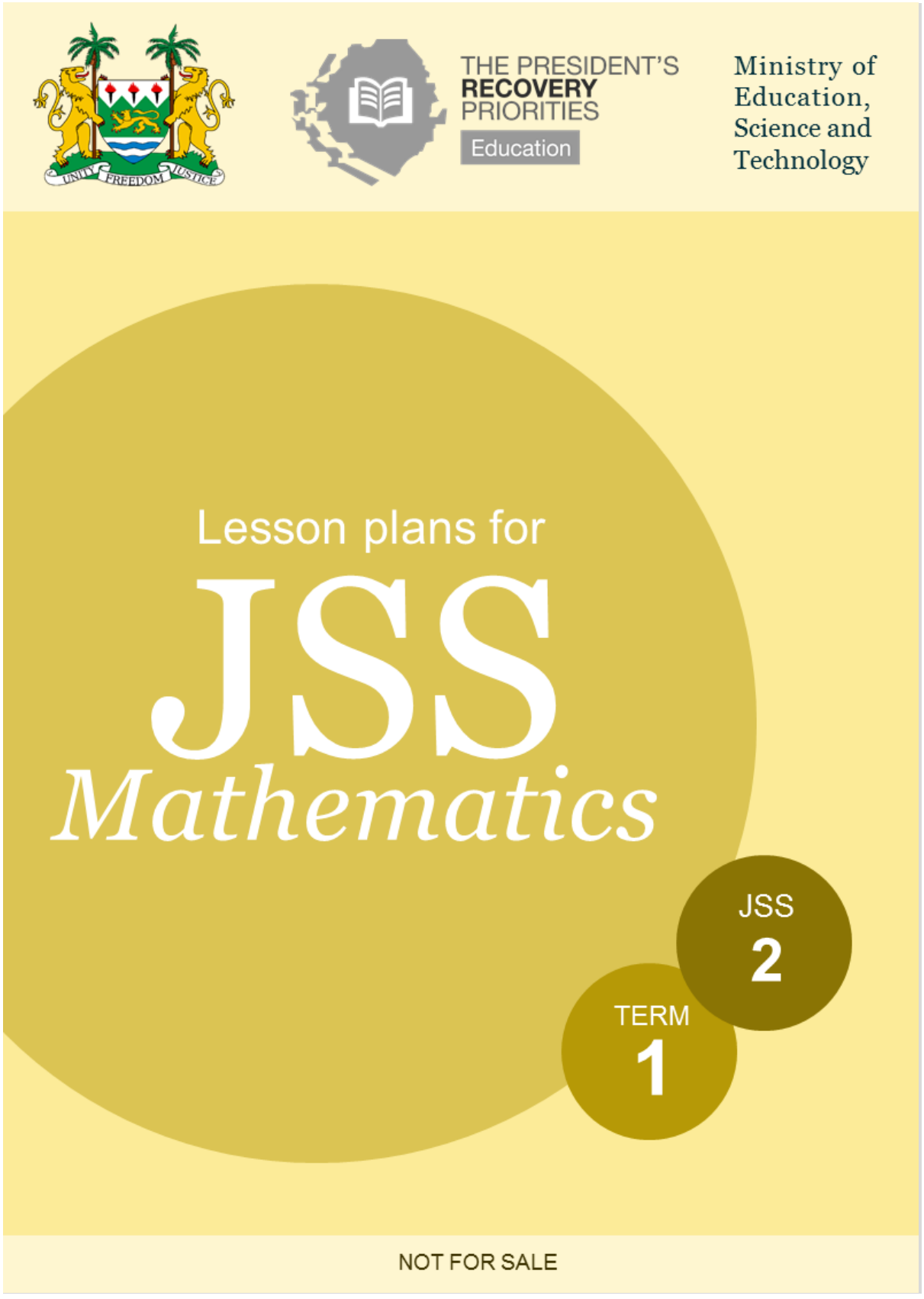
Sierra Leone Mathematics

JSS2 Topic Concept Charts (to support JSS3 pupils) TERM 1



Sierra Leone Mathematics

JSS2 Topic Concept Charts (to support JSS3 pupils) TERM 1

JSS3 Term 1	JSS2 resources for JSS3
Revision needed for the work that follows	**Topic 1: Revision** Term 1, Lesson 1 – 20 Fractions, decimals, factors, multiples
Lessons 1 – 11 (JSS3 PHB) Sets	*Not done in JSS2*
Lessons 12 – 15 (JSS3 PHB) Real numbers	*Not done in JSS2*
Lessons 16 – 20 (JSS3 PHB) Roman numbers; base 10 and base 2 numbers	*Not done in JSS2*
Lessons 21 (JSS3 PHB) Capacity and mass	*Used as a context for problems in Topics 1 to 6*
Lessons 22 – 23 (JSS3 PHB) Percentage	**Topic 2: Percentage** Term 1, Lesson 31 – 35 (JSS2 PHB)
Lessons 24 – 25 (JSS3 PHB) Ratio and rate	**Topic 4: Ratio and rate** Term 1, Lessons 41 – 45 (JSS2 PHB)
Lessons 26 – 28 (JSS3 PHB) Direct and indirect proportion	**Topic 5: Direct proportion** Term 1, Lessons 46 – 50 (JSS2 PHB) **Topic 6: Indirect proportion** Term 1, Lessons 51 – 55 (JSS2 PHB)
Lessons 29 – 30 (JSS3 PHB) Financial mathematics	**Topic 3: Profit and loss** Term 1, Lesson 36 – 40 (JSS2 PHB)
Lessons 31 – 34 (JSS3 PHB) Indices (exponents)	**Topic 7: Indices (Exponents)** Term 1, Lessons 21 – 27 & 28 – 30 (JSS2 PHB)
Lessons 35 – 40 (JSS3 PHB) Standard form, multiplying by powers of 10, small and large numbers	*Not done in JSS2*
Lessons 41 – 45 (JSS3 PHB) Right angled triangles and Pythagoras	**Topic 8: Perimeter and area** Term 2, Lessons 61 – 64 (JSS2 PHB) Perimeter and area of rectangles, squares, Parallelograms, trapeziums and **triangles**

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Topic 1: Revision M-08-001 to M-08-20 page 2 – 48

CONCEPTS:

FRACTIONS and DECIMALS

* Fractions of shapes are equal parts of the shape e.g. ½ is one part out of two equal parts. The **numerator** shows the number of equal parts we want and the **denominator** shows the total number of equal parts e.g. $\frac{3}{10}$ is 3 equal parts out of 10 equal parts. The whole has 10 equal parts.

* To change a decimal to a fraction, count the number of place values after the point. Example: 0.027 converts to 27 out of 1000 $\left(\frac{27}{1000}\right)$ 3 decimal places (thousandths).

