AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST TYM TEST - 26 Balliwala
SOLUTION Date 10 -11-2019

[PHYSICS]

1. $l = \frac{FL}{AY} \therefore l \propto \frac{1}{r^2}$ (F, L and Y are constant)

$$\frac{l_1}{l_2} = \left(\frac{r_2}{r_1}\right)^2 = (2)^2 = 4$$

2. According to Hooke's law

Within the elastic limit, stress is directly proportional to the strain i.e., Stress $\propto$ Strain

or Stress = k strain

$$\frac{\text{Stress}}{\text{Strain}} = k$$

when k is the proportionality constant and is known as modulus of elasticity.

3. Here, $r = 10\text{ mm} = 10 \times 10^{-3} = 10^{-3}\text{ m}$

$$L = 1\text{ m}, F = 100\text{ kN} = 100 \times 10^3\text{ N} = 10^5\text{ N}$$

Stress produced in the rod is

$$\text{Strain} = \frac{F}{A} = \frac{F}{\pi r^2} = \frac{100 \times 10^3\text{ N}}{3.14 \times (10^{-2}\text{ m})^2}$$
$$= 3.18 \times 10^8\text{ N m}^{-2}$$

4. Young's modulus depends upon the nature of material and not the radii of the wires.

5. $Y = \frac{Fl}{A\Delta l}$ or $F = \frac{YA\Delta l}{l}$

or $F = \frac{2.2 \times 10^{11} \times 2 \times 10^{-6} \times 0.5 \times 10^{-3}}{2} = 1.1 \times 10^2\text{N}$

6. $B = -\frac{\Delta P}{\Delta V / V} = -\frac{V\Delta P}{\Delta V}$

$$= -\frac{1.5 \times 140 \times 10^3}{-0.2 \times 10^{-3}} = 1.05 \times 10^9\text{ Pa}$$

7. $U=\frac{1}{2}\left(\frac{YA}{L}\right)l^2 \therefore U \propto l^2$

$$\frac{U_2}{U_1}=\left(\frac{l_2}{l_1}\right)^2=\left(\frac{10}{2}\right)^2=25 \Rightarrow U_2=25U_1$$

i.e., potential energy of the spring will be 25 V

8. $W=\frac{1}{2}Fl \therefore W \propto l$ (F is constant)

$\therefore \quad \frac{W_1}{W_2}=\frac{l_1}{l_2}=\frac{l}{2l}=\frac{1}{2}$

9. $U=\frac{1}{2}\times\frac{YAl^2}{L}=\frac{1}{2}\times\frac{2\times10^{11}\times3\times10^{-6}\times(1\times10^{-3})^2}{4}$
$=0.075$ J

10. The elastic pot. Energy $=\frac{1}{2}$stress $\times$ strain.

$$=\frac{1}{2}Y(\text{strain})^2=\frac{1}{2}Y\left(\frac{\Delta l}{L}\right)^2$$

$\therefore \quad \frac{U_2}{U_1}\propto\left(\frac{\Delta l_2}{\Delta l_1}\right)^2=\left(\frac{10}{2}\right)^2$

$\frac{U_2}{U_1}=25$

$\Rightarrow \quad U_2=25U_1$

So the correct choice is (b).

11. Viscosity of a liquid decreases with increase in temperature whereas viscosity of gases increases with increase in temperature.

12. $F=\frac{\eta Av}{y}=\frac{12\times2\times0.5}{1\times10^{-3}}\text{N}=12000\text{ N}$

13. $v_0 \propto r^2$

since r becomes one-half therefore v_0 becomes one-fourth.

14. Viscous force $=6\pi\eta rv=6\pi\times18\times10^{-5}\times0.03\times100$
$=101.73\times10^{-4}$ dyne

15. Initially the terminal velocity V of sphere of radius a is

$W_{eff}=6\pi\eta aV$ (1) (W_{eff} = weight – Buoyant force)

As the radius is doubled, mass is increased to 8 times and new terminal velocity will be

$$8W_{eff}=6\pi\eta 2aV' \quad (2)$$

from (1) and (2) $V'=4V$

16. Effective length = $2\pi r + 2\pi R$

17. $2l\sigma = 1 \times 980$ or $l = \frac{980}{2 \times 70}$ cm = 7 cm

18. As volume remains constant therefore $R = n^{1/3} r$

$$\frac{\text{surface energy of one big drop}}{\text{surface energy of } n \text{ drop}} = \frac{4\pi R^2 T}{n \times 4\pi r^2 T}$$

$$\frac{R^2}{nr^2} = \frac{n^{2/3}r^2}{nr^2} = \frac{1}{n^{1/3}} = \frac{1}{(1000)^{1/3}} = \frac{1}{10}$$

19. Energy needed = Increment in surface energy

= (surface energy of n small drops) – (surface energy of one big drop)

