RATIONAL NUMBERS
(chapter 4)
Exercise 4.1

1) Write $\frac{-9}{2}$ as a rational number with:

i) denominator 10.

$$\frac{-9}{2} = \frac{-9 \times 5}{2 \times 5} = \frac{-45}{10}$$

ii) $\frac{-9}{2} = \frac{-9 \times 8}{2 \times 8} = \frac{-72}{16}$

iii) $\frac{-9}{2} = \frac{-9 \times 9}{2 \times 9} = \frac{81}{-18}$

iv) $\frac{-9}{2} = \frac{-9 \times 4}{2 \times 4} = \frac{-36}{8}$

2) Write $\frac{63}{-36}$ with

i) $\frac{63}{-36} = \frac{63 \div 9}{-36 \div 9} = \frac{7}{-4}$

ii) $\frac{63}{-36} = \frac{63 \div 3}{-36 \div 3} = \frac{21}{-12}$

iii) $\frac{63}{-36} = \frac{63 \div 3}{-36 \div 3} = \frac{21}{-12} = \frac{-21}{12}$

iv) $\frac{63}{-36} = \frac{63 \div 9}{-36 \div 9} = \frac{7}{-4} = \frac{-7}{4}$

3) Write three rational numbers equivalent to:

i) $\frac{4}{5}$

We can multiply the numerator and denominator by any integer to get equivalent rational numbers.

$$\frac{4}{5} = \frac{4 \times 2}{5 \times 2} = \frac{4 \times (-1)}{5 \times (-1)} = \frac{4 \times (-3)}{5 \times (-3)} = \frac{4 \times 3}{5 \times 3}$$

$$\frac{4}{5} = \frac{8}{10} = \frac{-4}{-5} = \frac{-12}{-15} = \frac{12}{15}$$

Thus, ~~four~~ three rational numbers equivalent to $\frac{4}{5}$ are $\frac{8}{10}, \frac{12}{15}, \frac{-4}{-5}$

ii) $\frac{3}{-7} = \frac{3 \times 2}{-7 \times 2} = \frac{3 \times (-3)}{-7 \times (-3)} = \frac{3 \times 4}{-7 \times 4} = \frac{3 \times 5}{-7 \times 5}$

$$\frac{3}{-7} = \frac{6}{-14} = \frac{-9}{21} = \frac{12}{-28} = \frac{15}{-35}$$

∴ thus, three rational numbers equivalent to $\frac{3}{-7}$ are $\frac{6}{-14}, \frac{-9}{21}, \frac{12}{-28}$

iii) $\frac{-5}{8} = \frac{-5 \times 2}{8 \times 2} = \frac{-5 \times (-2)}{8 \times (-2)} = \frac{-5 \times 3}{8 \times 3}$

$$\frac{-5}{8} = \frac{-10}{16} = \frac{10}{-16} = \frac{-15}{24}$$

Thus, three rational numbers equivalent to $\frac{-5}{8}$ are $\frac{-10}{16}, \frac{10}{-16}, \frac{-15}{24}$

(iv) $\dfrac{7}{6} = \dfrac{7 \times 2}{6 \times 2} = \dfrac{7 \times 3}{6 \times 3} = \dfrac{7 \times 4}{6 \times 4}$

$\dfrac{7}{6} = \dfrac{14}{12} = \dfrac{21}{18} = \dfrac{28}{24}$

Thus, three rational numbers equivalent to $\dfrac{7}{6}$ are $\dfrac{14}{12}, \dfrac{21}{18}, \dfrac{28}{24}$.

(v) $\dfrac{-11}{12} = \dfrac{-11 \times 2}{12 \times 2} = \dfrac{-11 \times 3}{12 \times 3} = \dfrac{-11 \times 4}{12 \times 4}$

$\dfrac{-11}{12} = \dfrac{-22}{24} = \dfrac{-33}{36} = \dfrac{-44}{48}$

thus, three rational numbers equivalent to $\dfrac{-11}{12}$ are $\dfrac{-22}{24}, \dfrac{-33}{36}, \dfrac{-44}{48}$.

(4) Fill in the blanks :

(i) $\dfrac{3}{7} = \dfrac{3 \times (-8)}{7 \times (-8)} = \dfrac{\boxed{-24}}{-56}$

(ii) $\dfrac{10}{21} = \dfrac{10 \times (-5)}{21 \times (-5)} = \dfrac{\boxed{-50}}{-105}$

(iii) $\dfrac{-5}{4} = \dfrac{-5 \times (-4)}{4 \times (-4)} = \dfrac{20}{\boxed{-16}}$.

(iv) $\dfrac{11}{-4} = \dfrac{11 \times (-13)}{-4 \times (-13)} = \dfrac{\boxed{-143}}{52}$.

(v) $\dfrac{-7}{8} = \dfrac{-7 \times -15}{8 \times -15} = \dfrac{105}{\boxed{-120}}$.

vi, $\frac{-4}{5} = \frac{-4 \times 3}{5 \times 3} = \frac{-12}{15} = \frac{36}{-45} = \frac{-70}{75}$

$\therefore \frac{-4}{5} = \boxed{-12}$

vi,

$\frac{-4}{5} = \frac{-4 \times 3}{5 \times 3} = \frac{-4 \times 3}{15} = \frac{-4 \times (-9)}{5 \times (-9)} = \frac{-4 \times 15}{5 \times 15}$

$\frac{-4}{5} = \frac{\boxed{-12}}{15} = \frac{-12}{\boxed{15}} = \frac{36}{\boxed{-45}} = \frac{\boxed{-60}}{75}$

⑤ Reduce to lowest terms (standard form):

i, $\frac{25}{-35} = \frac{25 \div 5}{(-35) \div 5} = \frac{5}{-7} = \frac{5 \times (-1)}{(-7) \times (-1)} = \frac{-5}{7}$

ii, $\frac{-28}{35} = \frac{(-28) \div 7}{35 \div 7} = \frac{-4}{5}$.

