YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | Lecture -03

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Topics to be covered

1. Revision of Last Class
2. Dissociation constant of water, ionic product of water
3. Ph and its MIT
4. ★★★★★ Trick, Home work from modules

Rule to Attend Class

1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your home work along with DPP.
4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.

Rule to Attend Class

5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.
7. Don’t watch the videos in high speed if you want to understand better.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision of Last Class

lewis acid :-

Cations → H^+, Cl^+

Vacant d-orbital → PCl_5

Incomplete octet :- BF_3

$H_2C=O + OH^-$

lewis base
- → (-)vely → Cl^-, NaO^-, Br^- (OH^-)
- → neutral → $H_2\ddot{O}$, $:NH_3$

Ostwald Dilution Law

⇓

Weak electrolyte : $\alpha < 1$

$K_a = \frac{C\alpha^2}{1-\alpha}$ $\alpha > 0.05$ $\frac{K_a}{C} > 25\times10^{-4}$ $\ll$ $K_b = \frac{C\alpha^2}{1-\alpha}$

$\alpha <<< 1 \Rightarrow 1-\alpha \approx 1$

If $\alpha << 1 \Rightarrow 1-\alpha \approx 1$

$K_a = C\alpha^2$

$\alpha = \sqrt{\frac{K_a}{C}}$

$\alpha \leq 0.05$ or $\frac{K_a}{C} \leq 25\times10^{-4}$

$\Leftarrow$

$K_b = C\alpha^2$

$\alpha = \sqrt{\frac{K_b}{C}}$

Factors Affecting Degree of Dissociation (α)

There are Five type:

- **Nature of Solute:** ÷
- **Nature of Solvent** → D.C.↑ ∝ T
- **Temperature** → T↑ ∝ T.
- **Degree of Dilution** ÷ V↑C↓ ∝ T ∴ ions↑
- **Common ion Effect**

Common ion Effect

W.E. + S.E. → 1 ion Common

$[W.E.]_{initial} = [W.E.]_{eq.}$

$[Common\ ion]_{Total} \approx [Common\ ion]_{S.E.}$

*When a strong electrolyte is added to a solution of weak electrolyte having a common ion

Le Chatelier:

Ionic product of water (K_w)

$1H_2O \rightleftharpoons 1H^+ + 1OH^-$ or $2H_2O \rightleftharpoons 1H_3O^+ + 1OH^-$

$$K_c = \frac{[H^+]^1[OH^-]^1}{[H_2O]^1}$$

$$K_c[H_2O] = K_w = [H^+][OH^-]$$

or

$$K_w = [H_3O^+][OH^-]$$

MIT

① at 298 K $\Rightarrow K_w = 10^{-14}$ $\quad K_w = [H^+][OH^-]$

② $K_w \propto T$ ✓

③ $[H^+] = [OH^-]$

$K_w = 10^{-14} = [H^+]^2 = [OH^-]^2$

$[H^+] = [OH^-] = \sqrt{K_w} = \sqrt{10^{-14}} = 10^{-7}$ M at 25°C.

④ (i) acid added to water (acid soln)

$\therefore [H^+] \uparrow \quad [OH^-] \downarrow$

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

(ii) base added to water (basic soln)

$[OH^-] \uparrow \quad [H^+] \downarrow$

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

10^{-1} 0.1 $\quad 10^{-2}$ 0.01

10^{-13} ← 10^{-14} → 10^{-15}

18

QUESTION – (AIIMS 2018, 27 May)

The value of ionic product of water at 393 K is:

A. Less than 1×10^{-14}

B. Greater than 1×10^{-14}

C. Equal to 1×10^{-14}

D. Equal to 1×10^{-7}

QUESTION – (AIIMS 2002)

At 80°C, distilled water has (H_3O^+) concentration equal to 1×10^{-6} mol/litre. The value of K_w at this temperature will be