$= n4\pi r^2 T - 4\pi R^2 T = 4\pi T(nr^2 - R^2)$

20. $W = 8\pi T(r_2^2 - r_1^2) = 8\pi T\left[\left(\frac{2}{\sqrt{\pi}}\right)^2 - \left(\frac{1}{\sqrt{\pi}}\right)^2\right]$

$\therefore \quad W = 8 \times \pi \times 30 \times \frac{3}{\pi} = 720$ erg

[CHEMISTRY]

21.

$$N_2O_4 \rightleftharpoons 2NO_2$$

At Eqm. 4.8×10^{-2} mol L^{-1} 1.2×10^{-2} mol L^{-1}

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[1.2 \times 10^{-2}]^2}{[4.8 \times 10^{-2}]} = \frac{1.2 \times 1.2 \times 10^{-4}}{4.8 \times 10^{-2}} = \mathbf{3 \times 10^{-3}\ mol\ L^{-1}}$$

22.

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$; $\quad K_1 = 4 \times 10^{-4}$

$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$; $\quad K_2 = \frac{1}{K_1} = \frac{1}{4 \times 10^{-4}}$

$NO(g) \rightleftharpoons \frac{1}{2} N_2(g) + \frac{1}{2} O_2(g)$; $\quad K_c = (K_2)^{\frac{1}{2}} = \frac{1}{2 \times 10^{-2}} = \mathbf{50}$

23.

$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2} O_2(g)$; $\quad K_c = 4.9 \times 10^{-2}$

$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$; $\quad K = K_c^2 = (4.9 \times 10^{-2})^2$

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$; $\quad K' = \frac{1}{K} = \frac{1}{(4.9 \times 10^{-2})^2} = \frac{10000}{(4.9)^2} = \mathbf{416.5}$

The closest choice is **(d).**

24.

	$H_2(g)$	+	$I_2(g)$	$\rightleftharpoons$	$2HI(g)$
At $t = 0$	40 mL		50 mL		—
At Eqm.	30 mL		30 mL		60 mL

	consumed				produced
Ratio of volumes	(40 – 30)	:	(50 – 30)	:	60
Ratio of moles	1	:	2	:	6
(Avogadro's law)					

$$K_c = \frac{C_{HI}^2}{C_{H_2} \times C_{I_2}} = \frac{6 \times 6}{1 \times 2} = \mathbf{18}$$

25.

$$H_2 + I_2 \rightleftharpoons 2HI,\ K = 49$$

$$2HI \rightleftharpoons H_2 + I_2,\ K' = \frac{1}{K} = \frac{1}{49}$$

$$HI \rightleftharpoons \frac{1}{2} H_2 + \frac{1}{2} I_2,$$

$$K'' = (K')^{1/2} = \frac{1}{\sqrt{49}} = \frac{1}{7} = \mathbf{0.143}$$

26.

$$K_p = K_c (RT)^{\Delta n}$$

Since, Δn is [2 + 1 – 2] = 1, $\boldsymbol{K_p > K_c}$

27.

Δn (gaseous substances) for this equation is zero.

Hence, $K_p = K_c (RT)^{\Delta n} = \boldsymbol{K_c}$.

28.

$$\Delta n = (c+d) - (a+b)$$

$$K_p = K_c (RT)^{\Delta n} = \boldsymbol{K_c (RT)^{(c+d)-(a+b)}}$$

29.

$$SO_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons SO_3(g)$$

$$K_p = K_c (RT)^{\Delta n_g}$$

Here, $\Delta n_g = x = 1 - \left(1 + \frac{1}{2}\right) = -\mathbf{\frac{1}{2}}$

30.

$$X \rightleftharpoons 2Y$$

At $t=0$: X = 1 mole, $2Y$ = –

At Eqm.: X = $1-\alpha$, $2Y$ = 2α

Total moles $= 1-\alpha+2\alpha = 1+\alpha$

Total pressure $= P_1$

$$K_{p_1} = \frac{P_Y^2}{P_X} = \frac{\left(\frac{2\alpha}{1+\alpha}P_1\right)^2}{\left(\frac{1-\alpha}{1+\alpha}\cdot P_1\right)} = \frac{4\alpha^2 P_1^2(1+\alpha)}{P_1(1+\alpha)(1+\alpha)(1-\alpha)} = \frac{4\alpha^2 P_1}{1-\alpha^2} \quad ...(i)$$

$$Z \rightleftharpoons P + Q$$

At $t=0$: Z = 1 mole, P = –, Q = –

At Eqm.: Z = $1-\alpha$, P = α, Q = α

Total moles $= 1-\alpha+\alpha+\alpha = 1+\alpha$

Total pressure $= P_2$

$$K_{p_2} = \frac{P_P P_Q}{P_Z} = \frac{\left(\frac{\alpha}{1+\alpha}P_2\right)\cdot\left(\frac{\alpha}{1+\alpha}P_2\right)}{\left(\frac{1-\alpha}{1+\alpha}\right)P_2} = \frac{\frac{\alpha^2}{(1+\alpha)^2}\cdot P_2^2}{\left(\frac{1-\alpha}{1+\alpha}\right)P_2} = \frac{\alpha^2 P_2}{1-\alpha^2} \quad ...(ii)$$

