JEE EXPERT

PRACTICE TEST – 04 (01 APRIL 2020)

ANSWER KEY & SOLUTION

PHYSICS

(PART – A)

1. d	2. b	3. a	4. d
5. b	6. c	7. a	8. a
9. ad	10. b	11. ac	12. b
13. c	14. b	15. b	16. c

(PART – C)

1. 8	2. 8	3. 7	4. 5
5. 4	6. 4	7. 5	

CHEMISTRY

(PART– A)

1. c	2. a	3. c	4. d
5. d	6. b	7. b	8. bcd
9. bc	10. bcd	11. bd	12. b
13. d	14. c	15. d	16. a

(PART– C)

1. 2	2. 1	3. 8	4. 9
5. 1	6. 9	7. 4	

MATHEMATICS

(PART– A)

1. d	2. b	3. d	4. c
5. c	6. d	7. a	8 cd
9. ac	10. abc	11. abcd	12. a
13. d	14. c	15. d	16. a

(PART – C)

1. 8	2. 7	3. 8	4. 3
5. 6	6. 4	7. 0	

SOLUTION
PHYSICS

1. D

After time t it happens

$$\therefore \left(\frac{1}{2}m_o r^2 + \mu t r^2\right)\frac{W_o}{2} = \frac{1}{2}m_o r^2 W_o$$

$$\frac{1}{2}m_o r^2 + \mu t r^2 = m_o r^2 \Rightarrow \mu t = \frac{m_o}{2} \Rightarrow t = \frac{m_o}{2\mu}$$

2. B

Speed 2 V, radius 2 R.

$$\text{Acc.} = \frac{(2V)^2}{2R} = \frac{2V^2}{R}$$

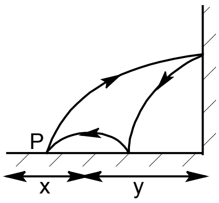
3. A

$$V_B \cos\theta_B = V_A \cos\theta_A \Rightarrow V_B = 15\,m/s$$

4. D

Horizontal speed = μ

Vertical speed = v



$$x + y = \mu.\frac{v}{g}$$

$$y = e\mu.\frac{v}{g}$$

$$x = e\mu.\frac{2ev}{g}$$

$$2e^2\frac{\mu v}{g} + e\frac{\mu v}{g} = \frac{\mu v}{g} \Rightarrow 2e^2 + e - 1 = 0 \Rightarrow 2e^2 + 2e - e - 1 = 0 \Rightarrow 2e(e+1) - 1(e+1) = 0$$

$$e = \frac{1}{2}$$

5. B

$\vec{v} = \left(2\hat{i} + 2\hat{j}\right)m/s$. Wall is parallel to $\hat{j}$ direction. So the velocity component will not change in that direction. So its final velocity is $x\hat{i} + 2\hat{j}$. Now $e = \frac{1}{2}$

$$\frac{-x}{2} = \frac{1}{2} = x = -1 \Rightarrow \therefore \text{ After collision velocity is } = -\hat{i} + 2\hat{j}\ m/s$$

6. C

Zero. They are perpendicular.

7. A

Let the max wt is = m kg.

$$\left(\pi(0.35)^2 \times 3 \times 10^3\right) = 10^3 + mg \Rightarrow m + 100 = \frac{22}{7} \times \frac{35}{7} \times 3.5 \times 3$$

m = 477 kg

8. A

$$\text{Total K.E} = \frac{1}{2}I_o W^2$$

$$I_o = 2m\left(\sqrt{2}\,\pi\right)^2 + m\left(\sqrt{2}\,\pi\right)^2 + m(2\pi)^2 + 2m\pi^2$$

$$= 12m\pi^2 \Rightarrow (K.E)_T = \frac{1}{2}.\ 12\ m\pi^2\left(\frac{V_o}{\pi}\right)^2 = 6mV_o^2$$