iii, $\frac{-52}{-24} = \frac{-52 \times (-1)}{-24 \times (-1)} = \frac{52}{24} = \frac{52 \div 4}{24 \div 4} = \frac{13}{6}$.

iv, $\frac{216}{-288} = \frac{216}{-288} \cdot \frac{54}{72} = \frac{54}{-72} \cdot \frac{27}{36} = \frac{27}{-36} \cdot \frac{3}{-4}$

$= \frac{3 \times (-1)}{-4 \times (-1)} = \frac{-3}{4}$

v, $\frac{-135}{-120} = \frac{-135 \times (-1)}{-120 \times (-1)} = \frac{135}{120} \cdot \frac{27}{24} = \frac{27}{24} \cdot \frac{9}{8} = \frac{9}{8}$

⑥ which of the two given rational numbers is greater?

i, $\frac{1}{-5}, \frac{-6}{7} \implies \frac{-1}{5} \gtrless \frac{-6}{7}$ (making denominator positive)

$-1 \times 7 = -7$ and $5 \times -6 = -30$

Because $-7 > -30$, ∴ we have $\frac{1}{-5} > \frac{-6}{7}$

ii) $\frac{3}{-4}$, $\frac{-5}{6}$ $\Rightarrow$ $\frac{-3}{4}$ ⤫ $\frac{-5}{6}$ (making denominator positive)

$-3 \times 6 = -18$ and $4 \times -5 = -20$

~~Bes~~ Because $-18 > -20$, ∴ we have $\frac{3}{-4} > \frac{-5}{6}$

iii) $\frac{-21}{5}$, $\frac{-32}{7}$ $\Rightarrow$ $\frac{-21}{5}$ ⤫ $\frac{-32}{7}$

$-21 \times 7 = -147$ and $5 \times (-32) = -160$

Because $-147 > -160$, ∴ we have $\frac{-21}{5} > \frac{-32}{7}$

iv) $\frac{7}{-8}$, $\frac{11}{-4}$ $\Rightarrow$ $\frac{-7}{8}$ ⤫ $\frac{-11}{4}$ (making denominator positive)

$-7 \times 4 = -28$ and $8 \times (-11) = -88$

Because $-28 > -88$, ∴ We have $\frac{7}{-8} > \frac{11}{-4}$

v) $\frac{-6}{11}$, $\frac{-9}{13}$ $\Rightarrow$ $\frac{-6}{11}$ ⤫ $\frac{-9}{13}$

$-6 \times 13 = -78$ and $11 \times (-9) = -99$

Because $-78 < -99$, we have $\frac{-6}{11} < \frac{-9}{13}$

Therefore $\frac{-9}{13} > \frac{-6}{11}$

vi) $\frac{-49}{2}$, $\frac{35}{-3}$ $\Rightarrow$ $\frac{-49}{2}$ ⤫ $\frac{-35}{3}$ (Making denominator positive)

$-49 \times 3 = -147$ and $2 \times (-35) = -70$

Because $-147 < -70$, we have $\dfrac{-49}{2} < \dfrac{35}{-3}$

Therefore $\dfrac{35}{-3} > \dfrac{-49}{2}$

VII) $\dfrac{16}{-7}$, $\dfrac{-12}{11}$ $\implies$ $\dfrac{-16}{7} \diagdown\!\!\!\!\diagup \dfrac{-12}{11}$ (Making denominator positive)

$-16 \times 11 = -176$ and $-12 \times 7 = -84$

Because $-176 < -84$, we have $\dfrac{16}{-7} < \dfrac{-12}{11}$

Therefor $\dfrac{-12}{11} > \dfrac{16}{-7}$

VIII) $\dfrac{9}{5}$, $\dfrac{-8}{-13}$ $\implies$ $\dfrac{2}{5} \diagdown\!\!\!\!\diagup \dfrac{-8 \times (-1)}{-13 \times (-1)}$

$\implies$ $\dfrac{9}{5} \diagdown\!\!\!\!\diagup \dfrac{8}{13}$

$2 \times 13 = 26$ and $5 \times 8 = 40$

Because $26 < 40$, we have $\dfrac{2}{5} < \dfrac{-8}{-13}$

$\therefore \dfrac{-8}{13} > \dfrac{2}{5}$.

7. Arrange in ascending order:

I, $\dfrac{2}{7}$, $\dfrac{-2}{5}$, $\dfrac{-3}{10}$.

Since $\dfrac{2}{7}$ is positive and other two numbers are negative, $\dfrac{2}{7}$ is the greatest of the three rational numbers.

Consider $\dfrac{-2}{5} \diagdown\!\!\!\!\diagup \dfrac{-3}{10}$

$-2 \times 10 = -20$ and $-3 \times 5 = -15$

Since $-20 < -15$, hence $\dfrac{-2}{5} < \dfrac{-3}{10}$.

