JEE EXPERT

PRACTICE TEST – 6 (03 APRIL 2020)

ANSWER KEY & SOLUTION

PART-I : PHYSICS

SECTION – A

Sol.1. **(C)**

$\overline{v}_{Cg} = \overline{v}_{CP} + \overline{v}_{Pg}$

$= -R\omega\hat{i} + 2j \ = -2\hat{i} + 2\hat{j}$

Sol.2. **(C)**

$\vec{a}_{Ag} = a_0 \cos\theta\hat{i} + a_0 \sin\theta\hat{j}$

$\vec{a}_{Bg} = a_0 \sin\theta\,\hat{j}$ ($\because$ length of string is constant)

$\Rightarrow \quad \vec{a}_{AB} = a_0 \cos\theta\hat{i}$

Sol.3. **(A)**

$\vec{v}_{SB} = v\hat{j} = \vec{v}_S + 3\hat{i}$

$\vec{v}_S = v\hat{j} - 3\hat{i}$ and $v = \frac{100}{50} = 2\,m/s$

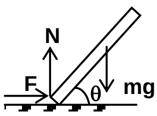
Drift = 50 × 3 = 150 m

Sol.4. **(D)**

$\mu mg = m2bt$

$t = \frac{\mu g}{2b}$

Sol.5. **(B)**

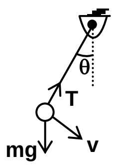


N = Mg

$F\frac{L}{2}\sin\theta = \frac{NL}{2}\cos\theta$

$\tan\theta = \frac{mg}{F} = \frac{3}{4}$

Sol.6. **(B)**



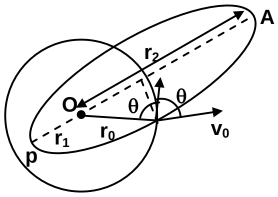
$T - mg\cos\theta = \frac{mv^2}{\ell}$

T = 2 mg

$mg\ell\cos\theta = \frac{1}{2}mv^2 - \frac{mv_0^2}{2}$

$\cos\theta = \frac{1}{4}$

Sol.7. (B)



$$TE = \frac{-GM_e m}{2r_0}$$

using conservation of angular momentum about O.

$$m V_P r_P = mV_A r_A = mV_0 r_0 \cos\theta$$

$$V_A r_A = V_P r_P = \frac{3v_0 r_0}{5}$$

using conservation of energy

$$\frac{1}{2}mv_p^2 + \frac{-GM_e m}{r_A} = \frac{-GM_e m}{r_0} = +\frac{1}{2}MV_0^2$$

$$\Rightarrow \quad \frac{9V_0^2 r_0^2}{50 r_A^2} - \frac{V_0^2 r_0}{r_A} = +\frac{V_0^2}{2} \quad \left[\text{Let } \frac{r_0}{r_A} = x\right]$$

$$\Rightarrow \quad 9x^2 - 50\,x + 25 = 0 \Rightarrow x = 5 \text{ or } (5/9)$$

$$\Rightarrow \quad \frac{V_P}{V_A} = \frac{r_A}{r_P} = 9$$

Sol.8. (C)

$$\frac{dV}{dt} = (2t + 5)$$

$$\int_0^V dV = \int_0^2 (2t+5)\,dt$$

$$V = 2\cdot\left.\frac{t^2}{2}\right|_0^2 + 5t\Big|_0^2 = 4 + 10 = 14 \text{ m/s}$$

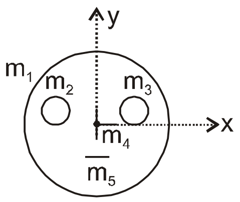
Sol.9. (A)

According to problem

$m_1 = 6m$, $m_2 = m_3 = m_4 = m_5 = m$

$\vec{r}_1 = 0\hat{i} + 0\hat{j},\ \vec{r}_2 = -a\hat{i} + a\hat{j},\ \vec{r}_3 = a\hat{i} + a\hat{j}$

$\vec{r}_4 = 0\hat{i} + 0\hat{j},\ \vec{r}_5 = 0\hat{i} - a\hat{j}$



Position vector of centre of mass

$$\vec{r}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + m_3\vec{r}_3 + m_4\vec{r}_4 + m_5\vec{r}_5}{m_1 + m_2 + m_3 + m_4 + m_5}$$

$$\vec{r}_{cm} = \frac{0 + m(-a\hat{i} + a\hat{j}) + m(a\hat{i} + a\hat{j}) + 0 + m(-a\hat{j})}{10m}$$

$$= 0\hat{i} + \frac{a}{10}\hat{j}.$$

So, the coordinate of centre of mass = $\left(0, \frac{a}{10}\right)$.

Sol.10. (D)

By fact base.