(A) 1×10^{-6}

(B) 1×10^{-12}

(C) 1×10^{-9}

(D) 1×10^{-15}

$[H^+] = [H_3O^+] = 10^{-6}\ M$

$[H^+] = [OH^-]$

$K_w = [H^+][OH^-]$

$= [H^+]^2 = (10^{-6})^2 = 10^{-12}\ M$

Dissociation Constt. of water :-

Water → $M = \frac{n_B}{V(L)}$

↓

$d = 1\ g/ml$

1 ml → mass of $H_2O = 1\ g$

$w_B = 1\ g$

$M_B(H_2O) = 18\ g$

$n_B = \frac{1}{18}$

$M = \frac{1 \times 1000}{18 \times 1} = 55.55\ M$

$1\ H_2O \rightleftharpoons 1\ H^+ + 1\ OH^-$

$C = 55.55\ M$ 0 0

$C - C\alpha$ $C\alpha$ $C\alpha$

$[H^+] = C\alpha$

$10^{-7} = 55.55\,\alpha$

$\alpha = \frac{10^{-7}}{55.55} = \frac{100 \times 10^{-9}}{55.55} = 1.8 \times 10^{-9}$

$$K_a(H_2O) = \frac{[H^+][OH^-]}{[H_2O]}$$

$$= \frac{10^{-7} \times 10^{-7}}{55.55}$$

$$= \frac{10^{-14}}{55.55} = \frac{10^{-14} \times 18}{1000} = \frac{18 \times 10^{-16}}{10} = 1.8 \times 10^{-16}$$

$$K_a = 1.8 \times 10^{-16}$$

K_a ↓ Dissociation Constt. of H_2O.

pH

pH → Potential or power of H^+

$$pH = -\log a_{H^+}$$

$$a_{H^+} = \gamma_{H^+}\,[H^+]$$

a_{H^+} : activity of H^+ ; γ_{H^+} : activity coefficient ; $[H^+]$: Conc.

Soln dilute ($[H^+] < 1M$) $\Rightarrow \gamma_{H^+} \approx 1$

$$a_{H^+} \approx [H^+]$$

$$pH = -\log [H^+]$$

MIT

① $pH = -\log[H^+]$ ($[H^+] < 1M$)

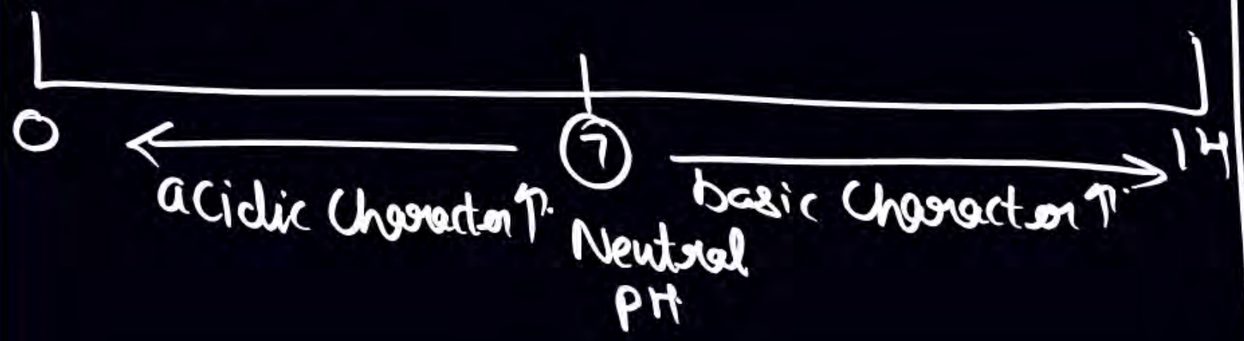
② pH scale value 0 to 14 at 298 K ⇒ 7 (Neutral pH)

0 to 13.6 at 310 K ⇒ 6.8 (37°C)