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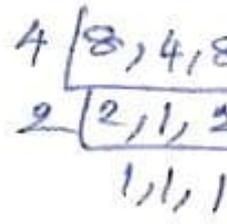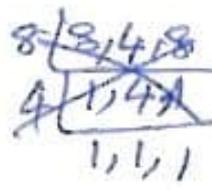
$$\Rightarrow \quad \frac{-30}{165} < \frac{88}{165} < \frac{132}{165}$$

$$\Rightarrow \quad \frac{-2}{11} < \frac{8}{15} < \frac{-4}{-5}$$

iv) $\dfrac{-5}{4}, \dfrac{-5}{8}, \dfrac{-5}{12}$

LCM of $4, 8, 12 = 24$

$$\begin{array}{c|c} 4 & 4, 8, 12 \\ \hline 2 & 1, 2, 3 \\ \hline 3 & 1, 1, 3 \\ \hline & 1, 1, 1 \end{array}$$

$$\frac{-5}{4} = \frac{-5 \times 6}{4 \times 6} = \frac{-30}{24}$$

$$\frac{-5}{8} = \frac{-5 \times 3}{8 \times 3} = \frac{-15}{24}$$

$$\frac{-5}{12} = \frac{-5 \times 2}{12 \times 2} = \frac{-10}{24}.$$

Since $\quad -30 < -15 < -10$

$$\Rightarrow \quad \frac{-30}{24} < \frac{-15}{24} < \frac{-10}{24}.$$

$$\Rightarrow \quad \frac{-5}{4} < \frac{-5}{8} < \frac{-5}{12}.$$

v) $\dfrac{-3}{7}, \dfrac{5}{-4}, \dfrac{11}{-14}$

Making the denominators positive
we get $\dfrac{-3}{7}, \dfrac{-5}{4}, \dfrac{-11}{14}$

LCM of $7, 4, 14 = 28$

$$\begin{array}{c|c} 7 & 7, 4, 14 \\ \hline 2 & 1, 4, 2 \\ \hline 2 & 1, 2, 4 \\ \hline & 1, 1, 1 \end{array}$$

$$\frac{-3}{7} = \frac{-3 \times 4}{7 \times 4} = \frac{-12}{28}$$

$$\frac{-5}{4} = \frac{-5 \times 7}{4 \times 7} = \frac{-35}{28}$$

$$\frac{-11}{14} = \frac{-11 \times 2}{14 \times 2} = \frac{-22}{28}$$

Since $-35 < -22 < -12$

$\Rightarrow \dfrac{-35}{28} < \dfrac{-22}{28} < \dfrac{-12}{28}$

$\Rightarrow \dfrac{-5}{4} < \dfrac{-11}{14} < \dfrac{-3}{7}$

vi) $\dfrac{3}{4}, \dfrac{-5}{6}, \dfrac{7}{8}$

LCM of $4, 6, 8 = 24$

$\dfrac{3}{4} = \dfrac{3 \times 6}{4 \times 6} = \dfrac{18}{24}$

$\dfrac{-5}{6} = \dfrac{-5 \times 4}{6 \times 4} = \dfrac{-20}{24}$

$\dfrac{7}{8} = \dfrac{7 \times 3}{8 \times 3} = \dfrac{21}{24}$

Since $-20 < 18 < 21$

$\Rightarrow \dfrac{-20}{24} < \dfrac{18}{24} < \dfrac{21}{24}$

$\Rightarrow \dfrac{-5}{6} < \dfrac{3}{4} < \dfrac{7}{8}$.

$$
\begin{array}{r|l}
2 & 4, 6, 8 \\ \hline
2 & 2, 3, 4 \\ \hline
2 & 1, 3, 2 \\ \hline
3 & 1, 3, 1 \\ \hline
& 1, 1, 1
\end{array}
$$

8) Arrange in descending order:

i) $\dfrac{2}{5}, \dfrac{11}{30}, \dfrac{71}{15}, \dfrac{31}{20}$.

LCM of $(5, 30, 15, 20) = 5 \times 2 \times 2 \times 3$
$\qquad\qquad\qquad\qquad\qquad = 60$

$\dfrac{2}{5} = \dfrac{2 \times 12}{5 \times 12} = \dfrac{24}{60}$

$\dfrac{11}{30} = \dfrac{11 \times 2}{30 \times 2} = \dfrac{22}{60}$

$$
\begin{array}{r|l}
5 & 5, 30, 15, 20 \\ \hline
2 & 1, 6, 3, 4 \\ \hline
2 & 1, 3, 3, 2 \\ \hline
3 & 1, 3, 3, 1 \\ \hline
& 1, 1, 1, 1
\end{array}
$$
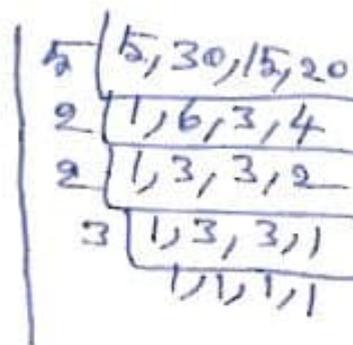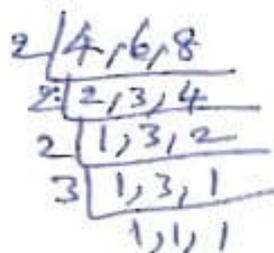
$$\frac{71}{15} = \frac{71 \times 4}{15 \times 4} = \frac{284}{60}$$

$$\frac{31}{20} = \frac{31 \times 3}{20 \times 3} = \frac{93}{60}$$

Since $284 > 93 > 24 > 22$

$$\Rightarrow \frac{284}{60} > \frac{93}{60} > \frac{24}{60} > \frac{22}{60}$$

$$\Rightarrow \frac{71}{15} > \frac{31}{20} > \frac{2}{5} > \frac{11}{30}.$$

(ii) $\frac{-5}{3}, \frac{-15}{4}, \frac{-2}{9}$

LCM of $(3, 4, 9) = 36$

$$\frac{-5}{3} = \frac{-5 \times 12}{3 \times 12} = \frac{-60}{36}$$

$$\frac{-15}{4} = \frac{-15 \times 9}{4 \times 9} = \frac{-135}{36},$$

$$\frac{-2}{9} = \frac{-2 \times 4}{9 \times 4} = \frac{-8}{36}.$$

```
3 | 3, 4, 9
3 | 1, 4, 3
4 | 1, 4, 1
    1, 1, 1
```