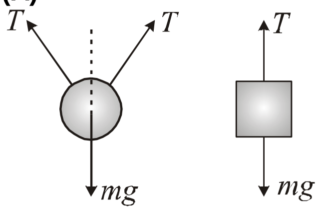
Sol.11. (B)

By fact base.

Sol.12. (A)
By fact base.

Sol.13. (C)
By fact base.

Sol.14. (A)



$2T \sin\theta = mg, \quad T = mg$

$\sin\theta = \frac{1}{2} \Rightarrow \theta = 30°$

Sol.15. (A)
From constraints, we have initially:

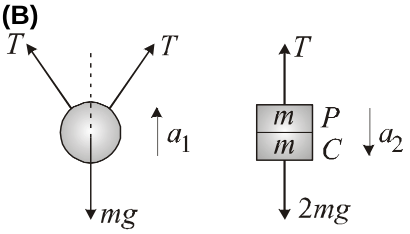
$$(l - y/2)^2 = (h - x)^2 + d^2$$

$$2\left(l - \frac{y}{2}\right)\frac{v_c}{2} = 2\,(h - x)\,v_r$$

$$\boxed{v_c = 2v_r \sin\theta}$$

$$a_2 = 2a_1 \sin\theta \quad \Rightarrow \quad a_2 = a_1$$

Sol.16. (B)



$2T \sin\theta - mg = ma_1, \quad \theta = 30°$

$$2mg - T = 2ma_2$$

Simplify to get :

$$a_1 + 2a_2 = g$$

From constraints, we have initially:

$$a_2 = 2a_1 \sin\theta$$

$\Rightarrow \quad a_2 = a_1$

Ans.17.(C)

Ans.18.(D)

Ans.19.(B)

Sol.17-19

$\vec{v}_I = -4\hat{i} + gt\,\hat{j}$

$\vec{v}_{II} = +9\hat{i} + gt\,\hat{j}$

$\vec{v}_I \cdot \vec{v}_{II} = 0 \Rightarrow$ t = 0.6 sec.

Distance between particles is
D = (9 + 4) × 0.6
D = 13 × 0.6 = 7.8 m

$V_{rel} = (9 + 4) = 13$ m/sec.

SECTION – B

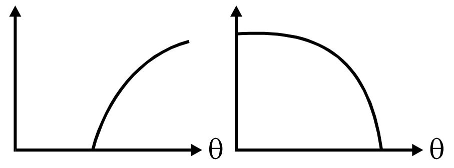
Sol.1. (A) P, R; (B) P, R; (C) S; (D) S
By fact base.

Sol.2. (A) Q , (B) S, (C) R, (D) P

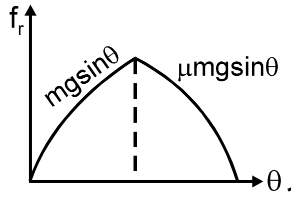
(i)Till $\theta = \tan^{-1}\mu$, T = 0

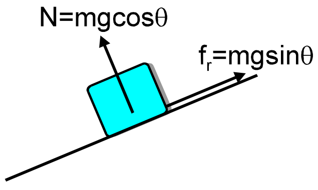
After $\theta = \tan^{-1}\mu$, T = mg sinθ – μ mg cosθ

So curve will be



(ii) N = mg cos θ



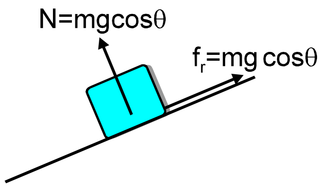


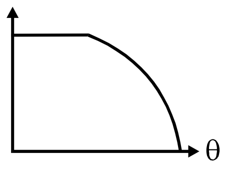
(iii) Till $\theta = \tan^{-1}\mu$

f_r will be static = mg sinθ

after $\theta = \tan^{-1}\mu$

f_r will be kinetic = μ mg cos θ





(iv) Net interaction force between the block and incline's

for θ = < $\tan^{-1}\mu$

Net reaction $\sqrt{(mg\cos\theta)^2 + (mg\sin\theta)^2}$ = mg

for $\theta > \tan^{-1}\mu$

Net reaction $\sqrt{(mg\cos\theta)^2 + (\mu g\cos\theta)^2}$

$= \sqrt{1+\mu^2}\ \cos\theta$

Sol.3. (A) Q ; (B) R ; (C) S ; (D) P
GIven :$V_{AC} = 5\hat{k}$, $V_{CT} = -5\hat{j}$, $V_{TB} = 10\hat{j}$, $V_{BD} = 6\hat{i}$, $V_{DP} = -3\hat{i}$, $V_{Pg} = -15\hat{i} + 15\hat{j}$
(A) $V_{AB} = V_{AC} + V_{CT} + V_{TB} = 5\hat{j} + 5\hat{k}$
(B) $V_{BP} = V_{BD} + V_{DP} = 3\hat{i}$
(C) $V_{Ag} = V_{AC} + V_{CT} + V_{TB} + V_{BD} + V_{DP} + V_{Pg} = -12\hat{i} + 20\hat{j} + 5\hat{k}$
(D) $V_{PA} = -V_{AP} = -(V_{AC} + V_{CT} + V_{TB} + V_{BD} + V_{DP}) = -3\hat{i} - 5\hat{j} - 5\hat{k}$

