

Answer ALL questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1. (a) Work out  $2\frac{1}{7} + 1\frac{1}{4}$

*Mixed numbers*

$$(2 + 1) + \left(\frac{1}{7} + \frac{1}{4}\right) = 3 + \frac{1}{7} + \frac{1}{4}$$

LCM of 7 and 4  $7 \times 4 = 28 =$  common denominator

To add 2 fractions, we need them to share a common denominator.

$$\frac{1}{7} = \frac{4}{28} \quad \frac{1}{4} = \frac{7}{28}$$

$$\frac{4}{28} + \frac{7}{28} = \frac{11}{28} = \left(\frac{1}{4} + \frac{1}{7}\right)$$

Then we also have the 3 to add on

$$3 + \frac{11}{28} = 3\frac{11}{28}$$

$$3\frac{11}{28}$$

(2)

(b) Work out  $1\frac{1}{5} \div \frac{3}{4}$

Give your answer as a mixed number in its simplest form.

Converting a mixed number into an improper fraction

$$1\frac{1}{5} \rightarrow \frac{5}{5} + \frac{1}{5} = \frac{6}{5}$$

$$\frac{6}{5} \div \frac{3}{4} = \frac{6}{5} \times \frac{4}{3} = \frac{6 \times 4}{5 \times 3} = \frac{24}{15}$$

Improper fraction - needs to be converted into a mixed number

$$1 \frac{24-15}{15} = 1 \frac{9}{15}$$

When dividing a fraction, you can simply multiply by the reciprocal of the second fraction.

9 and 15 share a factor of 3, so  $\frac{9}{15}$  can be divided by  $\frac{3}{3}$  to simplify it.

$$1 \frac{3}{5}$$

$$1 \frac{3}{5}$$

(2)

(Total for Question is 4 marks)

2. Work out  $3\frac{1}{2} \times 1\frac{3}{5}$

Give your answer as a mixed number in its simplest form.

$$3\frac{1}{2} \Rightarrow \frac{6}{2} + \frac{1}{2} = \frac{7}{2} \quad \textcircled{1}$$

$$1\frac{3}{5} \Rightarrow \frac{5}{5} + \frac{3}{5} = \frac{8}{5}$$

$$3\frac{1}{2} \times 1\frac{3}{5} = \frac{7}{2} \times \frac{8}{5} = \frac{56}{10} \quad \textcircled{1}$$

$$\frac{56}{10} = \frac{50}{10} + \frac{6}{10} = 5 + \frac{6}{10} = 5 + \frac{3}{5}$$

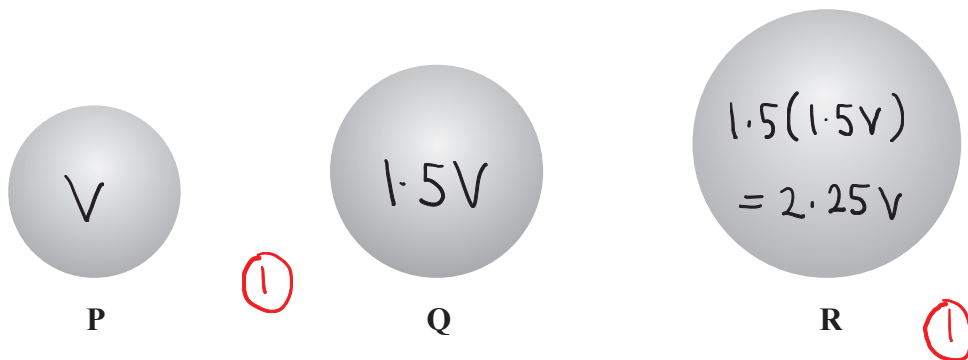
$$\frac{6}{10} = \frac{3}{5}$$

*(Note: The image shows a green arrow from 6 to 3 with  $\div 2$  above it, and another green arrow from 10 to 5 with  $\div 2$  below it.)*

$$\textcircled{1} \quad 5\frac{3}{5}$$

(Total for Question is 3 marks)

3. Here are three spheres.



The volume of sphere Q is 50% more than the volume of sphere P.  
The volume of sphere R is 50% more than the volume of sphere Q.

