and As_2O_3 present in reaction mixture is 1 : 1
(H) Sum of number of moles of As_2O_3 and As_2O_5 in the reaction mixture is always constant. (POAC)
(I) Sum of number of moles $UO_2(NO_3)_2$ and U_3O_8 present in the reaction mixture is always constant. (POAC)

Q31 If in long form of Periodic table :
(i) Number of electrons in outermost p-subshell of most electronegative element is 'x'.
(ii) Group number of element having maximum electron affinity is 'y'.
(iii) Number of electrons in outermost p-subshell of element having highest ionization energy is 'z'.
(iv) Number of electrons in outermost s-subshell of strongest reducing element agent is 'w'.
then determine value of (y – x – z – 3w).

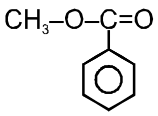
Q32 Total number of electrons having n + l = 4 in V (23) atom in its ground state is

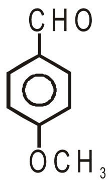
Q33 Calculate sum of structural methyl esters and carboxylic acids with molecular formula $C_5H_{10}O_2$.

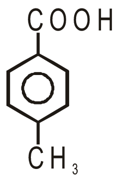
Q34 How many alkenes, alkynes and alkadienes can be hydrogenated to form Isopentane (Including all structural isomers)

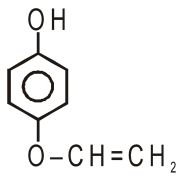
Q35 How many types of dicarbonyl compounds are formed by reductive ozonolysis of ortho xylene

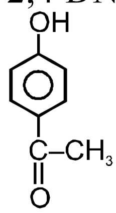
Q36 How many of the following isomers of $C_8H_8O_2$ will give positive 2,4 DNP test ?

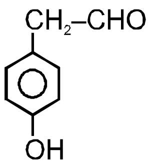
a. 

b. 

c. 

d. 

e. 

f. 

Mathematics

MTC-SCQ

Q37

List I	List II
(P) If $ax^2 + bx + 6 = 0$ does not have two distinct real roots where a ∈ R, b ∈ R. then least value of 3a + b is	(1) 4
(Q) The number of solutions of | [x] – 2x | = 4 where [·] is greatest integer value ≤ x	(2) 42
(R) Number of solution of |In| x|| = 1 are	(3) – 2
(S) If the range of the function $f(x) = \cos^{-1}[5x]$ is {a, b, c} and a + b + c = $\frac{\lambda\pi}{2}$, then λ is equal to (where [.] denotes G.I.F.)	(4) 3

a) P →4 Q →4 R →1 S →2
b) P →3 Q →1 R →1 S →4
c) P →1 Q →2 R →3 S →4
d) P →2 Q →2 R →3 S →1

Q38 Match the following :

Column – I	Column – II
(P) $\frac{log2}{log4}$	(1) 1
(Q) $\frac{log_5 16 - log_5 4}{log_5 128}$	(2) 2
(R) $log_{\frac{1}{4}}\left(\frac{1}{16}\right)$	(3) $\frac{1}{2}$
(S) $\frac{log_{27} 8}{log_3 2}$	(4) $\frac{2}{7}$

a) P →1 Q →2 R →3 S →4
b) P →3 Q →2 R →1 S →4
c) P →4 Q →2 R →3 S →1
d) P →3 Q →4 R →2 S →1

Multiple Choice Question

Q39 If a ≠ 0 then the in equation |x – a| + |x + a| < b

a) has no solution if b ≤ 2 |a|
b) has a solution set $\left(-\frac{b}{2}, \frac{b}{2}\right)$ if b > 2 |a|
c) has a solution set $\left(-\frac{b}{2}, \frac{b}{2}\right)$ if b < 2 |a|
d) has no solution if b > 2|a|

Q40 If $\sec\theta + \tan\theta = 1$ then one root of equation $a(b – c)x^2 + b(c – a)x + c(a – b) = 0$ is :

a) $\tan\theta$
b) $\sec\theta$
c) $\cos\theta$
d) $\sin\theta$

Q41 If $ax^2 – bx + c = 0$ has two distinct roots lying in the interval (0, 1), a, b, c ∈ N, then

a) $\log_5 abc = 1$
b) $\log_6 abc = 2$
c) $\log_5 abc = 3$
d) $\log_6 abc = 4$

Q42 If equation $ax^2 + bx + c = 0$, a, b, c ∈ R and a ≠ 0 has imaginary roots then

a) $(a + b + c)(a - b + c) > 0$
b) $(a + b + c)(a - 2b + 4c) > 0$
c) $(a - b + c)(4a - 2b + c) > 0$
d) None of these

Numerical

Q43 If $(b^2 - 4ac)^2 (1 + 4a^2) < 64a^2$, $a < 0$ and maximum value of quadratic expression $ax^2 + bx + c$ is always less than k, (k ∈ I) then minimum value of k is

Q44 The value of "a" for which all roots of quadratic equation, $f(x) = (a - 2)x^2 + 2ax + a + 3 = 0$ lies in (– 2, 1) belongs to $\left(-\infty, -\frac{1}{4}\right) \cup (m, n]$ then value of (n + m – 5) is

Q45 Let $f(x) = \frac{e^x - e^{-x}}{2}$ and $f(g(x)) = x$. If $g\left(\frac{e^{1002} - 1}{2e^{501}}\right) = \lambda$, then λ – 500 is :

Q46 If $f(x) = \frac{a^x}{a^x + \sqrt{a}}(a > 0)$, $g(n) = \sum_{r=1}^{2n-1} 2f\left(\frac{r}{2n}\right)$. Find the value g(4).

Q47 Let k be an integer and p is a prime number such that the quadratic equation $x^2 + kx + p = 0$ has two distinct positive integer solutions. Then the value of – (p + k) is

Q48 Let P(x) be a cubic polynomial with leading co-efficient unity. Let the remainder when P(x) is divided by $x^2 - 5x + 6$ equals 2 times the remainder when P(x) is divided by $x^2 - 5x + 4$. If P(0) = 100, find the sum of the digits of P(5):

Q49 Find out number of solution of equation $\sqrt{x + 1} - \sqrt{x - 1} = \sqrt{4x - 1}$

Q50 If $A = \log_2 \log_2 \log_4 256 + 2 \log_{\sqrt{2}} 2$ then A is equal to

Q51 Suppose x, y, z > 0 & different from one and ℓn x + ℓn y + ℓn z = 0, then value of : $x^{\frac{1}{\ell ny} + \frac{1}{\ell nz}} \cdot y^{\frac{1}{\ell nz} + \frac{1}{\ell nx}} \cdot z^{\frac{1}{\ell nx} + \frac{1}{\ell ny}}$ is e^{-k} then k equals ....

Q52 The number of roots of equation :
$$\left(\frac{(x-1)(x-3)}{(x-2)(x-4)} - e^x\right)\left(\frac{(x+1)(x+3)e^x}{(x+2)(x+4)} - 1\right)(x^3 - \cos x) = 0$$

Q53 If $\log\left(\frac{x^2}{y^3}\right) = 1$ & $\log(x^2y^3) = 7$ then log |xy| is equal to........

Q54 If cos A, cos B and cos C are the roots of cubic $x^3 + ax^2 + bx + c = 0$, where A, B, C are the angles of a triangle then find the value of $a^2 - 2b - 2c$.

Answer Key

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