0 to 13 at 333 K ⇒ 6.5

0 to 15 at 273 K ⇒ 7.5

③ at 298 K



$pOH = -\log[OH^-]$

$pK_a = -\log K_a$

$pK_b = -\log K_b$

$pK_w = -\log K_w$

3 < 5

-3 > -5

④ T ↑ pH scale ↓

⑤ $pK_w = pH + pOH$

at 25°C

$14 = pH + pOH$

$pH = 14 - pOH$

$$K_w = [H^+][OH^-]$$

$$-\log K_w = -\log[H^+] - \log[OH^-]$$

$$pK_w = pH + pOH$$

at 25°C

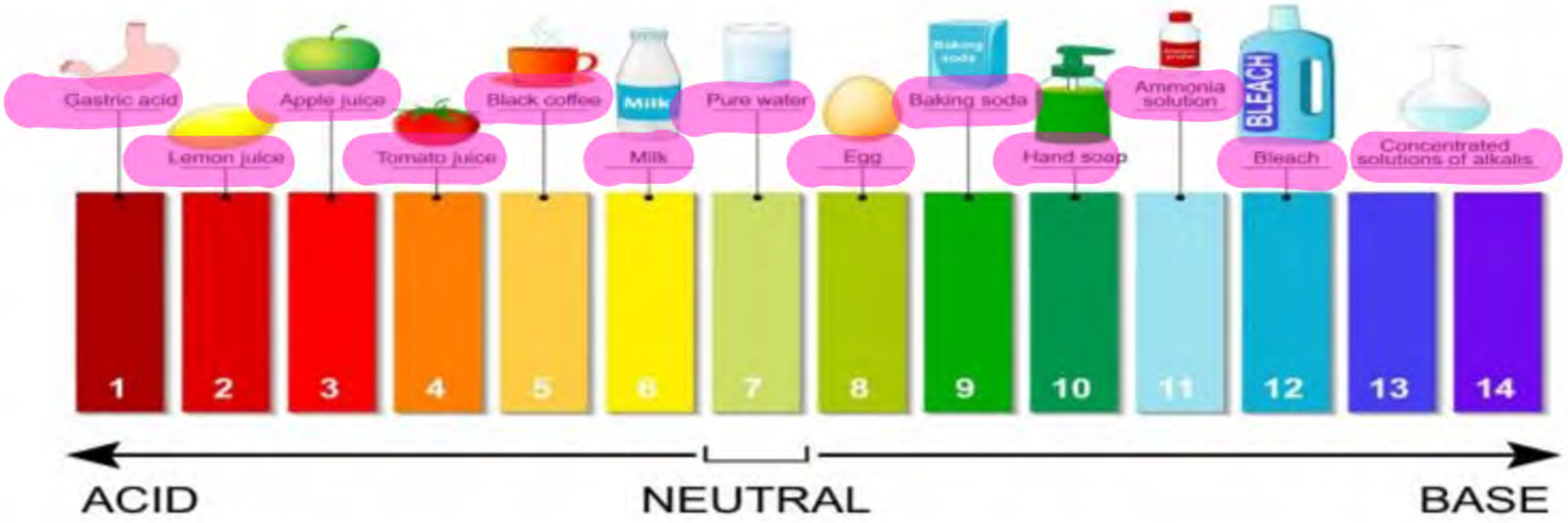
$$K_w = 10^{-14}$$

$$pK_w = -\log 10^{-14}$$

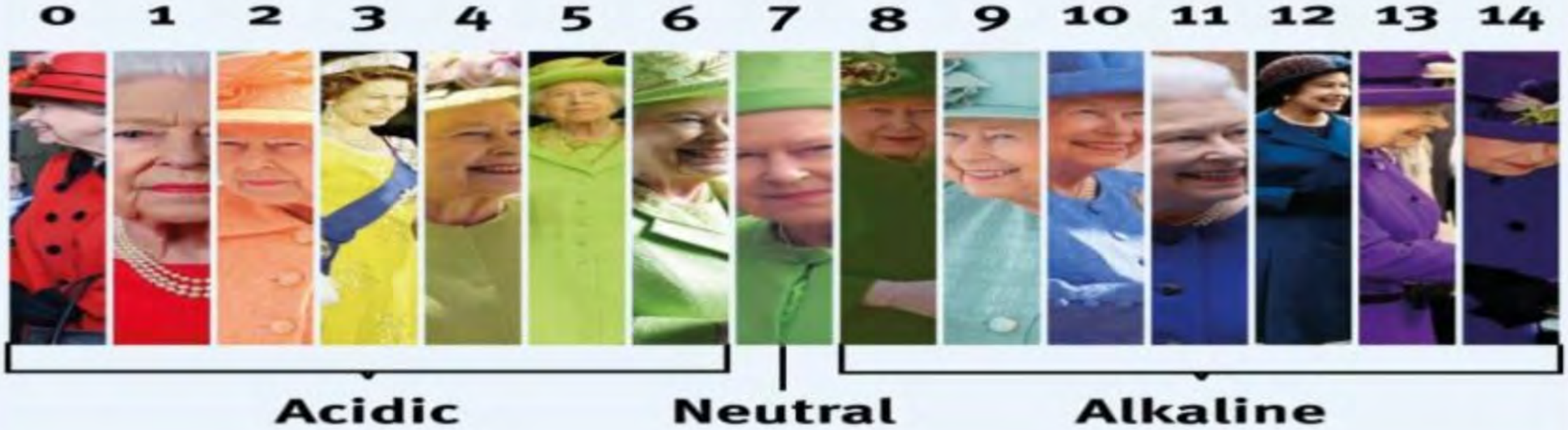
$$= -(-14)\log 10$$

$$= 14$$

The pH Scale


Gastric acid
Lemon juice
Apple juice
Tomato juice
Black coffee
Milk
Pure water
Egg
Baking soda
Hand soap
Ammonia solution
BLEACH
Bleach
Concentrated solutions of alkalis
1
2
3
4
5
6
7
8
9
10
11
12
13
14
ACID
NEUTRAL
BASE

Her Royal pH Scale



Log table ke #MIT

#MIT

① $\log_{10} 1 = 0$

$\log_{10} 2 = 0.3$

$\log_{10} 3 = 0.48$

$\log_{10} 4 = 0.6$

$\log_{10} 5 = 0.7$

$\log_{10} 6 = 0.78$

$\log_{10} 7 = 0.85$

$\log_{10} 8 = 0.9$

$\log_{10} 9 = 0.96$

$\log_{10} 10 = 1$

$\log_{10} 3.2 = 0.5$

① $\log m^n = n \log m$

$\log mn = \log m + \log n$

$\log \frac{m}{n} = \log m - \log n$

② $[H^+] = 10^{-x}$ M $\Rightarrow$ pH $= x$

$[H^+] = a \times 10^{-x}$ M $\Rightarrow$ pH $= x - \log a$

$\log 8 = \log 2^3$

$= 3 \times 0.3 = 0.9$

$\log 9 = \log 3^2$

$= 2 \times 0.48$

$= 0.96$

$[OH^-] = 10^{-y}$ M