* To change a fraction to a decimal, we need a denominator of 10, 100 or 1000 Example: $\frac{3}{4} = \frac{75}{100} = 0.75$

OPERATIONS on FRACTIONS and DECIMAL NUMBERS

* To add and subtract fractions, find the LCM first. $\frac{4}{5} + \frac{1}{3} = \frac{12}{15} + \frac{5}{15} = \frac{17}{15} = 1\frac{2}{15}$ (LCM of 5 and 3 is 15)

* To multiply fractions, multiply numerators together and multiply denominators together. Simplify by cancelling common factors. $\frac{3}{4} \times \frac{8}{9} = \frac{24}{36} = \frac{2}{3}$

* To divide fractions, multiply by the reciprocal of the second fraction. $\frac{2}{9} \div \frac{4}{3} = \frac{2}{9} \times \frac{3}{4} = \frac{6}{36} = \frac{1}{6}$

* To add or subtract with decimal numbers, use place value columns and keep the decimal point of each number lined up.

$$\begin{array}{r} 4.800 \\ -\ 0.357 \\ \hline 4.443 \end{array}$$

* To multiply decimal numbers, the answer must have the total of the decimal places of the numbers being multiplied.

Example: 0.25 × 0.3 = 0.075 (3 decimal places), but 2.5 × 0.3 = 0.75 (2 decimal places)

* To divide decimal numbers, first multiply by a power of 10 to make the divisor a whole number. Do the same to both numbers!

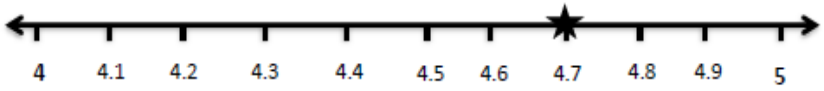
Example: 1.671 ÷ 0.03 = $\frac{1.671 \times \mathbf{100}}{0.03 \times \mathbf{100}} = \frac{167.1}{3} = 55.7$ (multiply by $\frac{\mathbf{100}}{\mathbf{100}}$ to make denominator 3)

* Order of operations BODMAS: **B**rackets, **O**f, **D**ivision & **M**ultiplication, **A**ddition & **S**ubtraction.

If you have addition and subtraction in the same calculation, work from left to right.

If you have division and multiplication in the same calculation, work from left to right.

ROUNDING OFF: Use a number line to help you round off e.g. 4.7 rounded to the nearest whole number is 5.



To round off a number, look at the place value just after the one you are rounding to.

* The digits 1, 2, 3, 4 round down; the digit 5 rounds up; the digits 6, 7, 8, 9 round up.

Topic 1: Revision continued M-08-001 to M-08-20 page 2 – 48

CONCEPTS:

MULTIPLES and FACTORS

* **Factors** – if a number divides exactly into another number, then it is a factor — Example: $12 \div 4 = 3$. 4 and 3 are both factors of 12.

* **Prime numbers** are numbers that only have TWO factors, 1 and itself. — Examples: 2, 3, 5, 7

* **Prime factors:** Factors of a number that are prime numbers. — Examples: The prime factors of 12 are 2 and 3. Other factors of 12 are not prime (1, 4, 6, 12)

* To multiply whole numbers by powers of 10, we must *write in* zeros — Example:. $325 \times 10^2 = 32\,500$.

* To divide whole numbers by powers of 10, we must *take out zeros* — Examples:. $32\,500 \div 10^2 = 325$

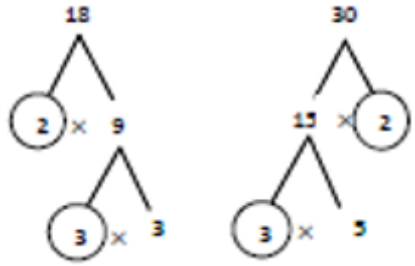
$5.03 \times 10^3 = 5\,030$ $\quad$ $5.03 \div 10^3 = 0.00503$

* **Common factors** of two numbers — Example: 3 is a common factor of 12 and 18.

* **Multiples:** If a number is multiplied by another number, the answer is a multiple of the number — Example: $8 \times 7 = 56$, so 56 is a multiple of 7 and of 8.

* To find the **HCF (highest common factor)** of two or more numbers, we can use a **factor tree**

Example: 18 and 30 have common factors 2 and 3, so HCF is 2 x 3 = 6



* To find the **LCM (lowest common multiple)** of two numbers, list the multiples of both until you find the lowest.
Example: Multiples of 3 are 3, 6, 9, **12**, 15, … and multiples of 4 are 4, 8, **12**, 16, … 12 is the LCM of 3 and 4.

Topic 1A: Revision M-08-001 to M-08-20

Examples:

1. Name all the factors of 27.

2. Find all the common factors of:
   a) 21 and 36 b) 20 and 35

3. Find the HCF and the LCM of
   a) 7, 14 and 21 b) 12, 15 and 30 c) 36 and 45

4. What are the prime factors of
   a) 37 b) 50 c) 132?

5. Use a factor tree to find the HCF of 90 and 210.

6. Which fraction is smaller? Use a number line or a fraction wall to help you.
   a. $\frac{3}{8}$ or $\frac{1}{3}$. b. $\frac{5}{6}$ or $\frac{6}{8}$.

7. Simplify
   a. $\frac{3}{4}+\frac{3}{8}$ b. $\frac{16}{24}-\frac{2}{3}$ c. $2\frac{1}{5}+3\frac{5}{6}$
   d. $\frac{14}{24}\times\frac{3}{4}$ e. $3\frac{1}{3}\div\frac{2}{9}$ f. $\frac{7}{8}\div 4$
   g. $\frac{10}{15}\times\frac{5}{7}$ h. $3\frac{2}{5}-\frac{7}{20}$ i. $\frac{24}{25}\div\frac{6}{15}$

Check your answers:

1. 1, 3, 9, 27.
2. a) only 3 is a common factor
   b) Only 5 is a common factor.
3. a) HCF is 7. LCM is 21.
   b) HCF is 3.
   LCM is $2\times2\times3\times5 = 60$.
   c) HCF is 9.
   LCM is $2\times2\times3\times3\times5 = 180$
4. a) only 37 (1 is not prime!)
   b) $50 = 2\times5\times5$, so prime factors are 2, 5 and 5.
   c) $132 = 2\times2\times3\times11$
   Prime factors are 2, 2, 3, and 11.
5. $90 = 2\times3\times3\times5$
   $210 = 2\times3\times5\times7$
   So HCF is $2\times3 = 6$

6a) $\frac{3}{8} = \frac{9}{24}$ and $\frac{1}{3} = \frac{8}{24}$, so $\frac{1}{3}$ is smaller.
b) $\frac{5}{6} = \frac{20}{24}$ and $\frac{6}{8} = \frac{18}{24}$, so $\frac{6}{8}$ is smaller.