9. AD

$T_1 = \mu mg$

$F = T_1 + 4\mu mg = 5\mu mg$

10. B

K.E is min when P.E. is maximum

$u \rightarrow \frac{v}{2}$

$\therefore loss = \frac{\frac{1}{2}mv^2 - \left[\left(\frac{1}{2}mu^2\right)^2 + \frac{1}{2}mv_y^2\right]}{\frac{1}{2}mv^2} \times 100$ = 25.1

11. AC

So the total time of flight of water is = $\sqrt{\frac{2(2h-y)}{g}}$

Velocity is $V = \sqrt{2gy}$

$\therefore$ x = vt = $\sqrt{2gy}\sqrt{\frac{2(2h-y)}{g}}$ = $2\sqrt{y(2h-y)}$

So using max min we get,

y = h $\Rightarrow$ x_m = 2h.

12. B

Pressure = $\frac{Mg}{A} \Rightarrow \therefore \frac{Mg}{A} = \frac{1}{2}\rho v^2$

$v = \sqrt{\frac{2Mg}{Ar}}$

Add these $H_{max} = \frac{v^2}{2g}$

13. C

av = Au $\Rightarrow u = \frac{a}{A}\sqrt{\frac{2Mg}{A\rho}} \Rightarrow mg = \rho av^2 \Rightarrow$ Find m.

14. B

Perpendicular to the plane the speed will became zero.

15. C

Perpendicular to the plane the speed will became zero.

16. D

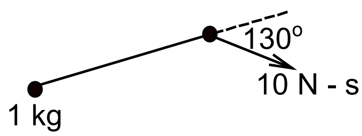
In this case the velocity component perpendicular to the plane remains same in collision.

Integer Type

1. 8

10 cos 30° = 2 mv

$v = \frac{5\sqrt{3}}{2}$



2. 8

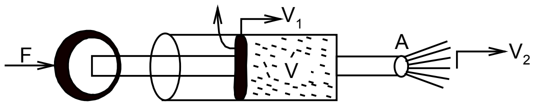
I = $5 \times \left[\frac{1}{3}ml^2\right] + ml^2 = \frac{8}{3}ml^2$

$5mg\frac{l}{2} + mgl = \frac{1}{2}.\frac{8}{3}ml^2 w^2$ = $w = \sqrt{\frac{21g}{8l}}$ = V_t = $l w = \sqrt{\frac{21}{8}gl}$ = k = 8

3. 7

$$\frac{1}{2}\rho v_1^2 + \frac{F}{S} = \frac{1}{2}\rho v_2^2$$

$$v_2^2 = \frac{2F}{\rho 4}\left[v_1 \simeq 0\right]$$

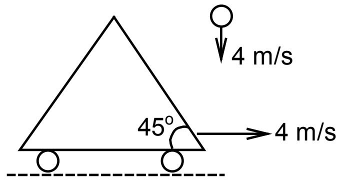


$$v_2 = \sqrt{\frac{2F}{\rho s}} \Rightarrow -\frac{dV}{dt} = \frac{d}{dt}(Ax) \Rightarrow -\frac{dv}{dt} = Av_2$$

$$-\int_v^o dv = A\,v_2 \int_o^t dt \Rightarrow v = A\sqrt{\frac{2F}{\rho s}}\,t \Rightarrow \frac{v^2\rho s}{A^2 t^2} = 2F \Rightarrow F = \frac{1}{2}\frac{\rho s v^2}{A^2 t^2}$$

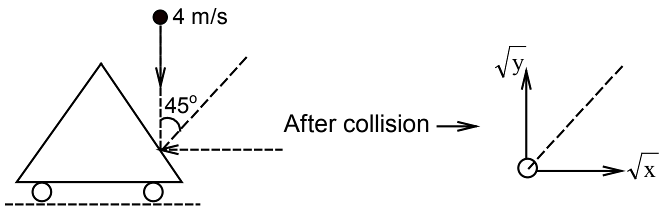
$$W = F.L = F.\frac{V}{S} = \frac{1}{2}\frac{\rho s v^2}{A^2t^2}.\frac{v}{s} = \frac{1}{2}\frac{\rho v^3}{A^2t^2} \Rightarrow \therefore x + y + z = 7$$

