Contents

Factors and Multiples

Chapter Summary

1. Prime numbers

A prime number is a number which has only two factors, 1 and the number itself.

Example :

{2, 3, 5, 7, 11, 13, 17, 19, …}

2. Composite numbers

A composite number is a number which has three factors or more.

Example :

{4, 6, 8, 9, 10, 12, …}

3. Prime factorisation

Prime factorization is a process where we express prime numbers as product of prime numbers.

Methods of prime factorization
- factor tree
- ladder method

4. Highest common factor (HCF)

Methods

- comparing

- ladder method

Example : comparing

$A = 2^2 \times 3^2 \times 11$

$B = 2 \times 3^3 \times 11$

$HCF = 2 \times 3^2 \times 11 = 198$

Example : ladder method

2	36, 48
2	18, 24
3	9, 12
	3, 4

$HCF = 2^2 \times 3 = 12$

5. Lowest common multiple (LCM)

Methods

- comparing

- ladder method

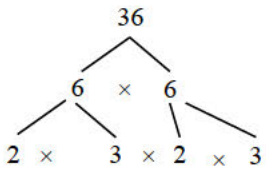
Example : comparing

$A = 2^2 \times 3^2 \times 11$

$B = 2 \times 3^3 \times 11$

$LCM = 2^2 \times 3^3 \times 11 = 1188$

Example : Factor tree



$36 = 2^2 \times 3^2$

Example : ladder method

2	36
2	18
3	9
3	3
	1

$36 = 2^2 \times 3^2$

Example : ladder method

2	36, 48
2	18, 24
2	9, 12
2	9, 6
3	9, 3
3	3, 1
	1, 1

LCM $= 2^4 \times 3^2 = 144$

6. Squares, Square roots, Cubes and Cube roots

A perfect square is a number that is the square of another number.

Example :

{0, 1, 4, 9, 16, 25 …}

A perfect cube is a number that is the cube of another number.

Example :

{0, 1, 8, 27, 64, …}

Factors and Multiples

Exam Questions:

Prime Factorisation, Highest common factor and lowest common multiples

1 (a) (i) Express 1617 as a product of its prime factors in index notation. [2]

(ii) State the smallest possible natural number n if $\frac{1617}{n}$ is a perfect square. [1]

(b) Written as a product of its prime factors, $270 = 2 \times 3^3 \times 5$.

(i) Express 250 as a product of its prime factors. [2]

(ii) Find the lowest common multiple of 250 and 270. Give your answer as the product of its prime factors. [1]

(iii) Find the smallest positive integer m such that $270m$ is a cube number. [2]

2 (a) Given that $\sqrt{n} = 3^2 \times 5$, find n as a product of its prime factors. [1]

(b) (i) Express 135 as a product of its prime factors, leaving your answer in index notation. [1]

(ii) Find the smallest whole number k, such that $135k$ is a perfect cube. [1]

3 180 expressed as a product of its prime factors is $2^2 \times 3^2 \times 5$.

(i) Express 2700 as a product of its prime factors. [1]

(ii) Find the smallest integer p such that $180p$ is a multiple of 2700. [1]

(iii) The lowest common multiple of two numbers is 2700.
The highest common factor of these two numbers is 180.
Both numbers are greater than 180. Find the two numbers. [2]

4 (a) The numbers P, Q and R, written as products of their prime factors are given below.

$$P = 2^3 \times 3^6$$

$$Q = 2^5 \times 3^3 \times 7^2$$

$$R = 2^2 \times 3 \times 5$$

Leaving your answers in index notation, find

(i) $\sqrt[3]{P}$, [1]

(ii) the lowest common multiple of P, Q and R, [1]

(iii) the highest common factor of P, Q and R. [1]

(b) m and n are positive integers. If m is less than n and $m \times n = 41$, write down the value of m and n. Explain your answer. [2]

5 (a) (i) Express 594 as a product of its prime factors. [1]

(ii) Find the smallest positive integer k such that $\frac{594}{\sqrt{k}}$ is a perfect cube. [1]

(b) (i) Megan is playing with 594 cubes. Megan uses all 594 cubes to make a cuboid. Each of the sides of the cuboid is made up of more than 3 cubes. Find the number of cubes on each side of the cuboid. [1]

(ii) Each cube has a volume of 2 cm^3. Calculate the maximum number of cubes that Megan can fit into a box of dimensions 8 cm by 10 cm by 10 cm. [2]

Applications of HCF and LCM

1 Derrick plans to pack 270 pieces of mask, 180 bottles of hand sanitizer and 360 packets of tissue paper equally into Care Packs for distribution to his neighbours.

(i) Find the maximum number of neighbours who can receive his Care Packs. [2]

(ii) He has 249 torchlights for equal distribution to the same neighbours who received his Care Packs. Find the number of extra torchlights needed to distribute equally amongst all neighbours. [2]

2 Three TraceTogether Token LED lights flashed together at 9:15am. If each of them flashed in intervals of 2 minutes, 3 minutes and 10 minutes respectively,

(i) find the next time they will flash together. [2]

(ii) Find the number of times they will flash simultaneously from 9:15am (inclusive) to 11:30am? [1]

3 Shufen needs to pack all 126 pens and 420 pencils into identical gift bags.

(i) Find the largest number of gift bags that can be packed. [2]

(ii) Hence, find the number of pens and pencils in each gift bag. [1]

4 Jovinna has 3 pieces of ropes with lengths of 7 m, 3 m 85 cm and 12 m 95 cm. She wishes to cut the 3 pieces into smaller pieces of equal length with no remainder.

(i) Find the greatest possible length of each of the smaller pieces of rope. [2]

(ii) Find the number of smaller pieces of rope can she get altogether. [1]

5 Lamp posts are positioned at intervals of 240 m along an expressway and pots of sunflower plants are placed at intervals of 192 m. The first pot of sunflower plant is placed at the foot of the first lamp post.

(i) If the last pot of sunflower plant is placed at the foot of a lamp post, find the distance between the first and the last pot of plant. [2]

(ii) Find the total number of lamp posts and pots of sunflower plants within this road segment. [2]

Real Numbers

Chapter Summary

1. Natural numbers

Natural numbers, N, are numbers which we count with.

Example :

{1, 2, 3, 4, 5, …}

2. Whole numbers

Whole numbers , W, are natural numbers with zero.

Example :

{0, 1, 2, 3, 4, …}

3. Integers

Integers, Z, are negative numbers, zero and natural numbers.

Examples :

{…, −3, −2, −1, 0, 1, 2, 3, …}

4. Rational numbers

Rational numbers, Q, are numbers which can be expressed in the form $\frac{a}{b}$, where a and b are integers and $b \neq 0$.

5. Irrational numbers

3 cases of irrational numbers :

(i) Square roots or cube roots of numbers which are not integers such as $\sqrt{2}, \sqrt{5}, \sqrt[3]{9}, \sqrt[3]{15}$

(ii) Terms involving π

(iii) Terms involving e

9. Addition of integers

(a) For any two negative integers, $-x$ and $-y$

$(-x) + (-y) = -(x + y)$

(b) For a positive integer x and a negative integer $-y$,

$x + (-y) = x - y$ if $x > y$

and $x + (-y) = -(y - x)$ if $x < y$

10. Subtraction of integers

For any two integers a and b, $a - b = a + (-b)$

11. Multiplication of integers

(+)(+) = (+)

(+)(−) = (−)

(−)(+) = (−)

(−)(−) = (+)

0 × anything = 0

12. Division of integers

(+) ÷ (+) = (+)

(−) ÷ (+) = (−)

(+) ÷ (−) = (−)

(−) ÷ (−) = (+)

0 ÷anything = 0, anything ÷ 0 = undefined

6. Real numbers

These are numbers that are on the number line.

7. Complex numbers

They are also known as imaginary numbers.

Example :

$\sqrt{-1}$

8. Recurring decimal

It is a decimal which has the same number of digits

repeated indefinitely.