PART-II : CHEMISTRY

SECTION – A

Sol.1. (C)

$HCl + NaOH \rightleftharpoons NaCl + H_2O$

$$K_C = \frac{[H_2O]}{[H^+][OH^-]}$$

$$K_C = \frac{[H_2O]}{KW}$$

$K_C = 5.5 \times 10^{15}$

Sol.2. (D)

$NH_4^+ \rightleftharpoons NH_3$

$K_1 = 5.6 \times 10^{-10}$

$H_2O \rightleftharpoons H^+ + OH^-$

$K_2 = 1 \times 10^{-14}$

$NH_4^+ + OH^- \underset{k'_2}{\overset{k'_1}{\rightleftharpoons}} NH_3 + H_2O$

$$K = \frac{5.6\times10^{-10}}{1\times10^{-14}}$$

Farther $K = \frac{k_1'}{k_2'}$

$$K_2' = \frac{3.4\times10^{10}}{5.6\times10^{4}} = 6 \times 10^5$$

Sol.3. (C)

O_3 and SO_2 are angular.

Sol.4. (B)

$$Z = \frac{PV}{nRT}$$

Sol.5. (B)

Down the group reactivity increases.

Sol.6. (D)

$$Mg + N_2 \xrightarrow{\Delta} Mg_3N_2 \xrightarrow{H_2O} Mg(OH)_2 + NH_3$$

Sol.7. (B)

$$\lambda = \frac{hC}{E}$$

Sol.8. (D)

$$E_H = -13.6\frac{Z^2}{n^2}eV$$

$$E_H = -13.6\frac{Z_H^2}{n_H^2}eV$$

$$E_{Li^{+2}} = -13.6\frac{Z_{Li^{+2}}^2}{n_{Li^{+2}}^2}eV$$

$E_H = E_{Li^{+2}}$

$$\frac{Z_H^2}{n_H^2} = \frac{Z_{Li^{+2}}^2}{n_{Li^{+2}}^2} \Rightarrow \frac{1}{4^2} = \frac{3^2}{n_{Li^{+2}}^2} = 12$$

Sol.9. (D)

$T \propto n^3$

$$\frac{T_1}{T_2} = \frac{n_1^3}{n_2^3} = 1:8$$

Sol.10. (C)
SO_3^{-2} is pyramidal.

Sol.11. (D)
van der Waal's constants can never be negative. They are independent of temperature and characteristics of gases.

Sol.12. (A)
Graham's law.

Sol.13. (C)
IP of lithium is maximum.

Ans.14.(B)
Ans.15.(B)
Ans.16.(B)

Sol.14-16.
Moles in flask A + moles in flask B = total moles

$$\frac{950 \times V_A}{760 \times R \times 300} + \frac{900 \times V_B}{760 \times R \times 300} = \frac{910 \times (V_A + V_B)}{760 \times R \times 300}$$

Sol.17. (B)
Substitution of all the variables in the equation $Pe^{V/2} = nCT$ gives C = 0.001.

Sol.18. (D)
Substitution of all the variables in the equation $Pe^{V/2} = nCT$ gives slope = $\frac{2}{1000\,e}$.

Sol.19. (A)
Moles of oxygen = $\frac{1 \times 200}{0.0821 \times 200}$

SECTION – B

Sol.1. (A) P, R; (B) P,S; (C) Q,R,S; (D) Q,S
Oxygen & Boron are paramagnetic while C_2 and N_2 are diamagnetic.

Sol.2. (A) R; (B) R; (C) Q; (D) P
$HClO_3$ is sp^3, PCl_4^+ is sp^3, NO_3^- is sp^2 and PCl_6^- is sp^3d^2.

Sol.3. (A) P; (B) S; (C) Q,R,S; (D) R,S
Solubility of alkali metal halides decreases down the group. Ionic character of s-block compounds increases down the group.