4. 5



$$\frac{\sqrt{x}\cos 45^o + \sqrt{y}\cos 45^o - 4\cos 45^o}{4\cos 45^o - \left[-4\cos 45^o\right]} = 1$$

$\sqrt{x} = 4\,m/s$ as the ball is massive



$\therefore \frac{\sqrt{y}}{\sqrt{2}} = 4\sqrt{2} = \sqrt{y} = 8\,m/s$

Total velocity is = $\sqrt{\sqrt{x^2} + \sqrt{y^2}}$

= $\sqrt{64+16} - \sqrt{80} = 4\sqrt{5}$

k = 5

5. 4

After collision velocity is = $\frac{V}{2}$

$\frac{V^2}{4} = 2gh_1 =$ Again $V^2 = 2gh = \therefore h_1 = \frac{h}{4} = k = 4$

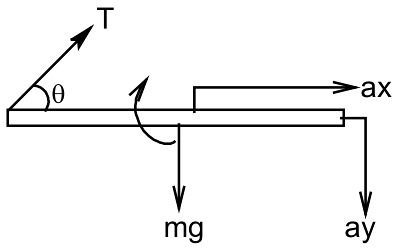
6. 4

$mg - T\sin\theta = ma_y$

$T\cos\theta = max \Rightarrow T\sin\theta.\frac{1}{2} = \frac{1}{12}ml^2\alpha$

Along the string acc of the end is o.

$\therefore a x\ \cos\theta + \alpha\frac{1}{2}\sin\theta = a g\ \sin\ \theta$



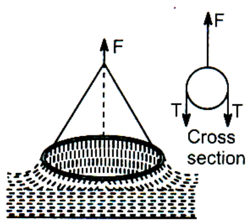
Solving we get $T = \frac{mg\ \sin\theta}{1 + 5\sin\theta}$

$\therefore p + q = 4$

7. 5

F = T $\left(2\pi r_1 + 2\pi r_2\right)$

T = $\frac{F}{2\pi\left(r_1 + r_2\right)}$



Putting the values we get

T = 500 dyne/cm

$\therefore$ k = 5.

SOLUTION
CHEMISTRY

1. C

$$A(g) \rightarrow 4B(g) + 3C(g)$$

At $t=0$: P_o 0 0

At $t=20\,\text{min}$: $P_o - x$ $4x$ $3x$

$P_o - x + 4x + 3x = 400 \Rightarrow P_o + 6x = 400 \Rightarrow 6x = 400 - 100 = 300$

x = 50

$$K = \frac{0.693}{t_{1/2}} = \frac{0.693}{20 \times 60} = 5.7 \times 10^{-4}\ \sec^{-1}$$

2. A
3. C
4. D

Extensive property is entropy.

5. D

For $X \rightleftharpoons 2Y$ α = degree of dissociation of X

No. of moles at eqm $1-\alpha$ 2α P_1 = Total pressure at eqm.

$$\therefore K_{p_1} = \frac{4\alpha^2}{1-\alpha^2}.P_1$$

For $Z \rightleftharpoons P + Q$ P_2 = Total pressure at eqm

No. of moles at eqm $1-\alpha$ α α

$$K_{P_2} = \frac{\alpha^2}{1-\alpha^2}.P_2$$

$$\frac{K_{P_1}}{K_{P_2}} = \frac{4P_1}{P_2} = \frac{1}{9} \text{ Hence, } \frac{P_1}{P_2} = \frac{1}{36}$$