7a) $\frac{3}{4}+\frac{3}{8} = \frac{6}{8}+\frac{3}{8} = \frac{9}{8}$
b) $\frac{16}{24}-\frac{16}{24} = 0$
c) $\frac{11}{5}+\frac{23}{6} = \frac{66}{30}+\frac{115}{30} = \frac{181}{30} = 6\frac{1}{30}$
OR $5+\frac{1}{5}+\frac{5}{6} = 5\frac{6}{30}+\frac{25}{30} = 5\frac{31}{30} = 6\frac{1}{30}$
d) $\frac{7}{12}\times\frac{3}{4} = \frac{21}{48} = \frac{7}{16}$ e) $\frac{10}{3}\times\frac{9}{2} = 15$
f) $\frac{7}{8}\times\frac{1}{4} = \frac{7}{32}$ g) $\frac{2}{3}\times\frac{5}{7} = \frac{10}{21}$
h) $\frac{17}{5}-\frac{7}{20} = \frac{68}{20}-\frac{7}{20} = \frac{61}{20} = 3\frac{1}{20}$
i) $\frac{24}{25}\div\frac{6}{15} = \frac{24}{25}\times\frac{15}{6} = \frac{12}{5} = 2\frac{2}{5}$

Topic 1B: Revision M-08-001 to M-08-20

Examples:

8. Convert the decimals to fractions
   a. 3.025 b. 30.25 c. 0.0325 d. 0.325

9. Convert the fractions to decimals
   a. $\frac{275}{100}$ b. $2\frac{3}{5}$ c. $5\frac{30}{40}$

10. Simplify
   a. 0.12×10^2 b. $0.12 \div 10^2$ c. $0.12 \div 10$ d. 0.12×10

11. Round 10.76491 to the nearest hundredth.
12. Round 635.705421 to 3 decimal places.
13. Round 22.517 to one decimal place.
14. Round 99.28 to the nearest tenth.
15. Round 0.666 to the nearest unit.

16. Four basketball players are weighed in kilograms as follows:
   97,04 kg 99,67 kg 98,56 kg 99,23 kg.
   Round off each weight to the nearest kilogram.

17. Calculate the answer
   a. 7.09 + 8.81 b. 1.3 − 0.96 c. 1.68 ÷ 0.2
   d. 5.9 × 0.4 e. 25.31 – ___= 15.06 f. 14.9 + ____= 15

18. a) There are 425.3 g of flour in the house. The recipe 125 g of flour.
   How much flour will be left over?
   b) What is 10 – 1.23?
   c) Your brother Sahr was 128 cm tall last year. He grew 2.7 cm. How tall is he now?

Check your answers:

8. a) $3\frac{25}{1000} = 3\frac{1}{40}$ b) $30\frac{25}{100} = 30\frac{1}{4}$
   c) $\frac{325}{10000} = \frac{13}{40}$ d) $\frac{325}{1000} = \frac{13}{4} = 3\frac{1}{4}$

9a) $2\frac{75}{100} = 2.75$
   b) $2\frac{6}{10} = 2.6$
   c) $5\frac{30}{40} = 5\frac{75}{100} = 5.75$

10a) 12 b) 0.0012
   c) 0.012 d) 1.2

11. 10.76
12. 635.705
13. 22.5
14. 99.3
15. 1

16. 97 kg; 100 kg; 99 kg; 99 kg.

17a) 15.9
   b. 0.34
   c. $1.68 \div 0.2 = 1.68 \times \frac{1}{0.2} \times \frac{10}{10} = \frac{16.8}{2} = 8.4$
   d. 2.36
   e. 25.31 – 15.06 = **10.25**
   f. 14.9 + **0.1** = 15

18a) 425.3 – 125 = 300.3 g of flour left over.
   b) 10 – 1 = 9 and 9 – 0.23 = 8.77
   c) 128 cm + 2.7 cm = 130.7 cm

Topic 2: Percentage M-08-031 to M-08-035 p73 – 85

Check that you can:	**Do you understand these words?**	*Refer to JSS2 Term 1*
* work out percentage of a given quantity	percentage increase; percentage decrease; change in quantity	

CONCEPTS:

*** To find a percentage of a number or a quantity**

Example 1: 20% of Le 480 means 20% × 480

$\frac{20}{100} \times 480$ (write percentage as fraction out of 100)

$= \frac{9600}{100}$ (multiply)

= 96 (divide)

*** One quantity as a percentage of another quantity**

Example 2:

There are 36 eggs in a tray, but 9 are broken. What percentage is left?

9 out of 36 are broken.

$\frac{9}{36}$ (write as a fraction)

$\frac{9}{36} \times \frac{100}{1}$ (to work out percent, multiply by 100)

$= \frac{900}{36} = \frac{100}{4} = \frac{25}{1}$ (multiply, divide, simplify)

So 25% of the eggs are broken and 75% of the eggs are left.

Example 3: Calculate 40 centimetres as a percentage of 16 metres.

First convert the quantities to the same unit of measurement (cm)

16 m = 16 × 100 cm = 1600 cm

$\frac{40}{1600} \times \frac{100}{1} = \frac{4000}{1600} = \frac{40}{16} = \frac{10}{4} = \frac{5}{2}$ = 2.5%

So 40cm is 2.5% of 16m.

*** Percentage increase or decrease**

Use this when a given number or quantity is increased or decreased and we want to know what the change is in percent.

Percentage increase = $\frac{\text{change in quantity}}{\text{original quantity}} \times \frac{100}{1}$ Change = new quantity – original quantity

Percentage decrease = $\frac{\text{change in quantity}}{\text{original quantity}} \times \frac{100}{1}$ Change = original quantity – new quantity

Example 4:

Mr Chang's shop is open for 8 hours on Fridays. On Saturdays, the shop is open for 10 hours. What is the percentage increase in hours on Saturdays?

Percentage increase = $\frac{\text{change in quantity}}{\text{original quantity}} \times \frac{100}{1}$

$= \frac{10-8}{8} \times \frac{100}{1} = \frac{2}{8} = 25\%$

The Saturday hours are 25% more (longer) than the Friday hours.

Example 5:

The population of a village was 2,500 people eight years ago. Since then, the population has dropped (decreased) by 15%. Calculate the population as of today.

New number $= \frac{100-\%\ \text{decrease}}{100} \times \frac{\text{given number}}{1} = 85\% \times 2500$

$\frac{85}{100} \times 2500 = 2125$ Population has decreased to 2125.

Topic 2: Percentage

Exercise

1. Calculate

   a) 25% of 800 b) 30% of 6 000 c) 60% of 60

2. Calculate 75 centimetres as a percentage of 25 metres.

3. 70 people watched a football match, 42 of them were girls. What is that as a percentage?

4. The price of bread increases from Le 8 000 to Le 9 600.

   By what percentage does the price of bread increase?

5. The number of people who attend a clinic monthly drops from 56 to 35.

   By what percentage does the number of people attending the clinic drop?

6. There were 250 pupils registered for JSS3 last year and there are 325 pupils registered for JSS3 this year. What is the percentage increase?

7. The cost of transport increased from Le 35,000 to Le 60,000. Calculate the percentage increase.

8. At the end of the rainy season the river is 2.5 m deep, but at the end of the dry season it is 75 cm deep. Calculate the percentage decrease.