PART-III : MATHEMATICS

SECTION – A

Sol.1. (A)
Put $a = 2 \sin \alpha$, $b = 2 \sin \beta$

Sol.2. (B)
kr, ks are +ve integers (where ‘k’ is LCM of denominators)
Now $p^r, p^r, \ldots\ldots$ ks times
& $q^s, q^s, \ldots\ldots$ kr times
Applying A.M. ≥ G.M. $\Rightarrow \frac{p^r}{r} + \frac{q^s}{s} \geq pq$

Sol.3. (A)
$(x - a)^2 + (y - b)^2 = R^2$
$a = 1 - R$, $b = 1 - (\sqrt{2} - 1)R$
$\Rightarrow (3 - 2\sqrt{2})R^2 - 2\sqrt{2}R + 2 = 0$

Sol.4. (C)
$a^4 - 7a^2 + 10 = 0$ and $a(a^2 - 2) = 0$

Sol.5. (B)
By fact base.

Sol.6. (A)
Applying A.M. ≥ G.M.
$a = b = c = d = 3$

Sol.7. (C)
Equation of circle comes
$|z + 7 - bi| = \sqrt{48 + b^2}$
Hence centre (–7, b)

Sol.8. (C)
AM ≥ GM

Sol.9. (B)
$x^2 - 3 = 1$

Sol.10. (A)
Perpendicular tangents meet on directrix.

Sol.11. (B)
$|1 - \bar{z}_1 z_2|^2 - |z_1 - z_2|^2 = (1 - r_1^2)(1 - r_2^2)$

Sol.12. (D)
AM ≥ GM

Sol.13. (A)
Imaginary roots occur in conjugate pairs.

Ans.14.(D)

Ans.15.(B)

Ans.16.(C)

Sol.14-16.

$\lambda_1 = \cot\frac{A}{2}$, $\lambda_2 = \cot\frac{B}{2}$, $\lambda_3 = \cot\frac{C}{2}$

Ans.17.(D)

Ans.18.(C)

Ans.19.(C)

Sol.17-19.

Parabola passes through (0, q), (a, 0), (b, 0) such that a + b = –p, ab = q

Let equation of circle be $(x-a)^2 + (y-b)^2 = R^2$

$\Rightarrow \quad a = -\frac{p}{2}, \; b = -\frac{q+1}{2},$

$\Rightarrow$ Reflection of (0, q) across the horizontal diameter is (0, 1)

SECTION – B

Sol.1. (A) P, Q; (B) R, S ; (C) S ; (D) P, Q

$P(x) = (x^2 + ax + c)\,(x^2 + bx + d)$

$\Rightarrow \quad P(x) = (x + 1)(x + 2)^2(x + 3) = (x^2 + 4x + 3)(x^2 + 4x + 4)$ or $(x^2 + 3x + 2)(x^2 + 5x + 6)$

So the ordered solutions for (a, b, c, d) can be (4, 4, 3, 4), (4, 4, 4, 3), (3, 5, 2, 6), (5, 3, 6, 2)

Sol.2. (A) Q; (B) S ; (C) R ; (D) P

(A) Equation of normal is $y = -tx + 2at + at^3$ at P(t)

It intersect the curve again at point $Q(t_1)$ on the parabola such that

$t_2 = -t - \frac{2}{t}$

Again slope of OP is $\frac{2}{t} = M_{OP}$

Also, slope of OQ is $\frac{2}{t_1} = M_{OQ}$

Since $M_{OP} \cdot M_{OQ} = -1 = \frac{4}{tt_1}$

$\Rightarrow tt_1 = -4$

$t\left(-t - \frac{2}{t}\right) = -4$

$\Rightarrow t^2 = 2$

(B) P(1, 2), Q(4, 4), R(16, 8)

Now, ar(ΔPQR) = 6 sq. units

(C) Equation of normal from any point $P(am^2, -2m)$ is

$y = mx - 2am - am^3$

It passes through $\left(\frac{11}{4}, \frac{1}{4}\right)$

$\Rightarrow 4m^3 + 8m - 11m + 1 = 0$

$\Rightarrow 4m^3 - 3m + 1 = 0$

Now, $f(m) = 4m^3 - 3m + 1$

$\Rightarrow f'(m) = 12m^2 - 3 = 0$

$\Rightarrow = m \pm \frac{1}{2}$

Since $f\left(\frac{1}{2}\right) f\left(-\frac{1}{2}\right) < 0$ has 3 normals are possible.

(D) Since, normal at P(t1) if meets the curve again at (t_2), then

$t_2 = -t_1 - \frac{2}{t_1}$

Such that here normal at P(1) meets the curve again at Q(t)

$\Rightarrow$ $t = -1 - \frac{1}{2} = -3$

Sol.3. (A) P,Q,R,S; (B) R,S ; (C) P,Q ; (D) R,S

(A) $\Sigma n^2 = 10 \times 7 \times 41$

(B) $G_{n+1} = 2 \times 3 \times 2 \times 9$

(C) Required term is $\frac{120}{7}$

(D) $S = \frac{35}{16}$