Example :

$0.\dot{3} = 0.3333333..$

$0.\dot{2}\dot{5} = 0.25252525..$

$0.2\dot{3}6\dot{9} = 0.2369369369\ldots$

Real Numbers

Exam Questions:

Calculation (BODMAS)

1 Evaluate each of the following. Show your workings clearly.

(a) $4-(-8)$ [1]

(b) $7-2\times 5$ [1]

(c) $-3\times\left(7-\sqrt{25}+3^2\right)$ [2]

(d) $\left(-\frac{5}{9}\right)\div\left(-2\frac{1}{3}\right)$ [2]

2 Evaluate

(a) $\sqrt[3]{64}+\sqrt{121}$ [2]

(b) $\frac{1}{12}+\left(-\frac{2}{3}+\frac{1}{2}\right)\div 2\frac{2}{3}$ [2]

3 Without the use of a calculator, evaluate

(a) $-12+(-8)\times 2-(-21+25)^2$ [2]

(b) $\left(\frac{28}{6}+\frac{2}{3}\right)\div\frac{4}{9}$ [2]

Temperature changes

1 The table shows the average day and night temperatures in one day in Beijing, Singapore and Alaska.

	Beijing	Singapore	Alaska
Day	3°C	32°C	−4°C
Night	−8°C	24°C	−12°C

(i) Arrange the night temperatures of the three cities from the lowest to the highest. [1]

(ii) Find the difference between the day temperature in Singapore and the night temperature in Alaska. [1]

2 On a certain day in a town, the temperature was 14.6°C at noon.
At 0200 on the next day, the temperature was −3.4°C.

(i) Calculate the difference between the temperatures. [1]

(ii) Find the average rate of change in temperature per hour during this period of time. [2]

3

Month	**Temperature**					
	Sydney		**Ontario**		**Beijing**	
	Max	Min	Max	Min	Max	Min
1st September	12	2	5	1	12	9
1st October	5	−1	15	6	9	3
1st November	11	3	4	0	15	1
1st December	−5	−9	−11	−7	2	−3
1st January	−11	−13	−14	−19	5	−13

The table above shows the temperatures of different cities on various days of the year 2011 to early 2012.

(i) Calculate the difference between the maximum and minimum temperatures on the 1st October in Sydney. [1]

(ii) State the city which has the greatest temperature difference on 1st January. [1]

(iii) There is a mistake in the data given for Ontario. Identify the mistake and comment why it is wrong. [1]

Arrangment/Identification of numbers

1 $49 \quad \sqrt{25} \quad \pi \quad 1\frac{2}{3} \quad -2.7 \quad 0.\dot{3}$

(i) State the perfect square. [1]

(ii) State the irrational number. [1]

(iii) State the integer(s). [1]

2 (i) Write the following in descending order.

$0.203, \quad \sqrt{0.04}, \quad 0.21, \quad \frac{\pi}{15}, \quad 0.21\dot{2}$ [2]

(ii) Write down all the irrational numbers in (i) [1]

3 For the following numbers:

$1, \quad 3, \quad -1.5, \quad (-3)^2, \quad \sqrt{11}, \quad \pi, \quad -1\frac{5}{9}$

(i) Arrange the numbers in ascending order. [2]

(ii) List all the prime numbers. [1]

(iii) List all the irrational numbers. [1]

4 (i) Write the following in order of size, starting with the smallest first. [2]

$\frac{1}{3} \quad 30\% \quad \sqrt{0.1} \quad \pi \quad 3$

(ii) Write down all the numbers that are

(a) irrational numbers, [1]

(b) integers. [1]

Problem sums involving rational numbers

1 In a music examination, $\frac{1}{3}$ of the candidates achieve a Distinction. $\frac{2}{5}$ of the remaining candidates achieve a Merit. Find the fraction of candidates who achieve neither a Distinction nor a Merit. [2]

2 A group of primary school students took the science placement test. The results of the test were : $\frac{1}{5}$ of the students scored A, $\frac{1}{3}$ of the students scored B, $\frac{3}{7}$ of the students scored C, and the rest of the students failed the test. A total of 112 students scored A and B in the test. Find the number of students who failed the test. [2]

3 Muthu gave $\frac{3}{7}$ of his year-end bonus to his wife, $\frac{1}{2}$ of the remainder to his parents and the rest of the money left to be divided equally among his four children. As a result, each of his children received \$500. Calculate

(i) the fraction of Muthu's year-end bonus received by his parents, [2]

(ii) the amount of money received by Muthu's wife. [1]

Estimation and Approximation

Chapter Summary

1. Rules for rounding a number to a given number of significant figures.

(a) Count the given number of significant figures from left to right, starting with the first non-zero figure. Include one extra figure for consideration.

(b) If the extra figure is less than 5, drop the extra figure and all other following figures. Use zeros to keep the place value if necessary.

(c) If the extra figure is 5 or more, add 1 to the previous figure before dropping the extra figure and all other following figures. Use zeros to keep the place value if necessary.

2. Rules for determining the number of significant figures

(a) All non-zero figures are significant.

(b) All zeros between non-zero figures are significant.

(c) All zeros before non-zero figures are not significant.

(d) All zeros after the last non zero digit may or may not be significant.

Examples :

12007 = 12010 (4 s.f)

1.235 = 1.2 (2 s.f)

0.12304 = 0.1230 (4 s.f)

0.0012348 = 0.001235 (4 s.f)

1038 = 1000 (1 s.f)

= 1000 (2 s.f)

= 1040 (3 s.f)

Estimate the value of $\frac{0.237 \times \sqrt{24.87}}{2.43}$ to 1 s.f

Step 1 : Estimate everything except numbers in square root or cube root to +1 significant figure

Step 2 : Calculate

Step 3 : Estimate to what the question requires

Solution :

$$\frac{0.237\times\sqrt{24.87}}{2.43}=\frac{0.24\times\sqrt{25}}{2.4}$$
$$=0.5$$
$$=0.5\,(1\text{s.f})$$

Evaluate $0.998\times60.26-\frac{2.97^3}{9.015}\times33.44$ giving your answer to 3 significant figures

Step 1 : Calculate

Step 2 : Estimate to what the question requires

Solution :

$$0.998\times60.26-\frac{2.97^3}{9.015}\times33.44=-37.03895163$$
$$=-37.0\,(3\,\text{s.f})$$

Estimation and Approximation

Exam Questions:

1 (a) By rounding off each number to 1 significant figure, estimate the value of

$$\frac{17 - 1.45^3}{\sqrt{99} + 2.4}$$

Show your workings clearly. [2]

(b) Express $\frac{68}{11}$ as

(i) a recurring decimal, [1]

(ii) a decimal correct to 4 significant figures. [1]

2 Shampoo are sold in two sizes of bottles. The first bottle has a volume of 100 ml, costing \$6.95 and the second bottle has a volume of 400 ml, costing \$35.90. Using estimation, decide which option is more value for money. Show your workings clearly. [2]

3 By writing each number correct to 1 significant figure, estimate the value of

$$\frac{465.3 \times 9.82}{24.99}.$$

You must show your working. [2]

4 Estimate the value of $\frac{\sqrt{26.5}-3.133^2}{\sqrt[3]{345}}$, leaving your answer as a fraction. [2]

5 Estimate the value of $\frac{4.002^2 \times \sqrt{2504}}{7.04+2.95}$, showing your workings clearly. [2]

6 Calculate $\frac{\sqrt{3.71}}{(5.74-2.98)8.01}$.

Give your answer correct to 2 decimal places. [2]

7 (i) Calculate $\frac{\pi-0.4^2}{\sqrt{0.4}}$.

Write down the first 5 digits on your calculator display. [1]

(ii) Write your answer to part (a) correct to 2 significant figures. [1]

8 An iron block has a mass of 311 grams, correct to the nearest gram.

(i) Find the least possible mass of the iron block. [1]

(ii) The volume of the iron block is 45 cm^3, corrected to the nearest cubic centimetre. Find the greatest possible mass of 1 cubic centimeter of the iron block. [2]

Introduction to Algebra

Chapter Summary

1 Notations used in algebra :

Sum of a and b : $a + b$

Difference of a and b : $a - b$ or $b - a$

Product of a and b : ab

Quotient of a and b : $a \div b$

2 Understanding algebra

$y + y = 2y$

$y \times y = y^2$

3 We substitute each variable in an algebraic expression with its value to evaluate the expression.

For example, when $a = 2$, $b = -1$, $c = 5$,

$3a + 4b - 5c = 3(2) + 4(-1) - 5(5)$

$= -23$

Introduction to Algebra

Exam Questions:

1 An apple cost x cents while an orange cost y cents more than an apple. Find the total cost of 10 apples and one dozen oranges, giving your answer in dollars. [2]

2 David bought 12 pens and 2 notebooks. Given that a notebook cost $2p$ cents and a pen cost $\frac{p}{3}$ cents respectively, calculate the total amount of money he needs to pay in terms of p cents. [2]

3 During a stationary promotion, a particular brand of pens and erasers cost \$$x$ and $20y$ cents each respectively. A correction tape of the same particular brand cost three times as much as the total cost of a pen and an eraser of this particular brand. Write down and simplify, in terms of x and y, the total cost, in dollars, of

(i) 5 such pens and 4 such erasers [1]

(ii) 2 such pens, 3 such erasers and 1 such correction tape. [2]

4 A shopkeeper bought 24 pens at x cents each and 40 pencils at y cents each. He then repacked the pens and pencils into packets which contained 3 pens and 5 pencils. He sold each packet for $(7x + 8y)$ cents each.

