WEEKLY TEST TYJ TEST - 26 B
SOLUTION Date 10-11-2019

[PHYSICS]

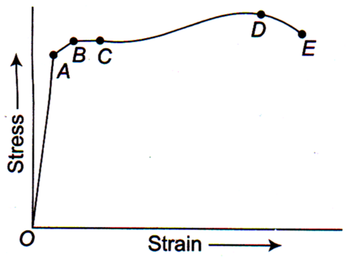
31. As stress is shown on x-axis and strain on y-axis

So we can say that $Y = \cot\theta = \dfrac{1}{\tan\theta} = \dfrac{1}{\text{slope}}$

So elasticity of wire P is minimum and of wire R is maximum.

32. In the region OA, the graph is linear showing that stress is proportional to the strain. Is proportional to the strain. Thus, in this region Hooke's law is obeyed.

The point D on the graph is known as ultimate tensile strength.



The point E on the graph is known as fracture point.

33. $Y = \tan\theta$. According to figure $\theta_A > \theta_B > \theta_C$

i.e., $\tan\theta_A > \tan\theta_B > \tan\theta_C$

or $Y_A > Y_B > Y_C$

$\therefore$ A, B, and C graph are for steel, brass and rubber respectively.

34. From the given graph for a stress of 150×10^6 N m^{-2} the strain is 0.002.

$\therefore$ Young's modulus $Y = \dfrac{\text{Stress}}{\text{Strain}}$

$$Y = \frac{150 \times 10^6}{0.002}\,\text{N m}^{-2} = 7.5 \times 10^{10}\,\text{N m}^{-2}$$

35. Tension in both string shall be same which can be observed by making FBD of string in figure (1)

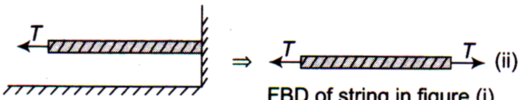


figure (i) FBD of string in figure (i)

36. Shearing strain $= \frac{\Delta x}{L}$

[CHEMISTRY]

21.

$$N_2O_4 \rightleftharpoons 2NO_2$$

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

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{[1.2\times10^{-2}]^2}{[4.8\times10^{-2}]} = \frac{1.2\times1.2\times10^{-4}}{4.8\times10^{-2}} = \mathbf{3\times10^{-3}\ mol\ L^{-1}}$$

22.

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g); \quad K_1 = 4\times10^{-4}$$

$$2NO(g) \rightleftharpoons N_2(g) + O_2(g); \quad K_2 = \frac{1}{K_1} = \frac{1}{4\times10^{-4}}$$

$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g); \quad K_c = (K_2)^{\frac{1}{2}} = \frac{1}{2\times10^{-2}} = \mathbf{50}$$

23.

$$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g); \quad K_c = 4.9\times10^{-2}$$

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g); \quad K = K_c^2 = (4.9\times10^{-2})^2$$

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g); \quad K' = \frac{1}{K} = \frac{1}{(4.9\times10^{-2})^2} = \frac{10000}{(4.9)^2} = \mathbf{416.5}$$

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)					

$$K_c = \frac{C_{HI}^2}{C_{H_2}\times C_{I_2}} = \frac{6\times6}{1\times2} = \mathbf{18}$$

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

30.

	X	$\rightleftharpoons$	$2Y$
At $t=0$	1 mole		–
At Eqm.	$1-\alpha$		2α

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

Total pressure $= P_1$

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

	Z	$\rightleftharpoons$	P	+	Q
At $t=0$	1 mole		–		–
At Eqm.	$1-\alpha$		α		α

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

Total pressure $= P_2$

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

From eqns. (i) and (ii)

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

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

From eqns. (iii) and (iv)

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

31.

$$\begin{array}{lcccc} & RCOOH + & R'OH & \rightleftharpoons RCOOR' + & H_2O \\ \text{At } t=0 & 100 \text{ moles} & 100 \text{ moles} & \text{Nil} & \text{Nil} \\ \text{At Eqm.} & 100-67 & 100-67 & 67 & 67 \end{array}$$

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

32.

$$\begin{array}{llll} & 2AB_2(g) & \rightleftharpoons 2AB(g) + & B_2(g) \\ \text{At } t=0 & 2 \text{ moles (let)} & — & — \\ \text{At Eqm.} & (2-2x) \text{ moles} & 2x \text{ moles} & x \text{ mole} \end{array}$$

(x is degree of dissociation)

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

Total pressure $= P$

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

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

33.

On adding the first two equations,

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

34.

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

35.

$$N_2 + 3H_2 \xrightleftharpoons{K_1} 2NH_3$$

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

$$N_2 + O_2 \xrightleftharpoons{K_2} 2NO; \; K_2$$

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

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

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

36.

$$k_f = 3k_b \quad \Rightarrow \quad K = \frac{k_f}{k_b} = \mathbf{3}$$

37.

$$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$

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

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

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

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

38.

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

39.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

	N_2	$3H_2$	$2NH_3$
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.

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