9. Mrs Yang's shop is open for 10 hours on Fridays. On Mondays, she increases the shop hours by 15%. For how many hours is her shop open on Mondays?

10. There were 1200 people living in a village in 2016. By 2021, the population had grown by 8%. What was the population in 2021?

Check your answers:

1. a) 25% × 800 = $\frac{25}{100} \times 800 = \frac{1}{4} \times 800$ $= 200$ b) 30% of 6 000 = $\frac{30}{100} \times 6\,000 = \frac{180\,000}{100}$ = 1 800

c) 60% × 60 = $\frac{60}{100} \times 60 = 36$

2. 75 cm out of 25 × 100 cm.

$\frac{75}{2\,500} \times \frac{100}{1} = \frac{7\,500}{2\,500} = \frac{3}{1}$ = 3%

3. $\frac{42}{70} \times \frac{100}{1} = \frac{4200}{70} = 60\%$

4. $\frac{9\,600 - 8\,000}{8\,000} \times 100$

$= \frac{1\,600}{8\,000} \times 100 = \frac{1}{5} \times 100 = 20\%.$

The price of bread increases by 20%.

5. $\frac{56 - 35}{35} \times 100 = \frac{2\,100}{35} = 60\%.$

The number attending the clinic drops by 60%.

6. $\frac{325 - 250}{250} \times 100 = \frac{7\,500}{250} = 30\%.$

7. $\frac{42\,000 - 35\,000}{35\,000} \times 100 = \frac{700\,000}{35\,000} = 20\%$

8. 2.5 m = 250 cm

$\frac{250 - 75}{250} \times \frac{100}{1} = \frac{17\,500}{250} = \frac{70}{1}$ = 70%

9. 15% of 10 = $\frac{15}{100} \times 10 = 1.5$

Mrs Yang's shop is open for 11.5 hours on Mondays.

10. 8% of 1200 = 96. The population is 1 296 in 2021.

Topic 3: Profit and loss M-08-036 to M-08-040 p86 – 98

Check that you can:	**Do you understand these words?**	*Refer to JSS2 Term 1*
* calculate percentage increase and decrease	profit; loss; capital decrease	

CONCEPTS:

You can use percentage increase or decrease to work out how much money you have earned or lost in a business.

Capital: The money you have to start and run a business.

If you make more money from your capital, then you have made a **profit**.
If you make more money on your sales, than the money you spend on costs, that is a **profit**.

If you lose money from your capital, then you have made a **loss**.
If you spend more money on your costs, than the money you make on sales, that is a loss.

$\text{percent profit} = \frac{\text{profit}}{\text{capital}} \times 100\%$ [profit or loss is *change in quantity*; capital is the *original amount*]

$\text{percent loss} = \frac{\text{loss}}{\text{capital}} \times 100\%$

*** Percentages greater than 100**

100% of an amount is the whole of it. For example, 100% of 50 is 50.
We can have more than 100% of an amount. For example, 120% of 50 is 50 + another 20% of 50.

120% of 50 = $\frac{120}{100} \times 50 = 60$

Example:

120% of 20 = $\frac{120}{100} \times 20 = 24$

Topic 3: Profit and loss

Exercise

1. Amad buys farmland for Le 120,000, and spends Le 15,000 on new tools, Le 20,000 on seeds, and Le 30,000 for Zinab to help him harvest the rice. He sells all of the rice for Le 400,000.
   a) What are the total costs and sales? b) Did Amad's farm have a profit or a loss?
   c) Calculate the profit or loss.
2. Esther paid her brother Le 5,000 to borrow his machete so she could collect coconuts in the bush. She collected 40 coconuts and she sold them for Le 300 each. Esther sold them all.
   Calculate her percentage profit.
3. Fatima fills her car with gasoline and pays Le 23,100. She drives 4 passengers for Le 7,700 each.
   Calculate her percent profit.
4. Fatmata sells biscuits in the market in her village. She pays Le 40,000 for a carton of 500 biscuits. She pays Le 15,000 for transport to Freetown and back to her village.
   She sells the 500 biscuits for Le 250 each. Calculate Fatmata's percent profit.
5. Zinab buys a furniture shop for Le 180,000 and spends Le 120,000 on supplies for the shop.
   During the first month he sells 6 pieces of furniture each costing Le 25,000. Calculate Zinab's percent loss.
6. Fatima has started a laundry business. She pays Le 730,000 for a washing machine and Le 20,000 for other supplies. After one month she has washed laundry for 10 clients for Le 30,000 each.
   Calculate Fatima's percent loss.
7. Mr Bhyat buys a car for Le 60 000 000, drives it for two years and sells it for Le 25,200 000.
   What is Mr Bhyat's percentage loss?
8. What is 160% as a fraction?
9. Calculate 200% of 90.
10. Calculate 140% of Le 60,000.

Check your answers:

1. Costs = 120,000 + 15,000 + 20,000 + 30,000
   = Le 185,000 Amad made a profit.
   400,000 – 185,000 = Le 215,000
2. Costs = Le 5,000; sales = 300 × 40 = Le 12,000
   Profit = Le 7,000
   Percentage profit = $\frac{12,000 - 5,000}{5,000} \times 100$
   = $\frac{7,000}{5,000} \times 100$ = 140%
3. 4 × 7,700 = 30,800
   Profit = 30,800 – 23,100 = 7,700
   Percentage profit = $\frac{7,700}{30,800} \times 100$ = 25%
4. Costs = Le 55,000 Sales = Le 125,000
   % profit = $\frac{125,000-55,000}{125,000} \times 100$ = 56%
5. Costs = Le 300,000 Sales = Le 150,000
   % loss = $\frac{300,000-150,000}{300,000} \times 100$ = 50%
6. costs = Le 750,000 Sales = Le 300,000
   % loss = $\frac{750,000-300,000}{750,000} \times 100$ = 60%
7. % loss = $\frac{60\,000,000-25\,200,000}{60\,000,000} \times 100$ = 58%
8. 160% = $\frac{160}{100} = 1\frac{60}{100} = 1\frac{3}{5}$
9. $\frac{200}{100} \times 90$ = 180
10. $\frac{140}{100} \times$ 60,000 = Le 84,000

Sierra Leone Mathematics

JSS2 Topic Concept Charts (to support JSS3 pupils) TERM 1

Topic 4: Ratio and rate M-08-041 to M-08-045 p99 – 108

Check that you:	**Do you understand these words?**	*Refer to JSS2 Term 1*
• Can calculate with fractions and with units of measurement	Ratio, rate, unit rate	

CONCEPTS:

* A **ratio** compares two quantities of the same kind or units (for example, people, cups, kilometres)

* The **order** of a ratio is important.

Example:
A ratio of 3 cups of milk to every 2 cups of flour in a recipe can be written as **3 : 2**
2 cups of flour to every 3 cups of milk is a ratio of 2 to 3, written as **2 : 3**.

* A ratio can compare two parts of a whole or compare a part to the whole.