6. B

Step I : H_2O (l, 1.01325 bar) $\rightarrow H_2O$ (g, 1.01325 bar)

$$\Delta s_1 = \frac{37.3 \times 10^3}{373\,K} J\,mol^{-1} = 100\,JK^{-1}\,mol^{-1}$$

Step II: H_2O (g, 1.01325 bar) $\rightarrow$ H_2O(g, 0.101325 bar)

$$\Delta s_2 = R\ln\frac{p_1}{p_2} = 8.314\,JK^{-1}mol^{-1} \times 2.303 \times \log\frac{1.01325}{0.101325} = 19.147\ J\ K^{-1}\ mol^{-1}$$

$\Delta S = \Delta S_1 + \Delta S_2$ = 100 JK^{-1} mol^{-1} + 19.147 JK^{-1} mol^{-1} = 119.14 JK^{-1} mol^{-1}

7. B

$Ca_3S_3^oO_9$ has the general formula $(SiO_3)_n^{2n-}$ and is a cyclic silicate, hence, no. of O atoms shared per tetrahedron is 2.

8. BCD

1 mole of $Ba(OH)_2$ $\equiv$ 2 equivalents of $Ba(OH)_2$ (n – factor = 2)
1 mole of H_2SO_4 $\equiv$ 2 equivalents of H_2SO_4(n – factor = 2)
1 mole of H_3PO_3 $\equiv$ 2 equivalents of H_3PO_3 (n – factor = 2)
2 mole of H_3PO_2 $\equiv$ 2 equivalents of H_3PO_2 (n – factor – 1)

9. BC

The forward reaction is endothermic & no. of moles of gaseous substances decreases. Hence, forward reaction is favoured by high temperature and high pressure.

10. BCD

Degree of hydrolysis (h) of a salt of strong acid and weak base is given by $h=\sqrt{\frac{k_h}{c}}=\sqrt{\frac{k_w}{k_b.c}}$

11. BD

Be_2C & Al_4C_3 are methanides & produce methane on hydrolysis.

12. B

From Arrhenius equation

$$\ln\frac{k_{27^\circ c}}{k_{17^\circ c}}=\frac{E_{a(f)}}{R}\left(\frac{300-290}{300\times 290}\right)$$

$$\Rightarrow \ln 2 = \frac{E_{a(f)}}{R}\times\frac{10}{300\times290} \Rightarrow E_{a(f)}=50\,kJ/mol$$

$$\Delta H=E_{a(f)}-E_{a(r)}=15\,kJ/mol$$

$$\therefore E_{a(r)}=35\,kJ/mol$$

13. D

From Arrhenius equation

$$\log k=\log A-\frac{Ea}{2.303R}\times\frac{1}{T}$$

By comparing, logA = OX = 5 $\therefore A=10^5$

$$\frac{E_a}{2.303R}=\frac{1}{2.303} \qquad \therefore E_a=R$$

$\therefore$ Arrhenius equation can be written as, $k=A.e^{-\frac{Ea}{RT}}=10^5\times e^{-\frac{1}{T}}$

14. C

X is borax, $Na_2B_4O_7.\ 10H_2O$

It aqueous solution can be used as buffer because it contains equal amount of weak acid & its salt.

$$\left[B_4O_5(OH)_4\right]^{-2}+5H_2O \rightleftharpoons 2B(OH)_3+2\left[B(OH)_4\right]^{-}$$

Its aqueous solution is weakly alkaline. Hence can be titrated by HCl using methyl orange indicator, not phenolphthalein.