Since, $-8 > -60 > -135$

$$\Rightarrow \frac{-8}{36} > \frac{-60}{36} > \frac{-135}{60},$$

$$\Rightarrow \frac{-2}{9} > \frac{-5}{3} > \frac{-15}{4}$$

(iii) $\frac{65}{12}, \frac{-13}{4}, \frac{-19}{3}$

LCM of $(12, 4, 3) = 12$

$$\frac{65}{12} = \frac{65}{12}, \quad \frac{-13}{4} = \frac{-13 \times 3}{4 \times 3} = \frac{-39}{12}$$

$$\frac{-19}{3} = \frac{-19 \times 4}{3 \times 4} = \frac{-76}{12}$$

Since $65 > -39 > -76$

$$\implies \frac{65}{12} > \frac{-39}{12} > \frac{-76}{12}$$

$$\implies \frac{65}{12} > \frac{-13}{4} > \frac{-19}{3}.$$

iv) $\frac{-17}{10}, \frac{-19}{5}, \frac{-31}{20}$

LCM of $(10, 5, 20) = 20$

$\begin{array}{r|l} 5 & 10, 5, 20 \\ \hline 2 & 2, 1, 4 \\ \hline 2 & 1, 1, 2 \\ \hline & 1, 1, 1 \end{array}$

$$\frac{-17}{10} = \frac{-17 \times 2}{10 \times 2} = \frac{-34}{20}$$

$$\frac{-19}{5} = \frac{-19 \times 4}{5 \times 4} = \frac{-76}{20}$$

$$\frac{-31}{20} = \frac{-31}{20}$$

Since $-31 > -34 > -76$

$$\implies \frac{-31}{20} > \frac{-34}{20} > \frac{-76}{20}$$

$$\implies \frac{-31}{20} > \frac{-17}{10} > \frac{-19}{5}.$$

v) $\frac{-4}{15}, \frac{-7}{5}, \frac{23}{20}$

LCM of $(15, 5, 20) = 60$

$\begin{array}{r|l} 5 & 15, 5, 20 \\ \hline 3 & 3, 1, 4 \\ \hline 4 & 1, 1, 4 \\ \hline & 1, 1, 1 \end{array}$

$$\frac{-4}{15} = \frac{-4 \times 4}{15 \times 4} = \frac{-16}{60}$$

$$\frac{-7}{5} = \frac{-7 \times 12}{5 \times 12} = \frac{-84}{60}$$

$$\frac{23}{20} = \frac{23 \times 3}{20 \times 3} = \frac{69}{60}$$

Since $69 > -16 > -84$

$$\Rightarrow \frac{69}{60} > \frac{-16}{60} > \frac{-84}{60}$$

$$\Rightarrow \frac{23}{20} > \frac{-4}{15} > \frac{-7}{5}$$

vi) $\quad \frac{15}{-7}, \frac{-11}{4}, \frac{-5}{2}$

Making the denominators positive,

We get $\quad \frac{-15}{7}, \frac{-11}{4}, \frac{-5}{2}$

LCM of $(7, 4, 2) = 28$

$$\frac{-15}{7} = \frac{-15 \times 4}{7 \times 4} = \frac{-60}{28}$$

$$\frac{-11}{4} = \frac{-11 \times 7}{4 \times 7} = \frac{-77}{28}$$

$$\frac{-5}{2} = \frac{-5 \times 14}{2 \times 14} = \frac{-70}{28}$$

Since $-60 > -70 > -77$

$$\Rightarrow \frac{-60}{28} > \frac{-70}{28} > \frac{-77}{28}$$

$$\Rightarrow \frac{-15}{7} > \frac{-5}{2} > \frac{-11}{4}.$$

$$\begin{array}{r|lll} 2 & 7, 4, 2 \\ 2 & 7, 2, 1 \\ 7 & 7, 1, 1 \\ & 1, 1, 1 \end{array}$$

Hallelujah

9) Represent each oth of the following
on a Separate number line.

1) $-\dfrac{3}{2} = -\left(\dfrac{3}{2}\right) = -\left(1+\dfrac{1}{2}\right) = -1-\dfrac{1}{2}$

$-\dfrac{3}{2}$ is negative number. ∴ it is on the left side of zero on the number line. denominator 2. ∴ we divide each unit into two equal parts.

$-\dfrac{3}{2}$
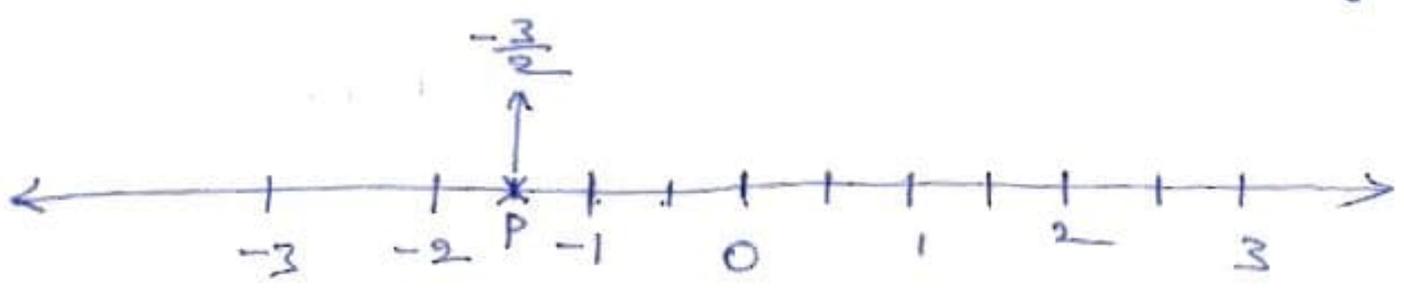
P represents $-\dfrac{3}{2}$ on numberline. it is between -1 and -2.

ii) $-\dfrac{4}{5}$.