From eqns. (i) and (ii)

$$\frac{K_{p_1}}{K_{p_2}} = \frac{4\alpha^2 P_1}{1-\alpha^2} \times \frac{1-\alpha^2}{\alpha^2 P_2} = \frac{4P_1}{P_2} \quad ...(iii)$$

Given, $$\frac{K_{p_1}}{K_{p_2}} = \frac{1}{9} \quad ...(iv)$$

From eqns. (iii) and (iv)

So, $$\frac{4P_1}{P_2} = \frac{1}{9} \Rightarrow \frac{P_1}{P_2} = \mathbf{\frac{1}{36}}$$

31.

$$RCOOH + R'OH \rightleftharpoons RCOOR' + H_2O$$

	$RCOOH$	$R'OH$	$RCOOR'$	H_2O
At $t=0$	100 moles	100 moles	Nil	Nil
At Eqm.	100–67	100–67	67	67

$$K = \frac{67\times 67}{33\times 33} = \mathbf{4.12}$$

32.

$$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g) \quad (x \text{ is degree of dissociation})$$

	$2AB_2(g)$	$2AB(g)$	$B_2(g)$
At $t=0$	2 moles (let)	—	—
At Eqm.	$(2-2x)$ moles	$2x$ moles	x mole

Total $= 2-2x+2x+x = (2+x)$ moles;

Total pressure $= P$

$$K_p = \frac{P_{AB}^2\cdot P_{B_2}}{P_{AB_2}^2} = \frac{\left(\frac{2x}{2+x}\cdot P\right)^2\left(\frac{x}{2+x}\cdot P\right)}{\left(\frac{2-2x}{2+x}\cdot P\right)^2} = \frac{x^3}{2}\cdot P$$

$$\Rightarrow \quad x = \left[\frac{\mathbf{2K_p}}{\mathbf{P}}\right]^{1/3} \quad (\text{given is } x << 1)$$

33.

On adding the first two equations,

$$K = K_1 \cdot K_2 = \mathbf{5 \times 10^{-23}}$$

34.

3^{rd} equation is the sum of first and second equation. Hence, its Eqm. Constt. = $\boldsymbol{K_1 \times K_2}$.

35.

$$N_2 + 3H_2 \overset{K_1}{\rightleftharpoons} 2NH_3$$

$$\Rightarrow \quad 2NH_3 \overset{K'}{\rightleftharpoons} N_2 + 3H_2;\ K' = \frac{1}{K_1}$$

$$N_2 + O_2 \overset{K_2}{\rightleftharpoons} 2NO;\ K_2$$

$$H_2 + \frac{1}{2}O_2 \overset{K_3}{\rightleftharpoons} H_2O$$

$$\Rightarrow \quad 3H_2 + \frac{3}{2}O_2 \overset{K''}{\rightleftharpoons} 3H_2O;\ K'' = K_3^3$$

Adding of eqns. (i), (ii) and (iii)

$$2NH_3 + \frac{5}{2}O_2 \longrightarrow 2NO + 3H_2O;\ K = ?$$

$$K = K' \times K_2 \times K'' = \frac{\boldsymbol{K_2 \cdot K_3^3}}{\boldsymbol{K_1}}$$

* For $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O;\quad K = \dfrac{K_2^2 \cdot K_3^6}{K_1^2}$

36. $k_f = 3k_b \quad \Rightarrow \quad K = \dfrac{k_f}{k_b} = \mathbf{3}$

37.

	$NH_2COONH_4(s)$	$\rightleftharpoons$	$2NH_3(g)$	+	$CO_2(g)$	
At $t=0$	solid		–		–	
At Eqm.	–		2 moles		1 mole	; $n_{total} = 3$

$$K_p = (P_{NH_3})^2\,(P_{CO_2})$$

For $\quad P = 3\text{ atm}$

$$K_p = \left(\frac{2}{3} \times 3\right)^2 \times \left(\frac{1}{3} \times 3\right) = \mathbf{4}$$

38. The third equation is obtained by adding the first and second. So, $\boldsymbol{K_3 = K_1 \cdot K_2}$

39.

	N_2	+	$3H_2$	$\rightleftharpoons$	$2NH_3$
At $t = 0$	10 moles		10 moles		Nil
At Eqm.	$1 \times \frac{6}{3}$ mol consumed *i.e.*, 8 moles left		4 mol left 6 moles consumed		$2 \times \frac{6}{3}$ moles *i.e.*, 4 moles produced

40% of 10 moles of H_2 = 4 moles left

Moles of H_2 consumed = 10 – 4 = 6

Total moles in the chamber at equilibrium = 8 + 4 + 4 = **16 mol**

40.

$$K = \frac{k_f}{k_b} = \frac{3.25 \times 10^{-3}}{1.62 \times 10^{-4}} = \mathbf{20}$$