Example:
10 pencils and 8 pens in a pencil bag -

Pencils **:** Pens = **10 : 8 = 5 : 4**

All stationery in the pencil bag **:** Pencils = **18 : 10 = 9 : 5**

Pens **:** All stationery = **8 : 18 = 4 : 9**

* We can also write ratios as **fractions**:

Example:
$\frac{\text{pencils}}{\text{pens}} = \frac{10}{8} = \frac{5}{4}$ or $\frac{\text{pencils}}{\text{all stationery in pencil bag}} = \frac{10}{18} = \frac{5}{9}$

* **Percentage** is a ratio that compares a number to 100.

25% = $\frac{25}{100} = 25 : 100$

A ratio can be written as a percentage.

2 : 5 = $\frac{2}{5} = \frac{2}{5} \times \frac{20}{20} = \frac{40}{100} = 40\%$

Rate is a special ratio that compares two quantities with different units of measurement like money in Le, time in hours, metres, litres and grams.

Example: A man buys 100 grams of rice for Le 3,600.

As a rate, this is $\frac{\text{Le } 3{,}600}{100\text{ g}}$ or $\frac{\text{Le } 360}{1\text{ g}}$.

We say this as Le 360 *per* gram.

Unit rate

When a rate is expressed as a quantity of 1, we call it a unit rate, because it is the rate per one unit.

Example:
5 kilograms of cassava costs Le 6,000. What does 1 kg cassava cost?
What is the price per kilogram?

$\frac{\text{Le } 6000}{5\text{ kg}} = \frac{\text{Le } 1200}{1\text{ kg}}$ The price is Le 1200 per kg.

Comparing prices

In the market you can buy 2 litres of cooking oil for Le 80,000 or 3.5 litres of cooking oil for Le 120,000. Which option has the lower unit price?

$\frac{\text{Le } 80.000}{2\text{ litres}} = \frac{\text{Le } 40{,}000}{1\text{ litre}}$ $\frac{\text{Le } 120.000}{3{,}5\text{ litres}} = \frac{\text{Le } 35{,}000}{1\text{ litre}}$

3.5 litres for Le 120,00 has the lower unit price.

Topic 4: Ratio and rate

Exercise

1. Binta has 35 pencils and 60 pens. Write down:
   a. The simplified ratio of **pens** to **pencils** in three forms. b. The ratio of **pencils** to **pens** as a fraction.
2. Hawa received an 76% mark on an exam. What ratio of correct answers did Hawa get?
3. Binta can carry 48 mangoes in 4 bags. How many mangoes fit per bag?
4. Massa is traveling home to her village. It takes her 4 hours to travel 240 km. What is her rate of travel in kph?
5. There are 414 pupils divided among 9 classrooms. What is the unit rate for 1 classroom?
6. The rate for 20 litres of gasoline is Le 54,000. What is the unit rate for gasoline?
7. 165 pupils take 3 buses to a field trip. What is the unit rate per bus?
8. Jinta can paint 84 m^2 in 4 hours. What is his unit rate per hour?
9. 7 kilograms of mangoes costs Le 5,600. What does 1 kg of mangoes cost?
10. 6 kg peanuts costs Le 9,600. What does 1 kg cost?
11. A carton of 200 biscuits is Le 13,000. What is the unit price per biscuit?
12. A bus ticket for a 280 km trip is Le 5,600. What is the unit price per km travelled?
13. A bucket of 20 cassavas is Le 460. What is the unit price per cassava?
14. Calculate the price per unit for tomatoes, if you buy 300 tomatoes for Le 5,700.
15. Mr Mahomet sells 30 kilograms of rice for Le 120,000. Mr Mayet sells 50 kg of rice for Le 210,000. Which rice has a lower unit price?

Check your answers:

1a. pens : pencils = 60 **:** 35 = 12 **:** 7
12 is to 7
For every 12 pens, there are 7 pencils.

b. pencils **:** pens = 7 **:** 12 = $\frac{7}{12}$

2. 76 **:** 100 = 19 **:** 25

3. $\frac{48 \text{ mangoes}}{4 \text{ bags}}$ = 12 mangoes per bag.

4. $\frac{240 \text{ km}}{4 \text{ hours}}$ = 60 kph

5. $\frac{414 \text{ pupils}}{9 \text{ classes}}$ = 46 pupils per class.

6. $\frac{\text{Le } 54{,}000}{20 \text{ litres}}$ = Le 2700 per litre.

7. $\frac{165 \text{ pupils}}{3 \text{ buses}}$ = 55 pupils per bus.

8. $\frac{84 \text{ m}^2}{4 \text{ hours}}$ = 21 m^2 per hour

9. $\frac{\text{Le } 5{,}600}{7}$ = Le 800 per mango.

10. $\frac{\text{Le } 9{,}600}{6 \text{ kg}}$ = Le 1,600 per kilogram.

11. $\frac{\text{Le } 13{,}000}{200}$ = Le 65 per biscuit.

12. $\frac{\text{Le } 5{,}600}{280 \text{ km}}$ = Le 20 per km

13. $\frac{\text{Le } 460}{20 \text{ cassavas}}$ = Le 23 per cassava.

14. $\frac{\text{Le } 5{,}700}{300 \text{ tomatoes}}$ = Le 19 per tomato.

15. Mr Mahomet: $\frac{\text{Le } 120{,}000}{30 \text{ kg}}$ = Le 4,000 per kg
Mr Mayet: $\frac{\text{Le } 210{,}000}{50 \text{ kg}}$ = Le 4,200 per kg
Mr Mahomet's rice is cheaper per kilogram.

Topic 5: Direct proportion M-08-046 to M-08-050 p109 – 119

Check that you can:
- Work with ratios, equivalent fractions and cross-multiplying

Do you understand these words?
Proportion; proportional; constant of proportion; extremes and means; unitary method; ratio method; cross multiply

Refer to JSS2 Term 1

CONCEPTS:

A **proportion** is a pair of equivalent ratios in which the units must be the same.
When two ratios are equivalent (with the same units), then they are in proportion.
If the ratios are in **direct proportion**, then as one ratio increases or decreases, the other ratio increases or decreases at the same rate.
Direct proportion is shown by y = kx, where y is equal to x multiplied by a constant k.
k is called the constant of proportionality.
$x \propto y$ means that x is proportional to y.
When two ratios are equal, we can cross-multiply and the two products will be equal.

Example:
2 : 4 = 5 : 10
2 and 10 are called the **extremes** of the proportion. 4 and 5 are called the **means** of the proportion.
$\frac{2}{4} = \frac{5}{10}$ Cross multiply 2×10 and 4×5. Both products are 20.
If $x \propto y$, and x = 2 and y = 10, find the constant of proportionality, k.
y = kx $10 = k \times 2$
so k = 5.

Example:
Given $\frac{3}{5} = \frac{c}{10}$, find the value of c to complete the direct proportion.
$3 \times 10 = c \times 5$
30 = 5c
c = 6

Example: Paul rode his bicycle 45 km in 3 hours. What distance could he ride in 5 hours, if he kept the same rate?