The glassy bead, called borax glass contains $NaBO_2$ & B_2O_3. B_2O_3 reacts with transition metal salts to give coloured metaborates.

$$MO+B_2O_3\rightarrow M(BO_2)_2$$

15. D

The anion in borax $\left[B_4O_5(OH)_4\right]^{-2}$ is made up of 2 triangular units (sp^2 hybridised B atom) & 2 tetrahedral units (sp^3 hybridised B atom)

16. A

Y is orthoboric acid, H_3BO_3

$$Na_2B_4O_7+H_2SO_4+5H_2O\rightarrow Na_2SO_4+4H_3BO_3$$

It is a monobasic Lewis acid. It has a layer structure in which planar BO_3 units (sp^2 hyb B atom) are joined by H-bonds. On strong heating, it gives B_2O_3.

$$H_3BO_3\xrightarrow{100^\circ C}HBO_2\xrightarrow{160^\circ C}H_2B_4O_7\xrightarrow{\Delta}2B_2O_3+H_2O$$

Diborane on hydrolysis, produces H_3BO_3.

$$B_2H_6+6H_2O\rightarrow 2B(OH)_3+6H_2$$

Integer Type

1. 2

X is Ra

$^{224}_{88}X \longrightarrow ^{208}_{82}Pb + 4\alpha + 2\beta$

It emits 2β - particles. Hence, 2 neutrons get converted into protons.

2. 1

For, the reaction,

$\Delta G^o = \Delta H^o - T\Delta S^o = -29.8 \times 1000 - 298 \times 100 = 0 = -RT\ln K \Rightarrow \therefore K = 1$

3. 8

K_{sp} of $B(OH)_2$ = 4 × (7 × $10^{-6})^3$ = 1.372 × 10^{-15} (mol/lit)^3

When solubility is 1.372 × 10^{-3} mol/lit. 1.372 × 10^{-3} × $[OH^-]^2$ = 1.372 × 10^{-15}

$\therefore \left[OH^-\right]^2 = 10^{-12}$ $\therefore \left[OH^-\right] = 10^{-6}$

pOH = 6, $\Rightarrow$ pH = 8

4. 9

At half neutralization point, pH = pK_a = 5.3 At neutralization point,

$pH = \frac{1}{2}PK_w + \frac{1}{2}pK_a + \frac{1}{2}\log c = 7 + \frac{1}{2} \times 5.3 + \frac{1}{2}\log\frac{0.1}{2} = 7 + 2.65 - 0.65 = 9$

5. 1

R $SiCl_3$ On hydrolysis followed by condensation polymerization give cross linked polymers.

6. 9

$C_6H_6 + 3H_2 \rightarrow C_6H_{12}$

$\Delta_{reaction} H = \Delta_{combustion} H(\text{Reactants}) - \Delta_{combustion} H(\text{Products})$

= - 3273 – 3 × (2861) + 3924 = - 3273 – 858.3 + 3924

= - 4139. 3 + 3924 = = - 207.3 kJ

$\Rightarrow$ 23 X = 207.3 $\Rightarrow$ X = 207.3/23

$\therefore$ X $\approx$ 9

7. 4

By first path, W_1 = 0, Q_1 = 20 kcal $\therefore \Delta E = 20\,\text{kcal}$

By second path, Q_2 = 18 kcal, W_2 = 0.5 W_{max}

$\therefore W_2 = \Delta E - Q_2 = 2\,\text{kcal} = 0.5\,W_{max}$ [Δ E is a state function, does not depend on path chosen]

$\therefore W_{max}$ = 4 kcal

SOLUTION
MATHEMATICS

1. D

The roots of the given equation are either real & equal or complex f (0) = 6 > 0 $\therefore$ f(3) $\geq$ 0 or complex.

2. B

Clearly w = a_1(1 – 3 i) & z = a_2 (1 – 3 i) where a_1, a_2 $\in$ R.

3. D

Equation of the directrix of the parabola is x + y = 0 and the focus is (2, 2)

4. C

$A = \sqrt{\left(1+\frac{1}{y}\right)\left(1+\frac{1}{z}\right)} = \sqrt{1+\frac{c+1}{yz}}$ A is minimum when yz is maximum, and maximum value of yz is $\frac{c^2}{4}$.