it is a negative number. ∴ it is on the left side of zero. we divide each unit into 5 equal parts. we count 4 parts on the left side of from zero. 4ᵗʰ part represent $-\dfrac{4}{5}$

$-\dfrac{4}{5}$
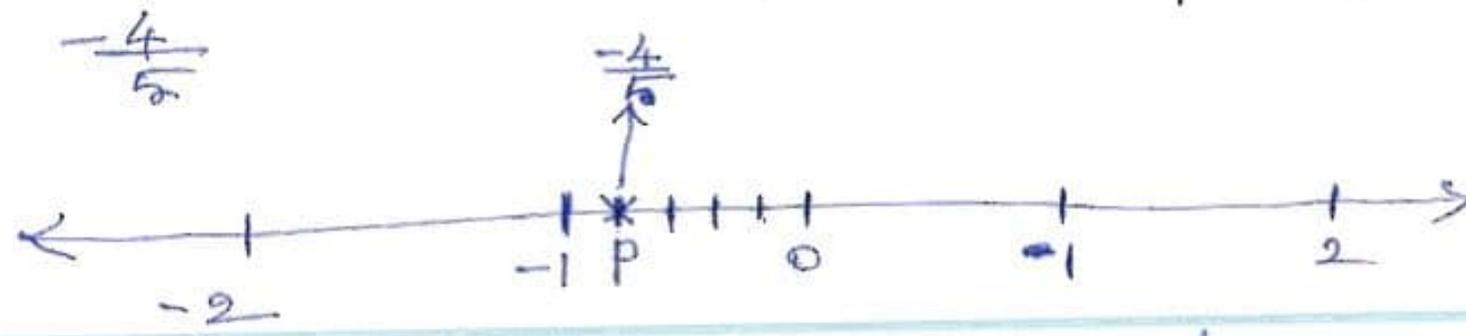
p represents $-\dfrac{4}{5}$ on number line. it

(iii, $\frac{3}{8}$

it is a positive number. ∴ it is on the right side of zero. we divide each unit into 8 equal parts. we count 3 parts on the right side of origin.

$$\frac{3}{8}$$

↑

←————+————————+—————————++++*++++++————————+——→
  −2   −1   0   P   1   2
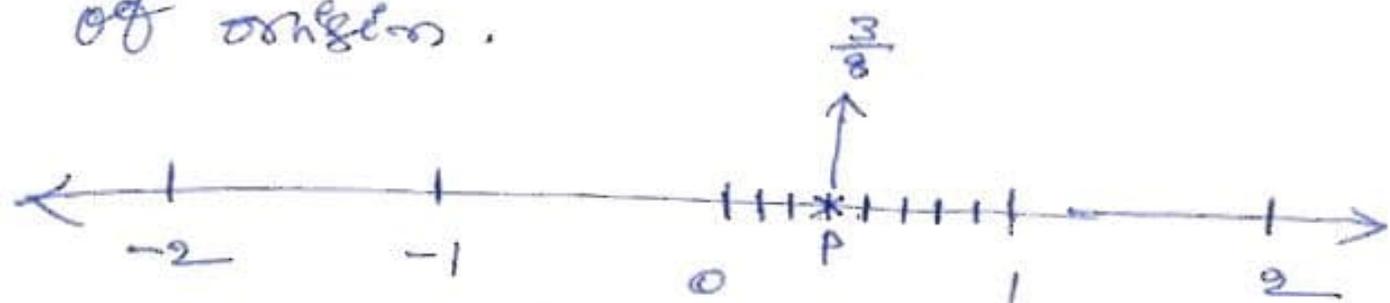
P represents the point $\frac{3}{8}$ on the number line. it is between 0 and 1

iv, $\frac{2}{7}$.

it is a positive number. ∴ it is on the right side of zero. we divide each unit into 7 equal parts. we count 2 parts on the right side of zero.

$$\frac{2}{7}$$

↑

←————+————————+—————————++*+++++++————————+——→
  −2   −1   0 P   1   2
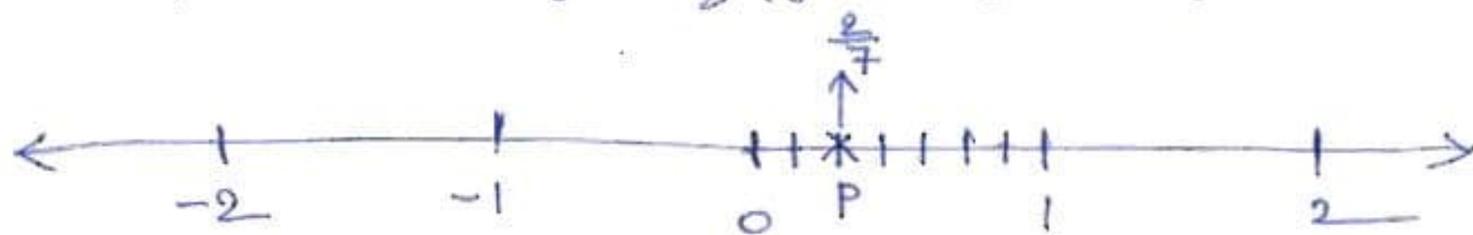
P represents $\frac{2}{7}$ on the number line. it is between 0 and 1