Unitary method:
Find the distance Paul rides in 1 hour first.
$\frac{45 \text{ km}}{3 \text{ hours}} = \frac{15 \text{ km}}{1 \text{ hour}}$ = 15 kph (kilometres per hour)
In 5 hours, Paul can ride 15×5 kilometres = 75 km.

Ratio method:
Write equivalent ratios and use cross multiplying.
$\frac{45 \text{ km}}{3 \text{ hours}} = \frac{d \text{ km}}{5 \text{ hours}}$
$45 \times 5 = 3d$
$225 = 3d$
d = 75 km

Topic 5: Direct Proportion

Exercise

1. Complete the sentence:
   Direct proportions are shown by the relationship one value (y) is equal to another value (x) _____.

2. Are the following fractions in direct proportion? $\frac{42}{7}$ and $\frac{18}{3}$. Give a reason for your answer.

3. a) Express the following direct proportions as fractions in their simplest form:
   12 : 16 = 45 : 60
   b) Identify the extremes and the means in this proportion.

4. Find the value for x that completes the direct proportion:
   a) $\frac{3}{8} = \frac{15}{x}$ b) $\frac{7}{6} = \frac{x}{42}$ c) $\frac{x}{92} = \frac{10}{115}$

5. $x \propto y$. If x = 8 and y = 96, find the constant of proportionality, k, and create a true proportion.

6. Find the value for p if $\frac{261}{3} = \frac{871}{p}$ is in direct proportion. Round off your answer to the nearest whole number.

7. A scale model of a building is 12 cm high. If the scale is 1 : 25, calculate the height of the actual building in m.

8. Fatmata travelled 532 km in 5 hours and Abu travelled 392 km in 3 hours.
   Is there a direct proportion between their speeds? Explain your answer.

9. I travel at 80 kph.
   a) How long will it take me to travel 400 km?
   b) How far will I have travelled in 12 minutes?

10. a) Joe travels 800 km in 10 hours. At the same constant speed, how far long will it take him to travel 600 km?
    Use direct proportion to calculate your answer. $\frac{x\ hours}{600\ km} = \frac{10\ hours}{800\ km}$
    b) Use the formula speed = $\frac{\text{distance}}{\text{time}}$ to calculate Joe's constant speed.

Check your answers:

1. multiplied by a constant k.

2. Yes. If we cross-multiply, we get $42 \times 3 = 126$ and $18 \times 7 = 126$.
   Equal products shows that $\frac{42}{7} = \frac{18}{3}$.
   Alternatively, $\frac{42}{7} = 6$ and $\frac{18}{3} = 6$

3a) $\frac{12}{16} = \frac{45}{60}$. Simplified to $\frac{3}{4} = \frac{3}{4}$.
b) 12 and 60 are the extremes; 16 and 45 are the means.

4a) $\frac{3}{8} = \frac{15}{x}$
$3x = 8 \times 15$
$x = 40$

b) $\frac{7}{6} = \frac{x}{42}$
$6x = 7 \times 42$
$x = 49$

c) $\frac{x}{92} = \frac{10}{115}$
$115x = 920$
$x = 8$

5. $y = kx$
$96 = k(8)$
$k = 12$

6. $261p = 871 \times 3$
$p = \frac{871 \times 3}{261} = 10$

7. $1 : 25 = 12 : x$ $\frac{1}{25} = \frac{12}{x}$
x = 300 cm = 3 metres

8. $\frac{532}{5} = 106.4$ kph and $\frac{392}{3} = 130.7$ kph
They are not in direct proportion.
They travel at different speeds.

9. a) 5 hours
b) 12 mins = $\frac{12}{60} = 0.2$ $0.2 \times 80 = 16$ km

10. $800x = 6000$, so x = 7.5 hours.
Speed = $\frac{800}{10} = 80$ kph.

Topic 6: Indirect proportion M-08-051 to M-08-055 p120 – 132

Check that you can:	**Do you understand these words?**	*Refer to JSS2 Term 1*
• work with ratios, equivalent fractions and cross-multiplying	equivalent, direct proportion, indirect proportion, inverse	

CONCEPTS:

If two equivalent ratios are in **indirect proportion**, then as one ratio increases, the other ratio decreases at the same rate.
If two equivalent ratios are in **indirect proportion**, then as one ratio decreases, the other ratio increases at the same rate.
For example, the more people work on a building project, the less days it takes to complete the project.

Indirect proportion is shown by y = k $\frac{1}{x}$, where y is equal to the inverse of x which is $\frac{1}{x}$, multiplied by a constant k.

k is called the constant of proportionality.

y $\propto \frac{1}{x}$ means that y is indirectly proportional to y.

We can still use cross-multiplication, but using $\frac{1}{x}$ instead of x.

Example: If 3 : 6 is indirectly proportional to 8 : 4, then $\frac{3}{6} = \frac{4}{8}$

We use the inverse of $\frac{8}{4}$, which is $\frac{4}{8}$.

Check by cross multiplying: $3 \times 8 = 6 \times 4 = 24$.

Example:
If a : 16 $\propto$ 10 : 5 are two indirectly proportional ratios, find the value for *a* that completes the proportion.

Invert the second ratio to make $\frac{5}{10}$, then cross-multiply.

$\frac{a}{16} = \frac{5}{10}$

$10a = 16 \times 5$

$10a = 80$

$a = 8$

Check: $\frac{8}{16} = \frac{1}{2}$ and $\frac{10}{5} = \frac{2}{1}$ and $\frac{1}{2} \propto 2$ (indirect proportion)

Example:
Abel is traveling to Freetown. If he drives at the rate of 60 kph it will take him 2 hours. How much faster would he get to Freetown if he drove at the rate of 80 kph?

If he drives faster, he will take less time, so we use indirect proportion.
Write equivalent ratios, invert the second ratio and use cross multiplying.

$\frac{60 \text{ kph}}{80 \text{ kph}}$ and $\frac{2 \text{ hours}}{t \text{ hours}}$, so $\frac{60}{80} = \frac{t}{2}$

$60 \times 2 = 80t$

$120 = 80t$

$t = \frac{120}{80} = \frac{3}{2} = 1\frac{1}{2}$

At a speed of 80 kph, Abel will take $1\frac{1}{2}$ hours to drive to Freetown.