pOH $= y$

$\log 25 = \log (5)^2 = 2 \log 5 = 2 \times 0.7 = 1.4$

$\log 12 = \log 3 \times 4 = \log 3 + \log 4 = 0.48 + 0.6 = 1.08$

$\log 13 \approx \log 12 \approx 1.08$

$[H^+] = 2 \times 10^{-3}\ M = a \times 10^{-x}$

$pH = -\log (2 \times 10^{-3})$

$= -[\log 2 + \log 10^{-3}]$

$= -[\log 2 - 3] = 3 - \log 2$

$[H^+] = 10^{-3}\ M$

$pH = -\log 10^{-3}$

$= -(-3) \log 10$

$= +3$

$K_a = 10^{-5}$

$pK_a = 5$

$K_b = 10^{-7}$

$pK_b = 7$

$K_w = 10^{-14}$

$pK_w = 14$

$[H^+] = 2 \times 10^{-3}$

$pH = 3 - \log 2$

$= 3 - 0.3 = 2.7$

0.3
0.48
0.78

$[H^+] = 36 \times 10^{-4}$

$pH = 4 - \log(6)^2$

$= 4 - 2 \times 0.78$

$= 2.44$

$K_{ba} = 10^{-14}$

$K_a = 2 \times 10^{-4}$

$K_a \uparrow$ ∴ acidic Character $\uparrow$ & $pK_a \downarrow$

$K_b \uparrow$ ∴ basic Character $\uparrow$ & $pK_b \downarrow$

$[H^+] = 3.2 \times 10^{-5}$

$pH = 5 - \log 3.2$

$= 5 - 0.5 = 4.5$

$\downarrow pK_b = -\log K_b \uparrow$

$0.9 + 0.6 - 1$

$1.5 - 1 = 0.5$

$3 < 5$

$-37 - 5$

$\log 32 \times 10^{-1} = 0.5$

$\log 32 + \log 10^{-1}$

$\log 8 \times 4 - 1$

$\log(2)^3 + \log 4 - 1$

pH of Strong Acid or Strong Base

$Sa(OH)_2$

$N = M \times n_f$

S.A.	S.B
① M acid	① M Base
② acid $+ H_2O \rightarrow H^+$ balance	② Base $+ H_2O \rightarrow OH^-$ Balance.
③ $[H^+]$ $pH = -\log[H^+]$	③ $[OH^-]$ $pOH = -\log[OH^-]$