(iv) $\frac{7}{4} = 1\frac{3}{4} = 1 + \frac{3}{4}$

$\frac{7}{4} > 1$ and < 2 ∴ it is between
1 and 2. We divide each unit into
4 equal parts. We count 3 parts on
the right side of 1.
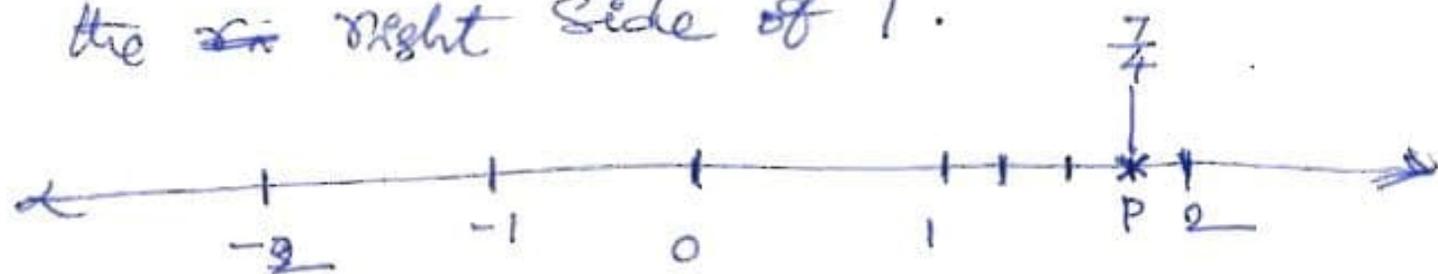
P represent $\frac{7}{4}$ on the number line.
it is between 1 and 2.

10, i, $\frac{3}{11}$ ☐ $\frac{-4}{15}$

$\frac{3}{11}$ is a positive number.

$\frac{-4}{15}$ is negative number.

∴ $\frac{3}{11} > \frac{-4}{15}$.

ii, $\frac{-11}{15}$ ☐ $\frac{23}{39}$

$\frac{-11}{15}$ is a ~~positive~~ negative number

$\frac{23}{39}$ is a positive number.

∴ $\frac{-11}{15} < \frac{23}{39}$

iii)

$$\frac{-14}{5} \ \Box \ \frac{-13}{6}$$

$-14 \times 6 = -84 \quad$ and $\quad -13 \times 5 = -65$

$$-84 < -65$$

$$\therefore \quad -\frac{14}{5} < \frac{-13}{6}.$$

iv)

$$\frac{22}{7} \ \Box \ \frac{39}{5}$$

$22 \times 5 = 110 \quad$ and $\quad 39 \times 7 = 273$

$$110 < 273$$

$$\therefore \quad \frac{22}{7} < \frac{39}{5}$$

v)

$$\frac{19}{16} \ \Box \ \frac{76}{64}$$

$$\cancel{19 \times 64} = \frac{76}{64} = \frac{\cancel{76}^{38}{}^{19}}{\cancel{64}_{32}{}_{16}} = \frac{19}{16}$$

$$\therefore \quad \frac{19}{16} \ \Box \ \frac{76}{64} \implies \frac{19}{16} \ \Box \ \frac{19}{16}$$

$$\implies \frac{19}{16} = \frac{19}{16}.$$

vi)

$$\frac{-21}{-35} \ \Box \ \frac{-15}{-25}$$

$$\left.\begin{array}{l} -21 \times -25 = 525 \\ -15 \times -35 = 525 \end{array}\right\} \implies 525 = 525$$

$$\therefore \quad \frac{-21}{-35} = \frac{-15}{-25}$$

Working

$$\begin{array}{r} 21 \times 25 \\ \hline 105 \\ 42 \\ \hline 525 \end{array}$$

$$\begin{array}{r} 15 \times 35 \\ \hline 75 \\ 45 \\ \hline 525 \end{array}$$

(vii) $\dfrac{16}{36} \,\Box\, \dfrac{20}{45}$

$16 \times 45 = 720$
$20 \times 36 = 720$ $\Big] \therefore 720 = 720$

$$\dfrac{16 \times 45}{}$$
$$\dfrac{80}{6\,4}$$
$$\overline{720}.$$

$$\dfrac{20 \times 36}{120}$$
$$\dfrac{60}{720}$$

$\therefore \dfrac{16}{36} = \dfrac{20}{45}$.

(viii) $\dfrac{-33}{61} \,\Box\, \dfrac{9}{-2}$

$-33 \times -2 = 66$
$9 \times 61 \neq 549$
$66 \lessgtr 549$

$$\dfrac{9 \times 61}{540}$$
$$\overline{549}.$$

$\therefore \dfrac{-33}{61} < \dfrac{9}{-2}$

$\Rightarrow \dfrac{-33}{61} \,\Box\, \dfrac{-9}{2}$ (making the denominator positive)

$-33 \times 2 = -66$
$-9 \times 61 = -549$
$-66 > -549$

$\therefore \dfrac{-33}{61} > \dfrac{-9}{2} \Rightarrow \dfrac{-33}{61} > \dfrac{9}{-2}$

(11) Find 4 rational numbers between each of the following:

(i) $-9, -8$.

$-9 = \dfrac{-9 \times 10}{1 \times 10} = \dfrac{-90}{10}$

$$-8 = \frac{-8 \times 10}{1 \times 10} = \frac{-80}{10}.$$

(you ~~cot~~ could make any other common denominat~~

$$-9 < -8$$

$$\therefore \quad \frac{-90}{10} < \frac{-80}{10}$$

∴ 4 numbers between −9 and −8

are $\quad -\frac{89}{10}, \; -\frac{88}{10}, \; -\frac{87}{10}, \; -\frac{86}{10}$

(ii)

$$-\frac{2}{3}, \quad \frac{-11}{6}$$

$$\frac{-2}{3} = \frac{-2 \times 6}{3 \times 6} = \frac{-12}{18}$$

$$\frac{-11}{6} = \frac{-11 \times 3}{6 \times 3} = \frac{-33}{18}$$

(you could make any other common denominator).

$$\frac{-12}{18} > \frac{-33}{18} \implies \frac{-2}{3} > \frac{-11}{6}$$

∴ 4 numbers between $-\frac{2}{3}$ and $\frac{-11}{6}$
are $\quad \frac{-13}{18}, \; \frac{-14}{18}, \; \frac{-15}{18}, \; \frac{-16}{18}.$