(i) Write down, in terms of x and y, an expression for

(a) the amount of money he spent on the stationery, [1]

(b) the total amount of money received for selling all the packets of stationery. [1]

(ii) Find his profit, giving your answer in the simplest form. [1]

Evaluation of expression(s)

1 It is given that $4W = \frac{1}{2}m(v^2 - u^2)$.
Find the positive value of v when $W = 10,\ m = 4,\ u = 1$. [2]

2 Without the use of a calculator, evaluate $\frac{5x^2-6}{58-2\sqrt{1-k}}$, given that $x = -2$ and $k = -8$. [2]

3 It is given that $\frac{mn^2-4x}{z} = 11y$. Find the value(s) of n when $m = 7,\ x = 2,\ y = 1$ and $z = 5$. [2]

4 Find the value of $\frac{2p-q+1}{5q}$ when $p = 2$ and $q = -1$. [2]

5 If $A = P + \frac{PRT}{100}$, find R when $A = 2597$, $P = 2450$ and $T = 2$. [2]

Algebraic Manipulation

Chapter Summary

1 Terms

$4x - 5y + z - 6$

In the above expression, there are **four** terms.

Coefficient of $x = 4$

Coefficient of $y = -5$

Coefficient of $z = 1$

Constant term $= -6$

2 Expansion

For example : $-5(x - 2y) = 5x + 10y$

3 Addition and subtraction of polynomials

(i) Remove brackets – Take note when there is a negative sign outside a pair of brackets

(ii) Rearrange

(iii) Simplify

Example :

Subtract $7(c - b + 6a)$ from $5(b + a - 6c)$

$5(b + a - 6c) - 7(c - b + 6a) = 5b + 5a - 30c - 7c + 7b - 42a$

$= 12b - 37a - 37c$

4 Addition and subtraction of algebraic fractions

(i) Find LCM

(ii) Multiply

(iii) Combine

(iv) Simplify

Example :

Simplify $\frac{x}{6} - \frac{x-3}{4}$

$$\frac{x}{6}-\frac{x-3}{4}=\frac{2(x)-3(x-3)}{12}$$

$$=\frac{2x-3x+9}{12}$$

$$=\frac{-x+9}{12}$$

5 Factorisation – Common factor

(i) Find the highest common factor of the terms

(ii) Express each term as a product of the HCF and its remaining factors

(iii) Factorise the given expression, with the HCF as one of its factors

Example :

Factorise $8x + 12xy$

$8x + 12xy = 4x(2 + 3y)$

6 Factorisation – Grouping

(i) Group the terms so that the first two terms have a common factor and the last two terms have a common factor

(ii) Factor out the HCF from each group

(iii) Further factorise the given expression, with the factor common to both groups as one of the factors

Example :

Factorise $2hx – 5x – 15y + 6hy$

$2hx – 5x – 15y + 6hy = x(2h – 5) – 3y(5 – 2h)$

$= x(2h – 5) + 3y(2h – 5)$

$= (2h – 5)(x + 3y)$

Algebraic Manipulation

Exam Questions:

Expansion

1 Simplify

(a) $3(2w-1)+1$, [1]

(b) $5(2x-y)+2(y-5x)$. [2]

2 Show that $2(3n-1)+14$ is a multiple of 6 for all integer values of n. [2]

3 Expand and simplify the following expressions.

(a) $2a(7+3b)-b(3a)$, [2]

(b) $7(3a-1)-2(1+4a)$. [2]

4 (a) Subtract $3x^3 - x^2 + 7x - 5$ from the sum of $2x^3 + 3x - 4$ and $x^3 + 6x^2 - 2x + 1$. [2]

(b) What must be added to $3x^3 - 6x^2 + 4x - 8$ to get $19 - 6x + 9x^2 + 7x^3$? [2]

5 (a) Simplify $2(x^2 - 5x) - 7(x - x^3 + x^2 - 1)$. [2]

(b) Expand and simplify $-(2a + 5) + 3(4 + 2a)$. [2]

Factorisation

1 Factorise

(a) $-14xy - 21y$, [1]

(b) $12ac - 6ab + 8c$. [1]

(c) $28mx - 4x$. [1]

2 Factorise

(a) $10ay + 5a - 25ax$. [1]

(b) $4x^2y^3 + 2xy^2 - 6x^3y^3$ [2]

3 Factorise each of the following completely

(a) $3x + 9y$ [1]

(b) $5x^2 - 10xy$, [1]

4 Factorise the following expressions.

(a) $4p(a - 2) - 16q(a - 2)$. [2]

(b) $2p(q + r) - 4s(q + r)$. [2]

Algebraic Fractions

1 Simplify

(a) $\frac{x+5}{3} - \frac{2-3x}{4}$ [2]

(b) $\frac{3x+4y}{6} - \frac{2x-2y}{4}$ [2]

(c) $\frac{2x-1}{2} - \frac{x+4}{7}$ [2]

2 (a) Expand and simplify the expression $\frac{2-3x}{3} - \frac{2(2x-3)}{4}$. [2]

(b) Expand and simplify the expression $\frac{9(1+k)}{4} - \frac{2k(3m-7)}{5}$ [2]

3 (a) Express $\frac{x+1}{2} - \frac{2x-1}{3} + 1$ as a single fraction in its simplest form. [3]

(b) Simplify the following expression into the simplest form. [3]

$3x - \frac{x+2}{2} - \frac{3x-2}{3}$.

4 Simplify

(a) $\frac{9-m}{6} + \frac{2m-1}{3}$. [2]

(b) $\frac{2x}{3} - \frac{3(2+x)}{5}$ [2]

Simple equations in one unknown

Chapter Summary

1 Linear equation

A linear equation is of the form $ax + b = 0$, where a and b are constants and $a \neq 0$.

2 Equations involving brackets

Remove the brackets first when solving such equations.

Example :

$4(5x - 8) = 3(6x - 5) + 10$

$20x - 32 = 18x - 15 + 10$

$20x - 18x = -15 + 10 + 32$

$2x = 27$

$x = 13.5$

3(a) Fractional equations [Fraction = Fraction]

(i) Cross multiply

(ii) Remove the brackets first when solving the equations.

Example :

$$\frac{x}{4x+5} = -\frac{2}{3}$$

$3(x) = -2(4x + 5)$

$3x = -8x - 10$

$3x + 8x = -10$

$11x = -10$

$$x = -\frac{10}{11}$$

3(b) Fractional equations

(i) Multiply each term by the LCM of the denominators.

(ii) Remove the brackets first when solving the equations.

Example :

$$\frac{x-4}{3}-\frac{2x+1}{6}=\frac{5x-1}{2}$$

$2(x-4)-(2x+1)=3(5x-1)$

$2x-8-2x-2=15x-3$

$2x-2x-15x=-3+8+2$

$-15x=7$

$$x=-\frac{7}{15}$$

4 Constructing linear equations to solve problems

(i) Read the question carefully and identify the unknown quantity

(ii) Use a letter to represent the unknown quantity

(iii) Express other quantities in terms of the letter

(iv) Form an equation based on the given information

(v) Solve the equation

(vi) Write down the answer statement

Simple Equations in one unknown

Exam Questions:

Linear Equations

1 Solve $2(3a - 1) = 5a - 12$. [3]

2 Solve $3(c - 2) = 1 - (3 - c)$. [2]

3 Solve the equation $6x - 8 = 2(6x + 3) - 4(3x - 1)$. [3]

4 Solve $3x - 4(2 - x) = 6$. [2]

5 (a) Solve the equation $-3(3 - y^2) = 3$ [3]

(b) Solve the equation $108 - x^2 = \frac{x^2}{3}$. [3]

Fractional equations

1 Solve the following equations.

(a) $\frac{5b+2}{3} = 4$ [2]

(b) $\frac{2x+7}{3} + \frac{x}{2} = 1$ [2]