Topic 6: Indirect Proportion

Exercise

1. Complete the sentence:
   Indirect proportions are shown by the relationship one value (y) is equal to another value $\left(\frac{1}{x}\right)$ _____.
2. The following fractions are in direct proportion. $\frac{42}{7} \propto \frac{18}{3}$. Use these values to write an indirect proportion.
3. a) Express the following indirect proportions as equivalent fractions:
   12 : 24 ∝ 64 : 32
   b) Identify the extremes and the means in this proportion.
4. Find the value for x that completes the direct proportion:
   a) $\frac{3}{8}$ and $\frac{a}{48}$ are indirectly proportional. Find the value of a.
   b) 5 : 7 ∝ b : 30 are indirectly proportional. Find the value of b.
   c) 9 : 4 ∝ 36 : c are indirectly proportional. Find the value of c.
5. $y \propto \frac{k}{x}$. If x = 7 and y = 84, find the value of k.
6. 39 : *p* ∝ 8 : 24 are two indirectly proportional ratios. Find the value for *p* that completes the proportion.
7. Hawa has land for her cattle. There is enough grass for 50 cows for 9 days.
   How many days would the grass last if there were 75 cows?
8. Three painters were hired to paint a house and they expect it to take them 12 days.
   Their contract needs them to complete the painting in only 4 days. How many more painters do they need to join them to get the job finished in time?
9. Joe drives at the rate of 100 kph and it takes him 2 hours to get to Freetown. How much faster would he get to Freetown if he drove at the rate of 120 kph?
10. For each situation, identify if the values are directly or indirectly proportional to each other.
    a) There are 50 customers. 6 people serve them take aways faster than if 4 people serve them.
    b) A farmer sells 40 chickens on Friday and 50 chickens at the same price on Saturday.
    c) The manager usually pays 4 workers to clean the factory in 4 hours. He increases the number of workers. How does this affect the hours needed?

Check your answers:

1. multiplied by a constant k.
2. $\frac{42}{7} = \frac{18}{3}$ is direct, so $\frac{42}{7} \propto \frac{3}{18}$
3a) $\frac{12}{24} = \frac{32}{64}$.
b) 12 and 64 are the extremes; 24 and 32 are the means.
4a) $\frac{3}{8} = \frac{48}{a}$ 3a = 8 × 48 a = 128
b) $\frac{5}{7} = \frac{30}{b}$ 5b = 210 b = 42
c) $\frac{9}{4} = \frac{c}{36}$ 4c = 324 c = 81
5. y = kx 96 = k(8) k = 12
6. 39 : *p* ∝ 8 : 24
$\frac{39}{p} = \frac{24}{8}$ 24p = 39 × 8
$p = \frac{39 \times 8}{24} = 13$
7. 50 : 75 and 9 : x are indirectly proportional
$\frac{50}{75} = \frac{x}{9}$ $x = \frac{50 \times 9}{75} = \frac{18}{3} = 6$
75 cows would have grass for 6 days.
8. 3 painters take 12 days
1 painter takes 36 days
x painters take 4 days
4x = 36 So x = 9 painters.
9. 100 kph × 2 hours = 120 kph × *x* hours
10. a) indirect proportion b) direct proportion. The more chickens sold, the more money he makes.
c) The more workers, the less time is needed. indirect proportion.

Topic 7: Indices (exponents) M-08-021 to M-08-030 p51 – 71

Check that you can:	**Do you understand these words?**	*Refer to JSS2 Term 1*
• work with ratios, equivalent fractions and cross-multiplying	equivalent, direct proportion, indirect proportion, inverse	

CONCEPTS:

* In the number $\mathbf{3^2}$, 3 is the base of the number and 2 is the index or the power of the number.

* 3 squared means 3 times by itself (3×3)

* 2^3 is "2 cubed" or "2 to the power of 3". $2^3 = 2 \times 2 \times 2 = 8$

* $7 \times 7 \times 7 \times 7 \times 7 = \mathbf{7^5}$ "7 to the power of 5"

Examples:

$5^1 = 5$ $1^3 = 1 \times 1 \times 1 = 1$

$2 \times 2 \times 2 + 3 \times 3 \times 3 \times 3 + 4 \times 4 = 2^3 + 3^4 + 4^2$

Remember that we cannot add two indices with different bases.

* A number with a negative index can be rewritten as $(\mathbf{a})^{-\mathbf{n}} = \frac{\mathbf{1}}{\mathbf{a^n}}$

Example: $(\mathbf{2})^{-\mathbf{3}} = \frac{\mathbf{1}}{\mathbf{2^3}} = \frac{\mathbf{1}}{\mathbf{8}}$

Laws of indices

Law 1: When multiplying two indices with the same base, simply add the powers.

$\mathbf{a^m \times a^n = a^{m+n}}$

Example: $3^2 \times 3^4 = 3^{(2+4)} = 3^6$

Law 2: When dividing two indices with the same base, subtract the powers.

$\mathbf{a^m \div a^n = a^{m-n}}$ Example: $3^4 \div 3^2 = \frac{3^4}{3^2} = 3^{4-2} = 3^2$

Law 3: Any integer raised to the power of zero is 1. $\mathbf{a^0 = 1}$

Examples: $3^0 = 1$; $100^0 = 1$; $5k^0 = 5 \times 1 = 5$

$3^3 \div 3^3 = \frac{3^3}{3^3} = 3^{3-3} = 3^0$ but $\frac{3^3}{3^3} = \frac{27}{27} = 1$ This shows that $3^0 = 1$

Law 4: When a number is raised to an index (power) and raised to another power, we can multiply the powers together. $\mathbf{(a^m)^n = a^{m \times n}}$

Example: $(3^2)^4 = 3^{(2 \times 4)} = 3^8$

Law 5: $(a \times b)^n = a^n \times b^n$ Example: $(3 \times 5)^3 = 3^3 \times 5^3$

Law 6: $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$ where $b \neq 0$ Example: $\left(\frac{3}{5}\right)^3 = \frac{3^3}{5^3}$

Example:

$\frac{(2^4 \times 2^3)^2}{2^5} = \frac{(2^7)^2}{2^5}$ (add powers to multiply for $2^4 \times 2^3$)

$= \frac{2^{14}}{2^5}$ (multiply powers for $(2^7)^2$)

$= 2^9$ (subtract powers to divide)

Example:

$2^{-2} \times 2^4 \div (2 \times 3)^2$

$= \frac{2^4}{2^2} \div (2^2 \times 3^2)$

$= \frac{2^2}{2^2 \times 3^2} = \frac{1}{3^2}$

Topic 7: Indices (exponents)

Exercise

1. 1. True or false:

a.	$3^2 = 6$	b.	$2^4 = 8$	c.	$3^3 = 27$
d.	$5^2 = 10$	e.	$3^0 = 3$	f.	$10^0 = 1$

2. a. Write $2 \times 2 \times 2 \times 5 \times 5$ in index form.

   b. Write 2^{-3} with a positive index.

   c. Write $\frac{1}{5^2}$ with a negative index.

3. a. What is the square of 2^3?

   b. Simplify $2^5 \div 2^3 \times 2^{-1}$

   c. Which is bigger? 3^{-2} or 2^{-3}? Show your working.

