

Railway Engineering Mathematics

Tutorial Sheet 1

Solutions

1. BIDMAS and order of operations

Evaluate the following:

(a) $2 \times 5 + 7$

(f) $5 + 2^2 \times 3$

(b) $2 \times (5 + 7)$

(g) $5 \times 2 - 4 \div 2$

(c) $24 - 6 \div 2$

(h) $(3 + 2)^2$

(d) $3 + 4 \times (7 + 1)$

(i) $(5 + 4)^2 \times 4 \div 2$

(e) $(3 + 4) \times 7 + 1$

(j) $4 \times 2^2 - 12 \div 4$

Solution:

(a) $2 \times 5 + 7 = 10 + 7 = 17$

(b) $2 \times (5 + 7) = 2 \times 12 = 24$

(c) $24 - 6 \div 2 = 24 - 3 = 21$

(d) $3 + 4 \times (7 + 1) = 3 + 4 \times 8 = 3 + 32 = 35$

(e) $(3 + 4) \times 7 + 1 = 7 \times 7 + 1 = 49 + 1 = 50$

(f) $5 + 2^2 \times 3 = 5 + 4 \times 3 = 5 + 12 = 17$

(g) $5 \times 2 - 4 \div 2 = 10 - 2 = 8$

(h) $(3 + 2)^2 = 5^2 = 25$

(i) $(5 + 4)^2 \times 4 \div 2 = 9^2 \times 4 \div 2 = 81 \times 4 \div 2 = 81 \times 2 = 162$

(j) $4 \times 2^2 - 12 \div 4 = 4 \times 4 - 12 \div 4 = 4 \times 4 - 3 = 16 - 3 = 13$

2. Adding and subtracting fractions

Evaluate the following:

$$(a) \quad \frac{1}{2} + \frac{1}{5}$$

$$(e) \quad 2\frac{3}{5} - \frac{4}{3}$$

$$(b) \quad \frac{2}{3} + \frac{5}{9}$$

$$(f) \quad 3\frac{2}{3} - 1\frac{1}{4}$$

$$(c) \quad \frac{2}{7} + \frac{3}{4}$$

$$(g) \quad 1\frac{1}{2} - \frac{7}{10}$$

$$(d) \quad \frac{1}{2} + \frac{1}{3} + \frac{1}{4}$$

$$(h) \quad 4\frac{1}{4} - \frac{2}{5} - \frac{1}{8}$$

Solution:

In each case, we first obtain a common denominator.

$$(a) \quad \frac{1}{2} + \frac{1}{5} = \frac{1 \times 5}{2 \times 5} + \frac{1 \times 2}{5 \times 2} = \frac{5}{10} + \frac{2}{10} = \frac{7}{10}$$

$$(b) \quad \frac{2}{3} + \frac{5}{9} = \frac{2 \times 3}{3 \times 3} + \frac{5}{9} = \frac{6}{9} + \frac{5}{9} = \frac{11}{9}$$

$$(c) \quad \frac{2}{7} + \frac{3}{4} = \frac{2 \times 4}{7 \times 4} + \frac{3 \times 7}{4 \times 7} = \frac{8}{28} + \frac{21}{28} = \frac{29}{28}$$

$$\begin{aligned} (d) \quad \frac{1}{2} + \frac{1}{3} + \frac{1}{4} &= \frac{1 \times 6}{2 \times 6} + \frac{1 \times 4}{3 \times 4} + \frac{1 \times 3}{4 \times 3} \\ &= \frac{6}{12} + \frac{4}{12} + \frac{3}{12} \\ &= \frac{13}{12} \end{aligned}$$

$$\begin{aligned}
 \text{(e)} \quad 2\frac{3}{5} - \frac{4}{3} &= \frac{13}{5} - \frac{4}{3} \\
 &= \frac{13 \times 3}{5 \times 3} - \frac{4 \times 5}{3 \times 5} \\
 &= \frac{39}{15} - \frac{20}{15} \\
 &= \frac{19}{15}
 \end{aligned}$$

$$\begin{aligned}
 \text{(f)} \quad 3\frac{2}{3} - 1\frac{1}{4} &= \frac{11}{3} - \frac{5}{4} \\
 &= \frac{11 \times 4}{3 \times 4} - \frac{5 \times 3}{4 \times 3} \\
 &= \frac{44}{12} - \frac{15}{12} \\
 &= \frac{29}{12}
 \end{aligned}$$

$$\begin{aligned}
 \text{(g)} \quad 1\frac{1}{2} - \frac{7}{10} &= \frac{3}{2} - \frac{7}{10} \\
 &= \frac{3 \times 5}{2 \times 5} - \frac{7}{10} \\
 &= \frac{15}{10} - \frac{7}{10} \\
 &= \frac{8}{10} = \frac{4}{5}
 \end{aligned}$$

$$\begin{aligned}
 \text{(h)} \quad 4\frac{1}{4} - \frac{2}{5} - \frac{1}{8} &= \frac{17}{4} - \frac{2}{5} - \frac{1}{8} \\
 &= \frac{17 \times 10}{4 \times 10} - \frac{2 \times 8}{5 \times 8} - \frac{1 \times 5}{8 \times 5} \\
 &= \frac{170}{40} - \frac{16}{40} - \frac{5}{40} \\
 &= \frac{149}{40}
 \end{aligned}$$