(iii) $\quad \frac{-4}{5}, \; \frac{3}{7}$

$$\frac{-4}{5} = \frac{-4 \times 7}{5 \times 7} = \frac{-28}{35}$$

$$\frac{3}{7} = \frac{3 \times 5}{7 \times 5} = \frac{15}{35}$$

(you could make any other ~~If~~ comm
    denominator).

$$\frac{3}{7} > \frac{-4}{5}$$

$$\therefore \frac{15}{35} > ~~\frac{25}{}~~ \frac{-28}{35}$$

$\therefore$ 4 numbers between $\frac{3}{7}$ and $\frac{-4}{5}$
are
$$\frac{-27}{35}, \frac{-26}{35}, \frac{-25}{35}, \frac{-24}{35}$$

(iv) $\frac{2}{9}$, $\frac{3}{4}$

$$\frac{2}{9} = \frac{2 \times 4}{9 \times 4} = \frac{8}{36}$$

$$\frac{3}{4} = \frac{3 \times 9}{4 \times 9} = \frac{27}{36}.$$

(you ~~co~~ could make any other comm
    denominator)

$$\frac{8}{36} < \frac{27}{36} \implies \frac{2}{9} < \frac{3}{4}$$

$\therefore$ 4 numbers between $\frac{2}{9}$ and $\frac{3}{4}$
are. $\frac{9}{36}, \frac{10}{36}, \frac{11}{36}, \frac{12}{36}.$

(v) $-10, -8$

$$-10 = \frac{-10 \times 5}{1 \times 5} = \frac{-50}{5}$$

$$-8 = \frac{-8 \times 5}{1 \times 5} = -\frac{40}{5}$$

(you could make any other common ~~dem~~ denominator).

$$-10 < -8 \implies -\frac{50}{5} < \frac{-40}{5}$$

∴ ~~the~~ 4 numbers between -10 and -8 are.

$$-\frac{41}{5}, -\frac{42}{5}, -\frac{43}{5}, -\frac{44}{5}$$

(vi) $-1, 0$

$$-1 = \frac{-1 \times 5}{1 \times 5} = \frac{-5}{5}$$

$$0 = \frac{0}{5} \quad (\text{you could make any other common denominate}$$

~~any~~ ~~of~~ $-1 < 0 \implies \frac{-5}{5} < \frac{0}{5}$

~~the~~ 4 numbers ~~to~~ between -1 and ~~$\neq$~~ 0

are $\quad \frac{-4}{5}, \frac{-3}{5}, ~~\emptyset~~ \frac{-2}{5}, \frac{-1}{5}$

(vii) $0, 1$

$$0 = \frac{0 \times 5}{1 \times 5} = \frac{0}{5} \quad (\text{you could make any}$$

$$1 = \frac{1 \times 5}{1 \times 5} = \frac{5}{5} \quad \text{other com denominat}$$

~~0~~ ~~$\leq$~~ ~~$\not$~~ $0 < 1 \implies \frac{0}{5} < \frac{5}{5}$

~~any~~ 4 numbers between 0 and 1 are $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \frac{4}{5}$

viii) $\dfrac{-17}{4}, \dfrac{-19}{4}$

$$\dfrac{-17}{4} = \dfrac{-17 \times 10}{4 \times 10} = \dfrac{-170}{40}.$$

$$\dfrac{-19}{4} = \dfrac{-19 \times 10}{4 \times 10} = \dfrac{-190}{40}.$$

(you could make any other common denominator).

$$\dfrac{-17}{4} > \dfrac{-19}{4} \Rightarrow \dfrac{-170}{40} > \dfrac{-190}{40}.$$

∴ 4 numbers between $\dfrac{-17}{4}$ and $\dfrac{-19}{4}$

$$\dfrac{-171}{40}, \dfrac{-172}{40}, \dfrac{-173}{40}, \dfrac{-174}{40}.$$

ix) $\dfrac{2}{3}, \dfrac{3}{2}$

$$\dfrac{2}{3} = \dfrac{2 \times 2}{3 \times 2} = \dfrac{4}{6}$$

$$\dfrac{3}{2} = \dfrac{3 \times 3}{2 \times 3} = \dfrac{9}{6}$$

(You ~~could~~ could make any other common denominator)

$$\dfrac{4}{6} < \dfrac{9}{6} \Rightarrow \dfrac{2}{3} < \dfrac{3}{2}$$

∴ 4 numbers between $\dfrac{2}{3}$ and $\dfrac{3}{2}$ are

$$\dfrac{5}{6}, \dfrac{6}{6}, \dfrac{7}{6}, \dfrac{8}{6}$$

(x) $\dfrac{7}{-6}$, $\dfrac{-3}{5}$ ⇒ $\dfrac{-7}{6}$, $\dfrac{-3}{5}$ (making denominators positive).

$\dfrac{-7}{6} = \dfrac{-7 \times 5}{6 \times 5} = \dfrac{-35}{30}$ (you could make any other common denominator)

$\dfrac{-3}{5} = \dfrac{-3 \times 6}{5 \times 6} = \dfrac{-18}{30}$

$\dfrac{-35}{30} < \dfrac{-18}{30} \Rightarrow \dfrac{-7}{6} < \dfrac{-3}{5}$

∴ 4 numbers between $\dfrac{-7}{6}$ and $\dfrac{-3}{5}$ are

$\dfrac{-34}{30}$, $\dfrac{-33}{30}$, $\dfrac{-32}{30}$, $\dfrac{-31}{30}$

12
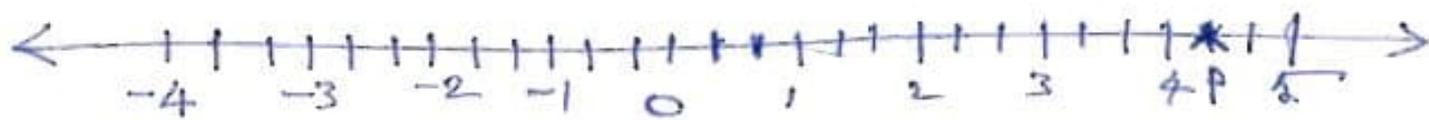
on the number line P is between 4 and 5. Here every unit is divided into 3 equal parts. ∴ each part = $\dfrac{1}{3}$

∴ P is after 1 part from 4.