$pH = 14 - pOH$ at $25^\circ C$

#MIT

QUESTION

Calculate pH of

		pH
A	10^{-2} N HCl	2
B	10^{-6} M HNO_3	6
C	10^{-1} M H_2SO_4	0.7
D	10^{-4} M $HClO_4$	4

(C) $1\ H_2SO_4 + H_2O \rightarrow 2\ H^+ + 1\ SO_4^{2-}$

10^{-1} M $\qquad\qquad 2 \times 10^{-1}$ M

$[H^+] = 2 \times 10^{-1}$ M

$pH = 1 - \log 2$

$= 1 - 0.3 = 0.7$

QUESTION

Find pH of 2×10^{-5} M HNO_3 solution.

$5 - \log 2 = 4.7$

#MIT

antilog x $= 10^{(x)}$ → jiske log ki value x hai wahin ans. hai

antilog $0.3 = 10^{0.3} = 2$

antilog $0.48 = 10^{0.48} = 3$

antilog $0.6 = 10^{0.6} = 4$

antilog $0.7 = 10^{0.7} = 5$

antilog $0.78 = 10^{0.78} = 6$

antilog $0.85 = 10^{0.85} = 7$

antilog $0.9 = 10^{0.9} = 8$

antilog $0.96 = 10^{0.96} = 9$

antilog $1 = 10^{1} = 10$

antilog $0.5 = 10^{0.5} = 3.2$

$pH = x \Rightarrow [H^+] = \text{antilog}\,-pH = 10^{-x}$

$pH = x - \log a \Rightarrow [H^+] = a \times 10^{-x}$

antilog $0.3 = 10^{0.3}$

QUESTION

Hydrogen ion concentration in mol/L in a solution of pH = 5.4 will be:

A 3.98×10^{-6}

B 3.68×10^{-6}

C 3.88×10^{6}

D 3.98×10^{8}

$pH = 5.4 \Rightarrow [H^+] = 10^{-5.4} = 10^{-5} \times 10^{-0.4}$

$= \frac{10^{-5}}{10^{0.4}} = \frac{10^{-5}}{2.5} = 4 \times 10^{-6}$

0.3 0.48

2 3

★ ★ ★ ★ ★ Trick

Square root of perfect sq. or imperfect square.

Sq. root	square
1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81
10	100

Last digit sq.	Sq. root
1	1 or 9
4	2 or 8
9	3 or 7
6	4 or 6
5	5
0	0

$\overline{6}\ \overline{55}\ \overline{36}$

① groups of 2 no. → starting from right

② divide 1st grp from left to nearest possible square

③ after every step add quotient + divisor to get new divisor

$$y + y = 2$$

④ Now new divisor can only be multiplied by suffix only.