3. Multiplying fractions

Evaluate the following:

$$(a) \quad \frac{3}{5} \times \frac{2}{7}$$

$$(b) \quad \frac{1}{8} \times \frac{5}{6}$$

$$(c) \quad 6 \times \frac{2}{5}$$

$$(d) \quad 2 \times \frac{5}{9}$$

$$(e) \quad 4 \times \frac{3}{10}$$

$$(f) \quad \frac{3}{4} \times \frac{7}{11}$$

$$(g) \quad \frac{3}{5} \times \frac{10}{12}$$

$$(h) \quad 2\frac{1}{5} \times 3\frac{2}{3}$$

Solution:

$$(a) \quad \frac{3}{5} \times \frac{2}{7} = \frac{3 \times 2}{5 \times 7} = \frac{6}{35}$$

$$(b) \quad \frac{1}{8} \times \frac{5}{6} = \frac{1 \times 5}{8 \times 6} = \frac{5}{48}$$

$$(c) \quad 6 \times \frac{2}{5} = \frac{6}{1} \times \frac{2}{5} = \frac{12}{5}$$

$$(d) \quad 2 \times \frac{5}{9} = \frac{2}{1} \times \frac{5}{9} = \frac{10}{9}$$

$$(e) \quad 4 \times \frac{3}{10} = \frac{4}{1} \times \frac{3}{10} = \frac{12}{10} = \frac{6}{5}$$

$$(f) \quad \frac{3}{4} \times \frac{7}{11} = \frac{21}{44}$$

$$(g) \quad \frac{3}{5} \times \frac{10}{12} = \frac{30}{60} = \frac{1}{2}$$

$$(h) \quad 2\frac{1}{5} \times 3\frac{2}{3} = \frac{11}{5} \times \frac{11}{3} = \frac{121}{15}$$

4. Dividing fractions

Evaluate the following:

(a) $\frac{1}{5} \div 2$

(g) $\frac{3}{5} \div \frac{1}{2}$

(b) $\frac{1}{6} \div 4$

(h) $\frac{3}{7} \div \frac{2}{9}$

(c) $\frac{1}{4} \div \frac{1}{2}$

(i) $\frac{6}{7} \div \frac{7}{12}$

(d) $\frac{1}{3} \div \frac{1}{3}$

(j) $2\frac{1}{10} \div 1\frac{1}{8}$

(e) $2 \div \frac{1}{5}$

(k) $5\frac{1}{4} \div \frac{3}{8}$

(f) $\frac{3}{4} \div \frac{2}{3}$

(l) $1\frac{1}{3} \div 3\frac{1}{4}$

Solution:

(a) $\frac{1}{5} \div 2 = \frac{1}{5} \div \frac{2}{1} = \frac{1}{5} \times \frac{1}{2} = \frac{1}{10}$

(b) $\frac{1}{6} \div 4 = \frac{1}{6} \div \frac{4}{1} = \frac{1}{6} \times \frac{1}{4} = \frac{1}{24}$

(c) $\frac{1}{4} \div \frac{1}{2} = \frac{1}{4} \times \frac{2}{1} = \frac{2}{4} = \frac{1}{2}$

(d) $\frac{1}{3} \div \frac{1}{3} = \frac{1}{3} \times \frac{3}{1} = \frac{3}{3} = 1$

Of course, any quantity (except zero) divided by itself gives 1.

$$\begin{aligned}
 \text{(e)} \quad 2 \div \frac{1}{5} &= \frac{2}{1} \div \frac{1}{5} \\
 &= \frac{2}{1} \times \frac{5}{1} \\
 &= \frac{10}{1} \\
 &= 10
 \end{aligned}$$

$$\text{(f)} \quad \frac{3}{4} \div \frac{2}{3} = \frac{3}{4} \times \frac{3}{2} = \frac{9}{8}$$

$$\text{(g)} \quad \frac{3}{5} \div \frac{1}{2} = \frac{3}{5} \times \frac{2}{1} = \frac{6}{5}$$

$$\text{(h)} \quad \frac{3}{7} \div \frac{2}{9} = \frac{3}{7} \times \frac{9}{2} = \frac{27}{14}$$

$$\text{(i)} \quad \frac{6}{7} \div \frac{7}{12} = \frac{6}{7} \times \frac{12}{7} = \frac{72}{49}$$

$$\begin{aligned}
 \text{(j)} \quad 2\frac{1}{10} \div 1\frac{1}{8} &= \frac{21}{10} \div \frac{9}{8} \\
 &= \frac{21}{10} \times \frac{8}{9} \\
 &= \frac{168}{90} \\
 &= \frac{28}{15}
 \end{aligned}$$

$$\begin{aligned}
 \text{(k)} \quad 5\frac{1}{4} \div \frac{3}{8} &= \frac{21}{4} \div \frac{3}{8} \\
 &= \frac{21}{4} \times \frac{8}{3} \\
 &= \frac{168}{12} \\
 &= 14
 \end{aligned}$$

$$\begin{aligned}
 \text{(l)} \quad 1\frac{1}{3} \div 3\frac{1}{4} &= \frac{4}{3} \div \frac{13}{4} \\
 &= \frac{4}{3} \times \frac{4}{13} \\
 &= \frac{16}{39}
 \end{aligned}$$