2 (a) Given that $a = -1$, $b = 2$, evaluate $\frac{-2a+b}{b-a^2}$. [1]

(b) Solve $\frac{5}{x+3} = \frac{2}{x}$. [2]

(c) Solve $\frac{x}{2} - \frac{x+2}{10} = 1$. [2]

3 Solve $\frac{3}{5x-2} = \frac{4}{1-x}$. [2]

4 Solve $\frac{x-2}{2} = \frac{3x-4}{4} - \frac{x-3}{8}$. [3]

5 Solve $\frac{3x}{4} - \frac{2(x-1)}{3} = 1 - \frac{2x+3}{6}$. [3]

Word problems on equations

1 The length of a rectangle is x cm. The breadth is 2 cm shorter.

(i) Express the breadth in terms of x. [1]

(ii) Given that the perimeter is 20 cm, form an equation in terms of x. [1]

(iii) Solve the equation and find the area of the rectangle. [2]

2 Andy has $2x$ books. Bill has 4 more books than Andy. Carol has half as many books as Bill.

(i) Write down an expression in terms of x for the number of books Carol has. [1]

(ii) Write down an expression for the total number of books they have. [1]

(iii) Hence, if the total number of books is 16, find the number of books Andy have. [1]

3 10 apples cost \$$x$.

An apple costs 20 cents less than a pear.

(i) Write down, in terms of x, an expression for the cost of an apple. [1]

(ii) Write down, in terms of x, an expression for the cost of a pear. [1]

Denise bought 10 apples and 3 pears for \$8.40.

(iii) (a) Write an equation in x to represent this information. [1]

(b) Solve the equation in (c)(i). [2]

(c) Calculate the cost of a pear. [1]

4 There are three numbers such that the second number is three times the first and the third is three less than four times the first. It is given that x is the first number and the sum of the three numbers is 37.

(i) Write down an algebraic expression for the second and third numbers. [2]

(ii) Form an equation connecting the three algebraic expressions. [1]

(iii) Solve the equation and find the largest number. [2]

5 The shaded region in the diagram represents a grass field bounded by a running track. In the field, there is a sand trap ABCD. The dimensions of the sand trap are given in the diagram below.

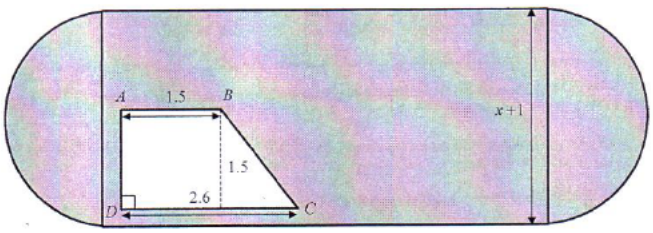
(i) The breadth of the rectangle is $(x + 1)$ m and the length is three times the breadth. Given that the perimeter of the rectangle is 40 m, form an equation in x and show that it reduces to $8x = 32$. [3]

(ii) Hence, find the value of x. [1]

(iii) Find the area of the sand trap ABCD. [1]

(iv) Using your answer from (ii), calculate the area of the grass field bounded by the track. [2]

(v) Every 5 m^2 of the grass field requires 13 litres of water. Find how much water is needed to water the entire field. [1]



Number Patterns

Chapter Summary

1 The n^{th} term, T_n, of a sequence is its general term.

2 Formula of a common difference number pattern : $a + (n - 1)d$

$a = 1^{st}$ term, $d = 2^{nd}$ term $- 1^{st}$ term

For example: 2, 5, 8, 11, (common difference = 3)

Thus the n^{th} term $= 2 + (n - 1)(3) = 3n - 1$

Number Patterns

Exam Questions:

1 The first four terms of a sequence are 2, 5, 8, 11.

(i) Write down the 7^{th} term of the sequence. [1]

(ii) Find an expression, in terms of n, for the n^{th} term of the sequence. [1]

(iii) One term in the sequence is 455. Find the value of n for this term. [1]

(iv) Explain why the term 460 cannot exist in this sequence. [2]

2 The first four numbers of a sequence are 3, 8, 13 and 18.

(i) Find the sixth term in the sequence. [1]

(ii) Write down, in terms of n, an expression for the nth term. [1]

(iii) Hence, find the 37^{th} term in the sequence. [1]

(iv) Explain clearly if 244 is a term in this sequence. [2]

3 In the following pattern, 2, 8, 18, 32, 50, …

(i) Find the 6^{th} term. [1]

(ii) Find the n^{th} term. [1]

(iii) Hence, state the n^{th} term for this pattern −1, 5, 15, 29, … [1]

4 The first four terms in a sequence of numbers, A_1, A_2, A_3, A_4, … are given below.

$$1^2, 2^2, 3^2, 4^2, \ldots$$

(a) Find an expression, in terms of n, for A_n. [1]

(b) The first four terms in another sequence of numbers, B_1, B_2, B_3, B_4, … are given below.

$$4, 7, 10, 13, \ldots$$

Find an expression, in terms of n, for B_n. [1]

(c) The first three terms in a different sequence of numbers, T_1, T_2, T_3, …, are given below.

$$T_1 = 1^2 + 4 = 5$$

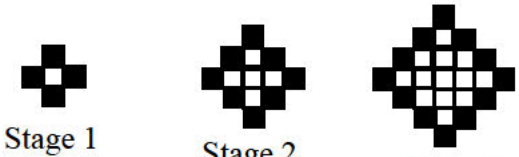
$$T_2 = 2^2 + 7 = 11$$

$$T_3 = 3^2 + 10 = 19$$

(i) By using your answers to part (a) and (b) of this question, find an expression, in terms of n, for T_n. [1]

(ii) Evaluate T_{20}. [2]

5 The diagram shows the start and the first 3 stages of a growing square of sides 1 unit each.



Stage 1 Stage 2 Stage 3

(i) Study the patterns and find the values of x, y and z. [2]

Stage n	Shaded area S	Perimeter P	Total area A
1	4	12	5
2	8	20	13
3	12	28	25
4	x	y	z

(ii) Express S in terms of n. [1]

(iii) Find a formula for P in terms of n. [1]

(iv) Determine if the number 166 would appear in the P column, stating your reasons clearly. [2]

(v) Find the total area in stage 25. [1]

Angles and Parallel lines

Chapter Summary

1. A point has a position and no size.

Example : point A • , point B ×

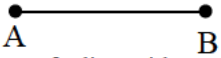
2. A line has an infinite number of points and has no width. It usually refers to a straight line.

Example :

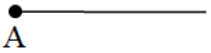
3. A curve refers to a curved line.

Example : 

4. A line segment is part of a straight line between and including two end points which has length.

Example : 

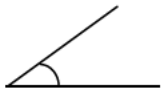
5. A ray is a part of a line with one end point.

Example : 

6. A plane is a flat surface which has no thickness.

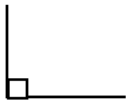
Example : 

7. An acute angle is an angle which is less than 90°.



8. An obtuse angle is an angle more than 90° but less than 180°.

9. A right angle is an angle which is equal to 90°.

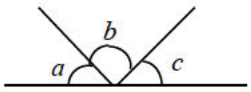


10. A reflex angle is an angle which is more than 180° but less than 360°.

11. Two angles are complementary angles if they add up to 90°.

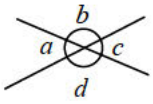
12. Two angles are supplementary if they add up to 180°.

13. Adjacent angles on a straight line



$a + b + c = 180°$ (adj $\angle$ s on st. line)

14. Angles at a point

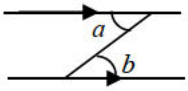


$a + b + c + d = 360°$ ($\angle$ s at a pt.)

15. Vertically opposite Angles

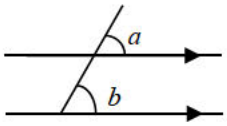
$x = y$ (vert. opp. $\angle$ s)

16. Alternate angles



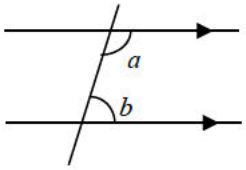
$a = b$ (alt. $\angle$ s)

17. Corresponding angles



$a = b$ (corr. $\angle$ s)

18. Interior angles



$a + b = 180°$ (int. $\angle$ s)

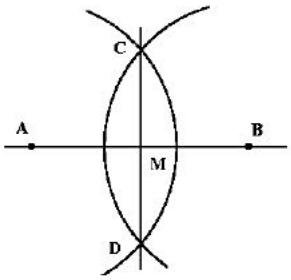
19. Constructing perpendicular bisector of the line AB

- Draw a given line segment AB

- With centre at A and radius more than half of the length AB, draw an arc on each side of AB

- With centre at B and same radius as in step two, draw an arc on each side of AB to cut the first two arcs at C and D.