4. Simplify the following. Leave your answer in the positive index form.

a.	$3^{-2} \times 2^2 \times (2^{-3})^2$	b.	$10^4 \times 10^{-4} \times 10$
c.	$5^3 \times 5^{-2} \times 2^{-3}$	d.	$2^3 \div 2^3$
e.	$x^7 \times y^2 \times y^{-3}$	f.	$x^0 \times x^4$
g.	$(2^4)^2\ (3^3)^2$	h.	$\frac{(3\times4)^2}{4^2}$
i.	$3^4 \div 3 \times 3^{-1}$	j.	$\frac{2^{-5}}{2^{-2}}$
k.	$\frac{x^4}{x^2} \times x^5$	l.	$y^2x^5 \div (xy)^3$
m.	$\left(\frac{2}{3}\right)^2 \times \left(\frac{3}{2}\right)^2$	n.	$3^5 \times 3^{-3} \div 3^0$

Check your answers:

1a. false $3^2 = 9$ b. false $2^4 = 16$ c. true

d. false $5^2 = 25$ e. false $3^0 = 1$ f. true

2a. $2^3 \times 5^2$ b. $\frac{1}{2^3}$ c. 5^{-2}

3a. 8

b. $2^5 \div 2^3 \times 2^{-1} = \frac{2^5}{2^3} \times \frac{1}{2} = \frac{2^2}{2} = 2$

c. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$ $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$ $\frac{1}{8} > \frac{1}{9}$

4a. $3^{-2} \times 2^2 \times (2^{-3})^2 = \frac{2^2}{3^2} \times 2^{-6}$

$= \frac{2^2}{3^2} \times \frac{1}{2^6} = \frac{1}{3^2 \times 2^4}$

b. $10^4 \times 10^{-4} \times 10 = 10^1$

c. $5^3 \times 5^{-2} \times 2^{-3} = 5^1 \times \frac{1}{2^3} = \frac{5}{2^3}$

d. $2^0 = 1$

e. $\frac{x^7y^2}{y^3} = \frac{x^7}{y}$

f. x^4

g. $2^8 3^6$

h. $\frac{(3\times4)^2}{4^2} = \frac{(3)^2(4)^2}{4^2} = 3^2$

i. $3^4 \div 3 \times 3^{-1} = 3^3 \times \frac{1}{3^1} = 3^2$

j. $\frac{1}{2^5} \div \frac{1}{2^2} = \frac{1}{2^5} \times \frac{2^2}{1} = \frac{1}{2^3}$

k. $x^2 \times x^5 = x^7$

l. $y^2x^5 \div (xy)^3 = \frac{y^2x^5}{x^3y^3} = \frac{x^2}{y}$

m. $\frac{2^2.3^2}{3^2.2^2} = 1$

n. $3^5 \times 3^{-3} \div 3^0 = \frac{3^2}{3^0} = 3^2$

Topic 8: Perimeter & Area Term 2, M-08-61 to M-08-67 p13 – 34

Check that you can:	**Do you understand these words?**	*Refer to JSS2 Term 2*
• Identify the perimeter and the area of any shape	Perimeter, area, length, width, perpendicular height, base, quadrilateral, trapezium	

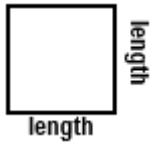
CONCEPTS:

Perimeter is the total length or distance around a shape.
Area is the size inside of a shape.

Quadrilaterals

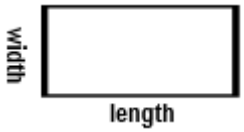
Perimeter (P) of a square = 4 × length (*l*)

Area (A) of a square = length (*l*) × length (*l*)

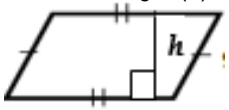


P of a rectangle = 2 × length (*l*) + 2 × width (*w*)

A of rectangle = *l* × *w*

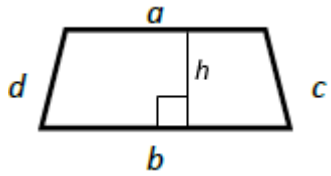


P of a parallelogram = 2 × length (*l*) + 2 × width (*w*)
A of a parallelogram = length of base × perpendicular height (*h*)



(A rhombus is a parallelogram with 4 equal sides)

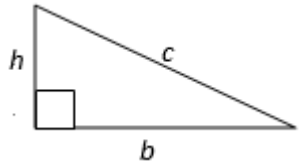
P of a trapezium = a + b + c + d
A of a trapezium = ½ h (a + b)



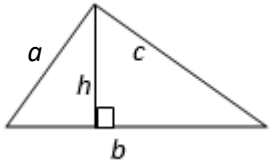
Triangles

P of any triangle = sum of the sides
P of right angled triangle = b + c + h

Area of right angled triangle = ½ × b × h

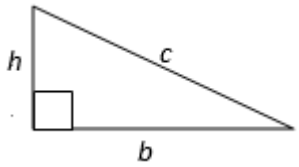


P of any triangle = a + b + c
Area of any triangle = ½ × b × h

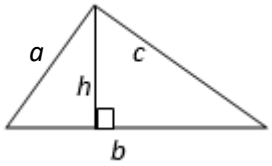


Topic 8: Perimeter & Area

Exercise

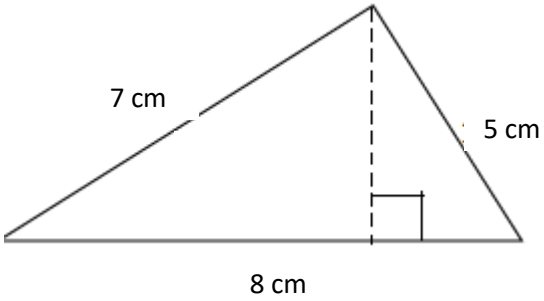


1. Refer to the right angled triangle.
   a. Calculate the perimeter of the triangle if:
      i. h = 2 m, c = 6 m and b = 5 m
      ii. h = 10 cm, b = 14 cm and c = 25 cm
   b. The perimeter of the triangle is 23 mm, h is 5 mm and b is 1 cm. Find the length of c in mm.
   c. The perimeter of the triangle is 18 m, h is 500 cm and c is 7 m. Find the length of b in metres.
   d. Calculate the area of the triangle if
      i. h = 2 m, c = 6 m and b = 5 m
      ii. h = 10 cm, b = 14 cm and c = 25 cm
   e. The area of the triangle is 30 m^2 and b is 12 m. Find the length of h in metres.



2. Refer to the triangle provided.
   Calculate the perimeter and the area if a = 6 cm, b = 9 cm, c = 7 cm and h = 3 cm.

3. Calculate the height of the triangle below if the area is 16 cm^2



Check your answers:

1a. i. 2 + 6 + 5 = 13 m.
ii. 10 + 14 + 25 = 49 cm
b. 1 cm = 10 mm
23 = 5 + 10 + c
c = 8 mm
c. 500 cm = 5 m
18 = 5 + 7 + b
b = 6 m
d. Area = ½ × b × h
i. Area = ½ × 5 × 2 = 5 m^2
ii. Area = ½ × 14 × 5 = 35 cm^2
e. Area = 30 m^2 = ½ × 12 × h
30 = 6h
h = 5 m
2. Perimeter = a + b + c
= 6 + 7 + 9 = 22 cm
Area = ½ × b × h
= ½ × 9 × 3 = 13.5 cm^2
3. Area = ½ × b × h
16 cm^2 = ½ × 8 × h = 4h
h = 16 ÷ 4 = 4 cm