∴ P represents $4\dfrac{1}{3}$ on number line. i.e $\dfrac{13}{3}$.

EXERCISE - 4.2

1) Find the sum of :

i) $\dfrac{-11}{12}$ and $\dfrac{1}{12}$

$$\dfrac{-11}{12} + \dfrac{1}{12} = \dfrac{-11+1}{12} = \dfrac{-10}{12}$$

$$= \dfrac{-10}{12}\,^5_6 = \dfrac{-5}{6}.$$

ii) $-\dfrac{5}{8}$ and $\dfrac{-7}{8}$

$$\dfrac{-5}{8} + \dfrac{-7}{8} = \dfrac{-5+(-7)}{8}$$

$$= \dfrac{-5-7}{8} = \dfrac{-12}{8}$$

$$= \dfrac{-12}{8}\,^3_2 = \dfrac{-3}{2}$$

iii) $\dfrac{3}{-7}$ and $\dfrac{-10}{7}$

$$\dfrac{3}{-7} + \dfrac{-10}{7} = \dfrac{-3}{7} + \dfrac{-10}{7}$$

$$= \dfrac{-3+(-10)}{7}$$

$$= \dfrac{-3-10}{7} = \dfrac{-13}{7}$$

iv) $\dfrac{17}{-21} + \dfrac{-5}{21} = \dfrac{-17}{21} + \dfrac{-5}{21}$

$$= \dfrac{-17+(-5)}{21} = \dfrac{-17-5}{21}$$

$$= \dfrac{-22}{21}$$

2. Simplify:

i) $\dfrac{-4}{27} + \dfrac{5}{9}$

LCM of 27 and $9 = 9 \times 3$

$\qquad\qquad\qquad = 27$

$\dfrac{5}{9} = \dfrac{5 \times 3}{9 \times 3} = \dfrac{15}{27}$

$\therefore\ \dfrac{-4}{27} + \dfrac{5}{9} = \dfrac{-4}{27} + \dfrac{15}{27}$

$\qquad\qquad\qquad = \dfrac{-4+15}{27}$

$\qquad\qquad\qquad = \dfrac{11}{27}$

$\begin{array}{r|l} 9 & 27,9 \\ \hline 3 & 3,1 \\ \hline & 1,1 \end{array}$

ii) $4 + \dfrac{-2}{7} = \dfrac{4 \times 7}{1 \times 7} + \dfrac{-2}{7}$

$\qquad\qquad = \dfrac{28}{7} + \dfrac{-2}{7}$

$\qquad\qquad = \dfrac{28-2}{7} = \dfrac{26}{7}$

iii) $\dfrac{5}{4} + \dfrac{-9}{14} = \dfrac{5 \times 7}{4 \times 7} + \dfrac{-9 \times 2}{14 \times 2}$

$\qquad\qquad = \dfrac{35}{28} + \dfrac{-18}{28}$

$\qquad\qquad = \dfrac{35 + (-18)}{28}$

$\qquad\qquad = \dfrac{35-18}{28} = \dfrac{17}{28}$

$\begin{array}{l} 2\,(4,14 \\ \quad 2,7 \\ LCM = 2 \times 2 \\ \qquad = 28 \end{array}$

iv) $\dfrac{-7}{16} + \dfrac{-11}{12} = \dfrac{(-21)+(-44)}{48}$

$\qquad\qquad = \dfrac{-65}{48}$

$\begin{array}{r|l} 4 & 16,12 \\ \hline & 4,3 \\ LCM = 4 \times 4 \times \\ \qquad = 48 \end{array}$

v) $\dfrac{5}{12} + \dfrac{-2}{15} = \dfrac{25 + (-8)}{60}$

$\qquad\qquad = \dfrac{25 - 8}{60}$

$\qquad\qquad = \dfrac{17}{60}$

$3\,\underline{|\,12, 15\,}$
$\quad\ \ 4, 5$
LCM $= 3 \times 4 \times 5$
$\qquad\quad = 60$

vi) $\dfrac{15}{8} + \dfrac{-11}{15} = \dfrac{225 + (-88)}{120}$

$\qquad\qquad = \dfrac{137}{120}$

$1\,\underline{|\,8, 15\,}$
$\quad\ \ 8, 15$
LCM $= 8 \times 15$
$\qquad\quad = 120$

vii) $\dfrac{3}{11} + \dfrac{-5}{12} = \dfrac{36 + (-55)}{132}$

$\qquad\qquad = -\dfrac{19}{132}$

LCM $= 11 \times 12$
$\qquad\quad = 132$

viii) $\dfrac{-7}{13} + \dfrac{6}{5} = \dfrac{(-35) + 78}{65}$ $\qquad$ (LCM $= 65$)

$\qquad\qquad\quad = \dfrac{43}{65}$

3 Evaluate :

i) $\dfrac{-1}{3} + \dfrac{3}{4} + \dfrac{-7}{2} = \dfrac{(-4) + 9 + (-42)}{12}$

$\qquad\qquad\qquad = -\dfrac{37}{12}$

$2\,\underline{|\,3, 4, 2\,}$
$2\,\underline{|\,3, 2, 1\,}$
$3\,\underline{|\,3, 1, 1\,}$
$\quad\ \ 1, 1, 1$
LCM $= 2 \times 2 \times 3$
$\qquad\quad = 12$