Find the volume of sphere P as a fraction of the volume of sphere R.

Volume of sphere P =  $V$ .

Volume of sphere R =  $2.25V$ .

$$\frac{V}{2.25V} = \frac{1}{2.25} = \frac{100}{225} = \frac{4}{9}$$

Handwritten annotations:  $\times 100$  (from 1 to 100),  $\div 25$  (from 2.25 to 225),  $\div 25$  (from 100 to 4),  $\times 100$  (from 2.25 to 225).

①  $\frac{4}{9}$

(Total for Question is 3 marks)

4. Work out  $1\frac{3}{4} \times 1\frac{1}{3}$

Give your answer as a mixed number.

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

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

① convert to top-heavy fractions

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

① calculate the product

$$\frac{28}{12} = 2\frac{4}{12} = 2\frac{1}{3}$$

① convert back to mixed number and simplify

$$2\frac{1}{3}$$

5. Show that  $\frac{\sqrt{180} - 2\sqrt{5}}{5\sqrt{5} - 5}$  can be written in the form  $a + \frac{\sqrt{5}}{b}$  where  $a$  and  $b$  are integers.

$$\begin{aligned}\sqrt{180} &= \sqrt{9 \times 20} \\ &= \sqrt{9} \times \sqrt{20} \\ &= 3 \times \sqrt{20} \\ &= 3 \times \sqrt{4 \times 5} \\ &= 3 \times \sqrt{4} \times \sqrt{5} \\ &= 3 \times 2 \times \sqrt{5} = 6\sqrt{5} \quad \checkmark_1\end{aligned}$$

$$\frac{a}{b+c} = \frac{a}{b} + \frac{a}{c}$$

$$\begin{aligned}\therefore a &= 1 \\ b &= 5\end{aligned}$$

$$\frac{a}{b-c} = \frac{a(b+c)}{(b-c)(b+c)} = \frac{a(b+c)}{b^2-c^2}$$

$$\frac{6\sqrt{5} - 2\sqrt{5}}{5\sqrt{5} - 5} = \frac{4\sqrt{5}}{5\sqrt{5} - 5}$$

$$\sqrt{ab} = \sqrt{a} \times \sqrt{b}$$

$$= \frac{4\sqrt{5} (5\sqrt{5} + 5)}{(5\sqrt{5} - 5)(5\sqrt{5} + 5)} \quad \checkmark_2$$

$$= \frac{100 + 20\sqrt{5}}{125 - 25}$$

$$= \frac{100 + 20\sqrt{5}}{100} \quad \checkmark_3$$

$$= \frac{100}{100} + \frac{20\sqrt{5}}{100}$$

$$= 1 + \frac{\sqrt{5}}{5} \quad \checkmark_4$$

(Total for Question is 4 marks)

6. Work out  $4\frac{1}{5} - 2\frac{2}{3}$

Give your answer as **a mixed number**.

$$4\frac{1}{5} = 4 + \frac{1}{5} = \frac{20}{5} + \frac{1}{5} = \frac{21}{5}$$

$$4\frac{1}{5} = \frac{21}{5}$$

$$2\frac{2}{3} = 2 + \frac{2}{3} = \frac{6}{3} + \frac{2}{3} = \frac{8}{3}$$

$$2\frac{2}{3} = \frac{8}{3} \quad \textcircled{1}$$

When subtracting fractions, we need a common denominator:

$$\begin{array}{l} \frac{21}{5} \xrightarrow{\times 3} \frac{63}{15} \\ \frac{8}{3} \xrightarrow{\times 5} \frac{40}{15} \end{array}$$

$$\frac{21}{5} - \frac{8}{3} = \frac{63}{15} - \frac{40}{15} = \frac{23}{15} \quad \textcircled{1}$$

$$\frac{23}{15} = \frac{15}{15} + \frac{8}{15} = 1 + \frac{8}{15} = \boxed{1\frac{8}{15}}$$

$$\textcircled{1} \quad 1\frac{8}{15}$$

(Total for Question **is 3 marks**)