- Draw the line CD. Then CD is the perpendicular bisector of AB



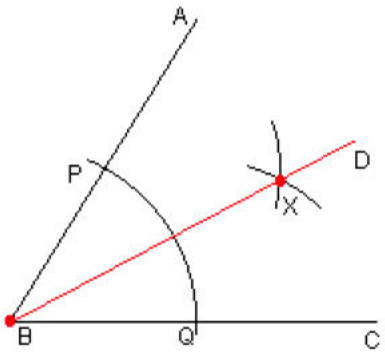
20. Constructing angle bisector

- Draw the given angle $\angle ABC$

- With B as centre, draw an arc to cut AB at P and BC at Q.

- With P and Q as centres and equal radii, draw two arcs to intersect at X.

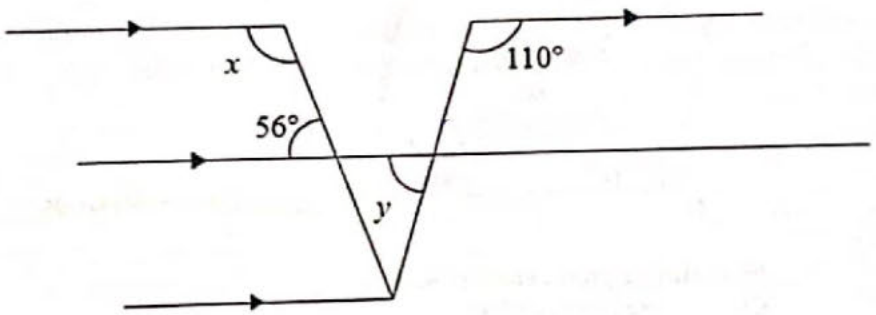
- Join B and X. Then BXD is the angle bisector of angle ABC.



Angles and Parallel lines

Exam Questions:

1 Find the values of x and y in the following figure. Show your working and state the reasons clearly. [3]

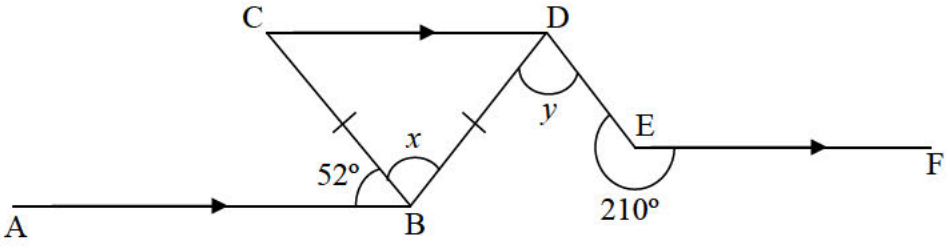


2 In the figure, BC = BD, $\angle ABC = 52^o$, $\angle DEF = 210^o$ and AB // CD // EF.

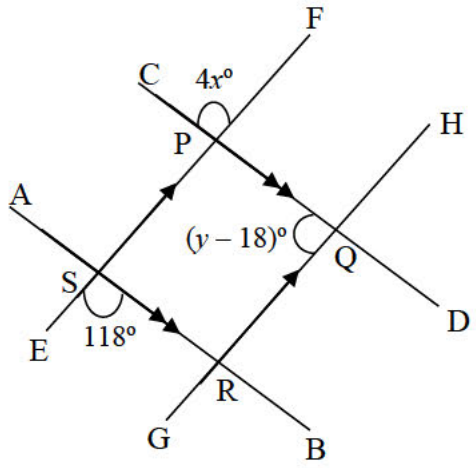
Find, stating reason(s) clearly,

(a) $\angle x$, [2]

(b) $\angle y$ [2]



3 In the diagram below, AB is parallel to CD and EF is parallel to GH. By stating the reasons clearly in your working, find the value of x and of y. [4]



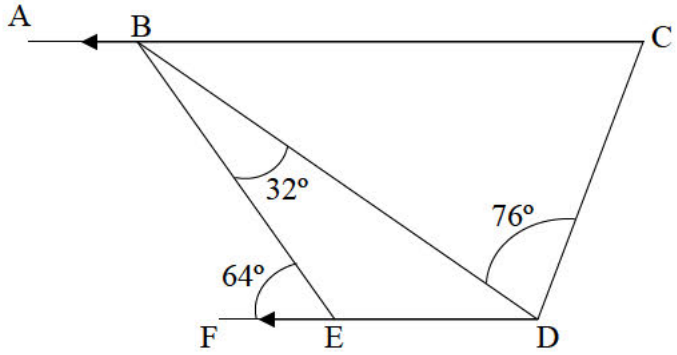
4 In the diagram, ABC and FED are straight lines.

AC is parallel to FD. Angle BEF = 64°, angle BDC = 76° and angle BCD = 72°.

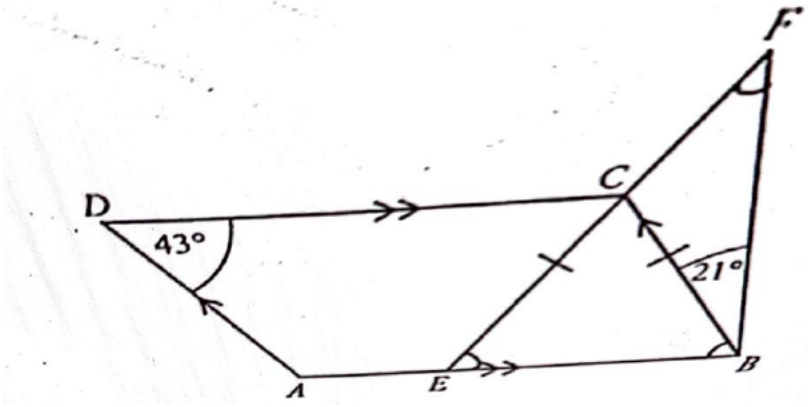
(a) Find angle BED. [1]

(b) Find angle BDE. [2]

(c) Show that triangle DEB is isosceles. [2]



5



$ABCD$ is a parallelogram. ECF and BF are straight lines. $CE = CB$, $\angle ADC = 43°$ and $\angle CBF = 21°$. E is a point on AB.

Stating your reasons clearly, find $\angle EFB$. [4]

Triangles and Polygons

Chapter Summary

1. In an equilateral triangle, all sides and angles are equal.

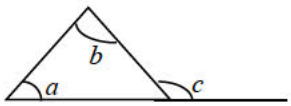
2. In an isosceles triangle, two sides and two angles are equal.

3. In a right-angled triangle, one of its angles is 90°.

4. In a triangle, all angles add up to 180°. (sum of $\angle s$ in Δ)

5. Two interior angles of a triangle add up to an exterior angle of a triangle. (ext. $\angle s$ of Δ)

(i.e. $a + b = c$)



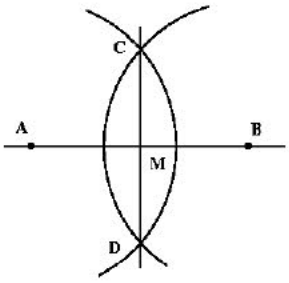
6. Properties of quadrilaterals (Please refer to page 21).

7. A regular polygon has equal sides and angles.

9. The sum of exterior angles of a polygon = 360°.

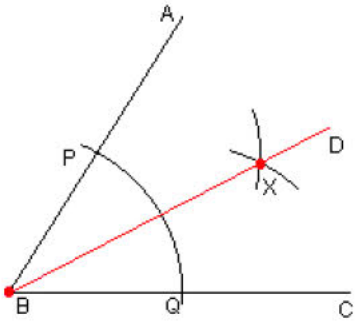
10. Constructing perpendicular bisector of the line AB

- Draw a given line segment AB
- With centre at A and radius more than half of the length AB, draw an arc on each side of AB
- With centre at B and same radius as in step two, draw an arc on each side of AB to cut the first two arcs at C and D.
- Draw the line CD. Then CD is the perpendicular bisector of AB



11. Constructing angle bisector

- Draw the given angle $\angle ABC$
- With B as centre, draw an arc to cut AB at P and BC at Q.
- With P and Q as centres and equal radii, draw two arcs to intersect at X.
- Join B and X. Then BXD is the angle bisector of angle ABC.