5. C

Let the two numbers are x & y

x, A_1, A_2, y are in A.P. , $\therefore$ x + y = A_1 + A_2 ……… (1)

x, G_1, G_2, y are in G.P., $\therefore G_1G_2$ = xy …………… (2)

$\frac{1}{x},\frac{1}{H_1},\frac{1}{H_2},\frac{1}{y}$ are in A.P., $\therefore \frac{1}{H_1}+\frac{1}{H_2}=\frac{1}{x}+\frac{1}{y}$ ……….(3)

Eliminate x & y from (1), (2) & (3)

6. D

a = 0, a = 1/2 venders one of the quadratics linear. Hence $a\neq 0$; $a\neq \frac{1}{2}$ $\therefore$ a = 2/9

7. A

We know,

$|Z_1|-|Z_2|\le|Z_1+Z_2|\le|Z_1|+|Z_2|$ using $\Rightarrow |Z_1|-|Z_2|\le|Z_1+Z_2|\Rightarrow |Z|-\frac{2}{|Z|}\le 2$

$\Rightarrow (|Z|-1)^2-(\sqrt{3})^2\le 0\Rightarrow |Z|\le(\sqrt{3}+1)$

8. CD

The given equation can be written as $\frac{3}{4}(\log_2^x)^2+\log_2^x-\frac{5}{4}=\log_x^{\sqrt{2}}$

Solving, $x=\frac{1}{4},\frac{1}{2^{1/3}},2$

9. AC

Let the mid – point of the chord is (h, k)

As, h + k = 1 & the chord passes through (a, 2a)

$\therefore$ $h^2 - 2h + 1 + 2a^2 - 2a = 0$ $\Rightarrow$ $\therefore D > 0$ $\Rightarrow 0<a<1$

10. ABC

As $| z_1 | = | z_2 | = 1$

$\therefore$ Let $z_1 = \cos\theta+i\sin\theta$ & $z_2=\cos\alpha+i\sin\alpha$

11. ABCD

Let the four terms of the G.P are a, ar, ar^2, ar^3 $\Rightarrow$ $\therefore a^2r^4 = 1$ & $a^4r^6 = 4$ $\Rightarrow$ Solving, $r=\pm\frac{1}{2}$ & $a=\pm 4$

Passage – I

The mid – point of z_2 & z_3 divides the line joining the points z_1 & $i\sqrt{3}$ in the ratio 1:3 internally.

12. A

13. D

Passage – II

Equation of the chord of contact from Q to the circle $x^2 + y^2 = 4$ is $x\alpha+y\beta=4$ where $\beta t=\alpha+2t^2$.

Putting $\alpha=\beta t-2t^2$ in $x\alpha+y\beta=4$, the point of concurrency of chord of contact is $xt^2 + 2 = 0$ & $y = - xt$

Eliminating t, the regular locus is $y^2 + 2x = 0$.

14. C

15. D

16. A

Integer Type

1. 8

Clearly, z_2, z_3 & (3, 0) forms an equilateral triangle.

2. 7

Apply $A^*\ge G^*$ $\Rightarrow$ $\frac{3.\frac{2x}{3}+2.\frac{5y}{2}+4.\frac{3z}{4}}{9}\ge\left[\left(\frac{2x}{3}\right)^3\left(\frac{5y}{2}\right)^2\left(\frac{3z}{4}\right)^4\right]^{1/9}$

3. 8

P_1 is the parabola: $y^2=\frac{4}{3}\left(x-\frac{2}{3}\right)$ & so on.

4. 3

Applying D < 0, 2 < K < 4

5. 6

a_4 & h_7 can be found very easily.

6. 4

(i) $D > 0 \Rightarrow 9(K-1)^2 - 4K > 0$

Let $3^x = u$ $\therefore u^2 + 3(K-1)u + K = 0$ …….(i)

1 lies in between the roots of equation (1)

$\therefore f(1) < 0$

7. 0

L.H.S is always > 0 & R.H.S is always < 0

Hence no real solution.