$2x \times x$

$2w \times w$

$2a \times a$

Sq. root of 529 → Ans. 23

2	5 29	23
	4	
43	1 29	
	1 29	
	X	

41 × 1

42 × 2

43 × 3

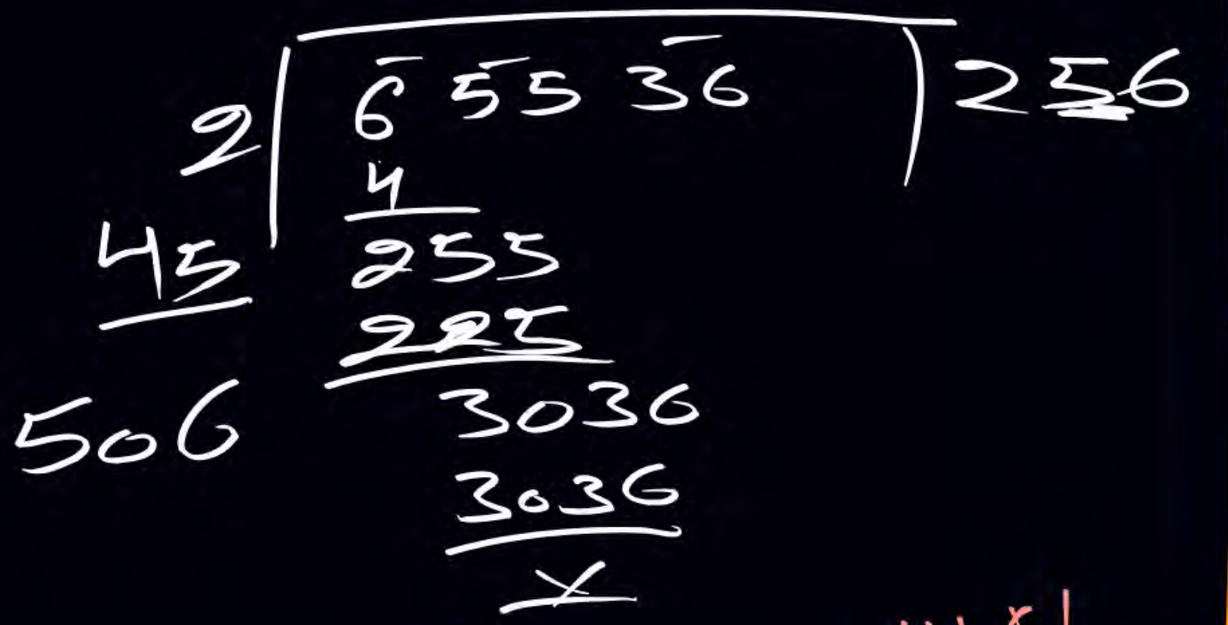
44 × 4

Sq. root of 3249 → Ans. 57

5	32 49	57
	25	
107	749	
	749	
	X	

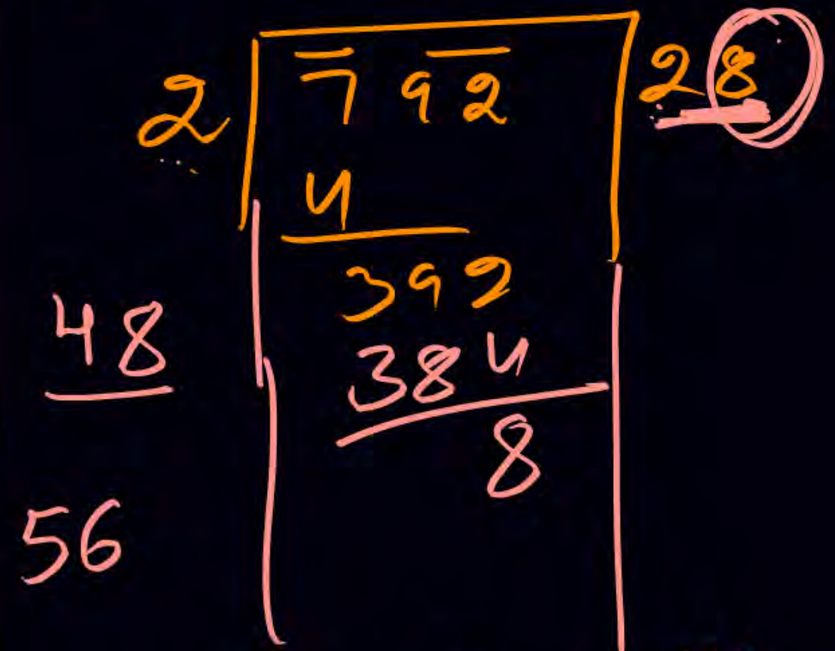
101 × 1

102 × 2



41 × 1
42 × 2
43 × 3
44 × 4

Sq. root of 792 → ans: 28.14



$\frac{8}{56} = 0.14$

$$
\begin{array}{r|l|l}
 & \overline{6\,5\,6} & 25 \\
9 & 4 & \\
\hline
45 & 256 & \\
 & 225 & \\
\hline
50 & 31 &
\end{array}
$$

ans 25.62

$$\frac{31}{50} = 0.62$$

THANK YOU