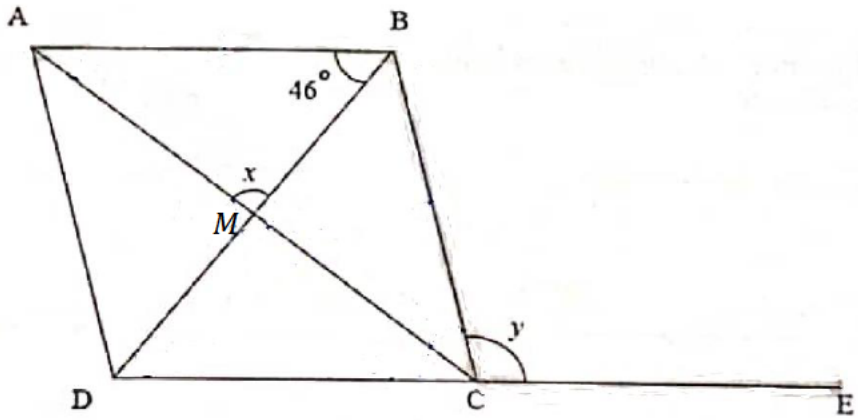
Triangles and Polygons

Exam Questions:

Polygons

1 (a) A regular polygon has interior angles of $156°$ each. Find the number of sides of the polygon. [2]

(b) The diagram shows a rhombus $ABCD$. $BD = 14$ cm, $\angle ABM = 46°$ and DCE is a straight line.



Find, stating your reasons clearly,

(i) the length of BM, [1]

(ii) $\angle x$, [1]

(iii) $\angle y$. [2]

2 (a) Find the size of each interior angle of a regular 24-sided polygon. [2]

(b) An n-sided polygon has 3 exterior angles that are 15°, 20° and 25°. The remaining exterior angles are 60° each. Find the number of sides, n, of this polygon. [3]

3 The figure below illustrates a regular n-sided polygon.

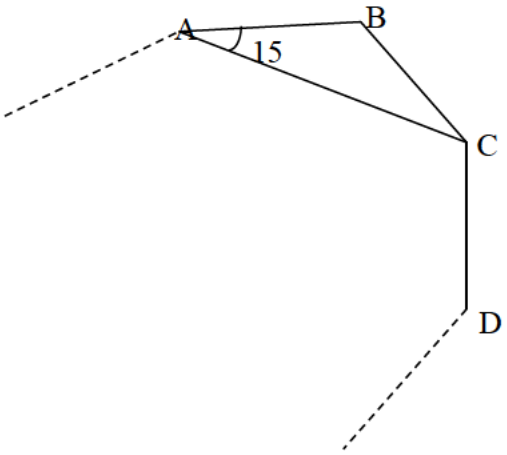
(i) State the special name given to triangle ABC. [1]

Find

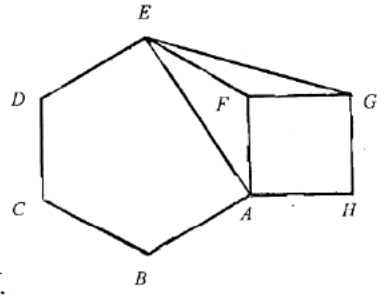
(ii) $\angle ABC$ [1]

(iii) value of n, [3]

(iv) reflex $\angle ACD$ [2]



4 In the figure, $ABCDEF$ is a regular hexagon and $AFGH$ is a square.
Find



(i) $\angle ABC$, [1]

(ii) $\angle EFG$, [1]

(iii) $\angle AED$, [2]

(iv) the sum of the interior angles of $ABCDEGH$. [2]

5 A regular polygon has n sides. The ratio of each exterior angle to each interior angle is 2:7.

(i) Find the size of each exterior angle. [1]

(ii) Calculate the value of n. [2]

Construction

1 (i) Construct a triangle ABC where AB = 8 cm, BC = 7 cm and AC = 5 cm. [1]

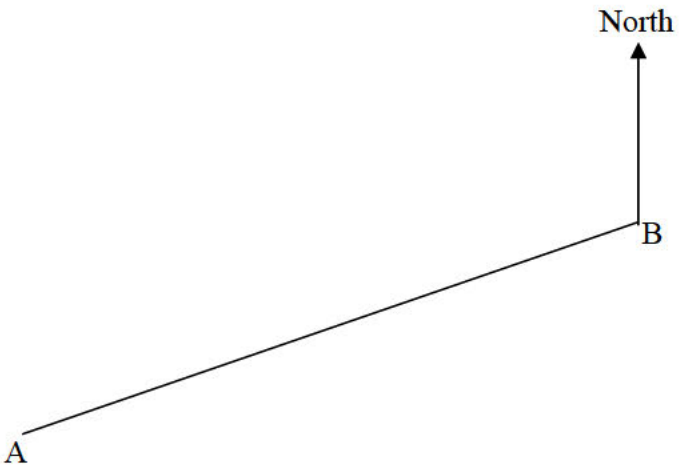
(ii) Draw the perpendicular bisector of AB. [1]

(iii) Draw the angle bisector of angle BAC. [1]

(iv) X is the point of intersection between the perpendicular bisector of AB and the angle bisector of angle BAC. Mark on your diagram the point X. [1]

2 A map is drawn to a scale of 1 cm to 3 km.

The diagram below shows the positions of two villages A and B on the map.



(i) A third village, C lies north of the line AB.

It is 21 km from A and 18 km from B.

Using ruler and compasses only, construct triangle ABC. [2]

(ii) Construct the perpendicular bisector of AB. [1]

(iii) Construct the angle bisector of $\angle ABC$. [1]

(iv) The villages A, B and C want to build a petrol station, P. One of the condition is that the petrol station must be of equal distance from the three villages. Show on the diagram and mark with point P where the petrol station should be built. [2]

3 In trapezium ABCD, AB = 6 cm, AD = 6.5 cm, DC = 10 cm, $\measuredangle ADC = 60°$ and A is above the line DC. AB is parallel to DC.

(i) Using a ruler, compass and a protractor, construct trapezium ABCD with DC as the base of the trapezium. [2]

(ii) Construct

(a) the bisector of angle BCD, [1]

(b) the perpendicular bisector of DC. [1]

4 The diagram below shows a fidget spinner. Points A, B and C are corresponding points at each blade on the spinner.

(i) Construct the perpendicular bisector of AB. [1]

(ii) Construct an angle bisector of $\measuredangle ACB$. [1]

(iii) Suggest a possible characteristic of all fidget spinners. [1]

Ratio, Rate and Speed

Chapter Summary

1. Ratio is a comparison of two similar quantities.

$$a : b = \frac{a}{b}$$

2. Rate is a comparison of two quantities. It is usually expressed as one quantity per unit of another quantity.

Example : \$2.50 /kg

3. Average speed = $\dfrac{\text{total distance travelled}}{\text{total time taken}}$

4. From m/s to km/h : multiply by 3.6

5. From km/h to m/s : divide by 3.6

Ratio, Rate and Speed

Exam Questions:

Ratio

1 (a) Express 150 m : $1\frac{4}{5}$ km in its simplest form. [1]

(b) Given that $a:b = 3:8$ and $b:c = 2:5$, find the ratio of $a:b:c$ in its simplest form. [2]

2 Vinegar and water are mixed in the ratio 1:4 by volume. If the volume of the solution is 900 cm^3,

(i) find the volume of vinegar in the solution, [1]

(ii) how much vinegar must be added to the solution so that the ratio of volume of vinegar to volume of water in the solution becomes 1:3? [2]

3 Amy had a number of red pens and green pens. The ratio of the number of red pens to the number of green pens is 3:5. $\frac{1}{2}$ of the red pens and $\frac{2}{3}$ of the green pens ran out of ink. Find the new ratio of the number of red pens and green pens, giving your answer in its simplest form. [3]

4 There are 8.1 million adult citizens in a country. 7.2 million adult citizens voted for one of three candidates to be the new president during the presidential election. The votes received by the candidates were in the ratio 3:4:9. Calculate

(a) the number of votes received by the winner, [2]

(b) the percentage of the adult citizens who did not vote. [2]

Rate

1 (a) A builder works for 7 hours daily. He receives a daily wage of $91.

(i) Find his hourly wage. [1]

(ii) If he works 5 days a week, find his weekly wage. [1]

(b) The builder is paid an extra 50% for overtime work.

