Railway Engineering Mathematics
Tutorial Sheet 1
Solutions

1. **BODMAS and order of operations**

   Evaluate the following:

   (a) $2 \times 5 + 7$

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

   (c) $24 - 6 \div 2$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Solution:

In each case, we first obtain a common denominator.

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

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

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

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

(e) $$2\frac{3}{5} - \frac{4}{3} = \frac{13}{5} - \frac{4}{3}$$
$$= \frac{13 \times 3}{5 \times 3} - \frac{4 \times 5}{3 \times 5}$$
$$= \frac{39}{15} - \frac{20}{15}$$
$$= \frac{19}{15}$$

(f) $$3\frac{2}{3} - 1\frac{1}{4} = \frac{11}{3} - \frac{5}{4}$$
$$= \frac{11 \times 4}{3 \times 4} - \frac{5 \times 3}{4 \times 3}$$
$$= \frac{44}{12} - \frac{15}{12}$$
$$= \frac{29}{12}$$

(g) $$1\frac{1}{2} - \frac{7}{10} = \frac{3}{2} - \frac{7}{10}$$
$$= \frac{3 \times 5}{2 \times 5} - \frac{7}{10}$$
$$= \frac{15}{10} - \frac{7}{10}$$
$$= \frac{8}{10} = \frac{4}{5}$$

(h) $$4\frac{1}{4} - \frac{2}{5} - \frac{1}{8} = \frac{17}{4} - \frac{2}{5} - \frac{1}{8}$$
$$= \frac{17 \times 10}{4 \times 10} - \frac{2 \times 8}{5 \times 8} - \frac{1 \times 5}{8 \times 5}$$
$$= \frac{170}{40} - \frac{16}{40} - \frac{5}{40}$$
$$= \frac{149}{40}$$

3. **Multiplying fractions**

Evaluate the following:

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

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

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

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

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

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

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

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

Solution:

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

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

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

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

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

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

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

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

4. **Dividing fractions**

Evaluate the following:

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

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

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

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

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

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

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

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

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

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

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

(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.

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

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

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

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

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

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

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

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