(i) Calculate his hourly wage for overtime work. [1]

(ii) Find the number of overtime hours he must work to earn $552.50 in a week. [2]

2 On a particular day, the exchange rate between the American dollar (US$) and the Singapore dollar (S$) is US$1 = S$1.36.

A man bought a camera for S$250.

Find the cost of the camera in US$ to the nearest dollar. [2]

3 The rate of exchange between pounds (£) and United State dollars ($) was £1 = $1.65. On the same day, the rate of exchange between pounds (£) and euros was £1 = 1.44 euros.

(i) Javier changed £500 into dollars. Calculate the amount received in dollars. [1]

(ii) Tricia changed 900 euros into pounds. Calculate the amount received in pounds. [1]

(iii) Kenny changed $792 into euros. Calculate the amount received in euros. [1]

4 Charisse bought a bag during her tour in Paris at 3336 Euros (€).

(a) If the exchange rate is 1 SGD = €0.624, find the amount Charisse paid in SGD, to the nearest dollar. [1]

(b) The same bag appeared on a local website shown below.

Calculate the percentage discount Charisse received from the purchase in Paris as compared to the price below. [2]

CHENAL'S GABREIL HOBO BAG

AGED CALFSKIN, SMOOTH CALFSKIN

SILVER-TONE & GOLD-TONE METAL

BEIGE & BLACK

25 × 31 × 10 CM

SGD 5940

(c) After a few months, Charisse sold the bag online at $4000. Express the loss Charisse would have incurred if she bought it in Singapore as a fraction of the local price. [1]

5 Diana takes 6 mins to mark 1 script. Eileen takes 2 more minutes to mark 1 script.

(a) Find the number of scripts Eileen can mark in 40 minutes. [1]

(b) Calculate the amount of time, in hours and minutes, they take to mark 42 scripts in a combined effort. [2]

Speed

1 A man took 18 minutes to cycle from his house to the food centre at an average speed of 16 km/h.

(i) Find the distance between his house and the food centre. [2]

(ii) If he increased his average speed by 8 km/h, find the difference in the time taken to travel the same distance. Leave your answer in minutes. [2]

(iii) Convert 20 km/h to m/s. [2]

2 A bus leaves Town A at 8:00 am and arrives at Town B on the same day at 1.15 pm. The distance between Town A and Town B is 315 km.

(a) Find the time taken for the bus journey, in hours and minutes, correct to the nearest minute. [1]

(b) Calculate the average speed of the bus for the entire journey in kilometres per hour. [3]

3 Amir left City A at 10.20 a.m. and arrived at City B, 150 km away, at 11.50 a.m.

(a) What was the speed, in km/h, for his journey between City A and City B? [1]

After a 20 minutes rest at City B, he travelled to City C for 1 hour 15 minutes.

(b) Find the time that he would reach City C. [1]

Amir's speed between City C and City B is 20 km/h faster than his previous speed.

(c) What was the average speed, in km/h, for the whole journey? Leave your answer to 2 decimal places. [2]

4 During their physical education lessons, Eva and Linda took their 2.4 km running test.

(a) Eva completed the run in 16 minutes.
Express her speed in metres per second. [2]

(b) Eva's speed was 5% slower than Linda.
Calculate the speed of Linda. [2]

5 (a) The 18.45 km race of the Straits Times Run 2017 was flagged off at 0500 hr and was won by Kenyan James Karanga who clocked 1 hr 35 min 54 sec.

Find the time James Karanga finished the race in 12 hour format. [1]

(b) Calculate the average speed of James Karanga in m/s. [2]

(c) Ivan Low, who won the 2013 edition, clocked 53 min 22.34 sec in the 15 km race. Comment on whether James is a better runner than Ivan. [2]

Percentage

Chapter Summary

Summary notes

1 A percentage is a fraction with 100 as the denominator. (i.e. $x\% = \frac{x}{100}$)

2 $\text{Percentage increase} = \frac{\text{new value} - \text{original value}}{\text{original value}} \times 100\%$

3 $\text{Percentage decrease} = \frac{\text{original value} - \text{new value}}{\text{original value}} \times 100\%$

4 $\text{Percentage discount} = \frac{\text{marked pice} - \text{selling price}}{\text{marked price}} \times 100\%$

Percentage

Exam Questions:

1 In 2019, the cost of water was \$1.50 per m^3. In 2020, it increased to \$1.80 per m^3.

(i) Calculate the percentage increase in the cost of water from 2019 to 2020. [2]

(ii) In 2021, the cost of water is reduced by 5% as compared to that of 2020. Calculate the cost of water in 2021. [2]

2 In a year, David earned a gross annual income of \$105 000.

Personal relief	\$3000
Wife relief	\$2000
Child relief	\$2600 per child
Central Provident Fund (CPF) contributions	\$21 000

David has a wife and four children.

(i) Find the total amount of reliefs David is entitled to. [2]

(ii) The taxable amount of income can be calculated using

Taxable amount of income = Gross annual income – Reliefs.

From the taxable amount of income, the income tax payable for the first \$40 000 is \$550 and the tax rate for the rest is 7%.

Find his income tax payable. [3]

3 A new car is selling at a price of $105 000.

Michael bought the car on a hire purchase scheme according to the terms shown below.

- A downpayment of 40%
- The remaining amount is to be paid in monthly instalments over 84 equal monthly payments at a simple interest rate of 2.5% per annum.

(i) Calculate the remaining amount to be paid in monthly instalments. [1]

(ii) Find Michael's monthly instalment. [4]

4 The cash price of a car is $168 000. Alan buys the car on hire purchase. He pays a downpayment of 40% of the cash price and takes a car loan for the remaining amount. He pays a monthly instalment of $1810.24 for 5 years to the bank.

(i) What is the total amount Alan will pay for the car? [1]

(ii) Find the extra cost of buying the car on hire purchase as a percentage of the cash price. [2]

(iii) Find the annual interest rate on the loan. [4]

5 The length and breadth of a rectangle are p cm and q cm respectively.

(i) Write down an expression, in terms of p and q, for the area of the rectangle. [1]

The length of the rectangle is increased by 20% and the breadth of the rectangle is decreased by 20%.

(ii) Find an expression, in terms of p and q, for the area of the new rectangle. [2]

(iii) Hence, calculate the percentage change in the area of the rectangle. [2]

Coordinates and Linear Graphs

Chapter Summary

1 Coordinates of C = (a, b), where

a = x-coordinate

b = y-coordinate

2 Gradient of line L = $\dfrac{\text{vertical change}}{\text{horizontal change}} = \dfrac{y_2 - y_1}{x_2 - x_1}$

3 A linear function is a straight line with equation $y = mx + c$, where

m = gradient

c = y-intercept

Coordinates and Linear Graphs

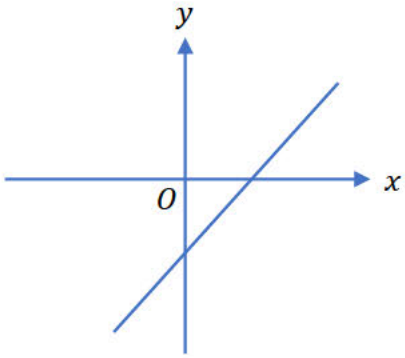
Exam Questions:

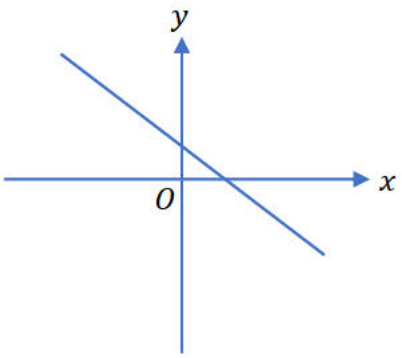
Theory

1

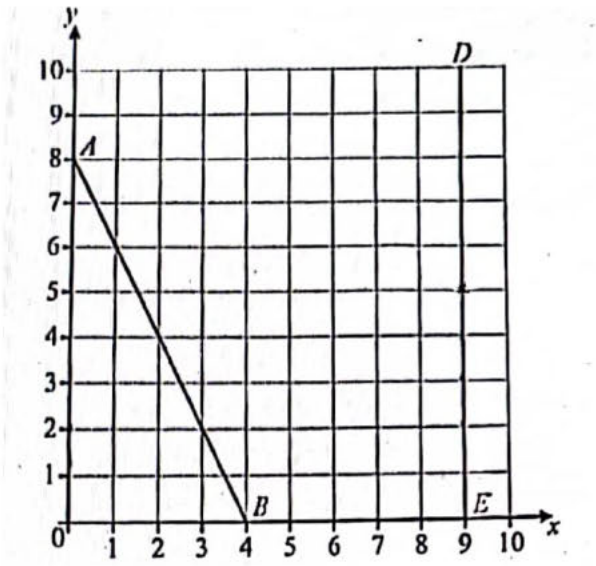
$y = 3x + 2$	$y = 3x - 2$	$y = -3x + 2$	$y = -3x - 2$

The diagrams below shows sketches of two of these lines. Write the correct equation below for each of the diagrams using those stated above. [2]





2 Straight lines AB and DE are drawn on the grid.



(i) Find the gradient of the line AB. [1]

(ii) Write down an equation of the line AB. [1]

(iii) Point C lies in the middle of A and B. Write down the coordinates of C. [1]

(iv) Write down the equation of the line DE. [1]

3 The line $y = \frac{2x+1}{3}$ intersects $x = -1$ at A and $y = 4$ at B. Find the coordinates of

(i) point A, [1]

(ii) point B. [1]

3 The diagram below shows the graph of two straight lines l and p.

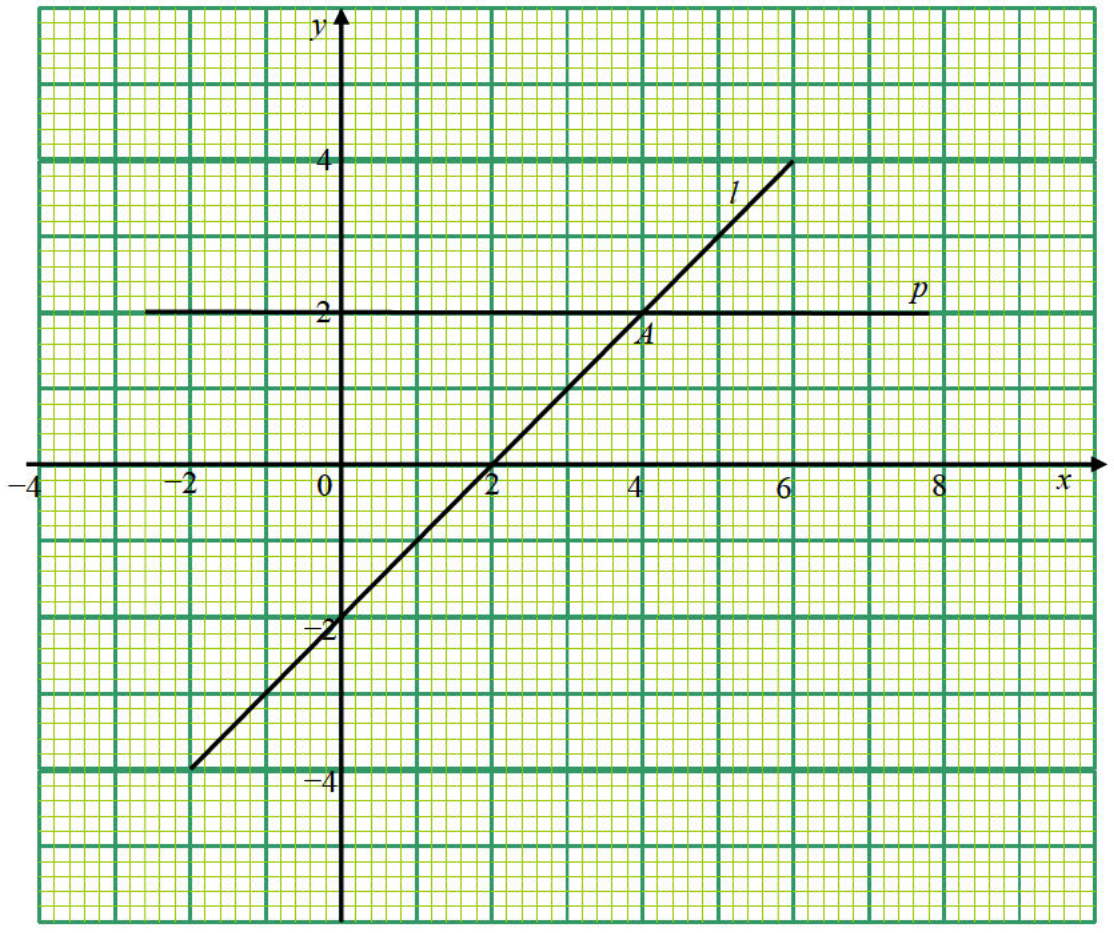
(i) State the coordinates of the point A where the line p intersects the line l. [1]

(ii) Find the gradient of the line l. [1]

(iii) Mark the point B(0, −4) on the grid below. [1]

(iv) Hence, calculate the area of the triangle whose vertices are points A, B and O. [2]

(v) The point C(4, h) is such that A, B, C and O form a parallelogram. Write down a possible value of h. [1]



Plotting

1 **Answer the whole of this question on a sheet of graph paper.**

The variables x and y are connected by the equation

$$y = Ax + B,$$

where \$$y$ represents the cost of selling plates of chicken rice in a food stall and x represents the number of plates of chicken rice.

The corresponding values of x and y, are given in the table below.

x	0	20	40	60	80
y	10	28	46	64	82

(a) Using a scale of 2 cm to represent 10 units on the x-axis, draw a horizontal x-axis for $0 \leq x \leq 80$ and using a scale of 2 cm to represent 10 units on the y-axis, draw a vertical y-axis for $0 \leq y \leq 90$. On your axes, plot the points given in the table and join them.

Using the graph drawn in (a),

(b) state the cost of selling 50 plates of chicken rice, [1]

(c) state the value of B and explain its significance, [2]

(d) calculate the value of A and explain its significance. [2]

2 A graph is represented by a function $y = 5 - 2x$. The following table shows the corresponding x and y values.

x	-4	-2	-1	4
y	p	9	q	-3

(i) Find the values of p and q.

(ii) Draw the graph on a graph paper.

(iii) From the graph, find the

(a) value of y when $x = 3$.

(b) value of x when the graph touches x-axis.

(iv) Find the gradient of the graph $y = 5 - 2x$.

(v) On the same grid lines, draw the line $y = 20$.

3 Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = 4x - 4.$$

Some corresponding values of x and y are given in the table below.

x	-1	0	1	2	3	4
y	p	-4	0	4	8	12

(i) Find the value of p. [1]

(ii) Using a scale of 2 cm to represent 1 unit, draw a horizontal x-axis for $-1 \leq x \leq 4$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y-axis for $-8 \leq y \leq 12$.
On your axes, plot the points given in the table and join them with a smooth curve. [2]

(iii) From the graph in (b), find the values of

(a) x when $y = 9$, [1]

(b) y when $x = 1.5$ [1]

(iv) The point $(-0.5, a)$ lies on the graph $y = 4x - 4$. Use the graph to find the value of a. [1]

4 A graph is represented by a function $y = 5 - 2x$. The following table shows the corresponding x and y values.

x	-4	-2	-1	4
y	p	9	q	-3

(a) Find the values of p and q. [1]

(b) Draw the graph on a graph paper. [2]

(c) From the graph, find the

(i) value of y when $x = 3$. [1]

(ii) value of x when the graph touches x-axis. [1]

(d) Find the gradient of the graph $y = 5 - 2x$. [1]

(e) On the same grid lines, draw the line $y = 20$. [1]

5 **Answer the whole of this question on a sheet of graph paper.**

The variables x and y are connected by the equation $y = 2x - 4$. Some corresponding values of x and y are shown in the table.

x	-1	0	1	2	3	4
y	a	-4	-2	0	2	4

(a) Calculate the value of a. [1]

(b) Using a scale of 2 cm to 1 unit on the x-axis and 2 cm to 1 unit on the y-axis, draw and label the graph of $y = 2x - 4$ for $-1 \leq x \leq 4$. [2]

(c) Using your graph from **(b)**, find

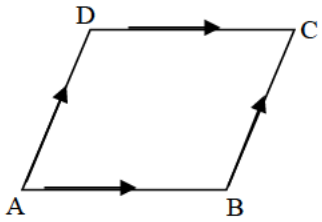
(i) the gradient of the graph drawn, [1]

(ii) the value of x when $y = -1$. [1]

Perimeter and Area

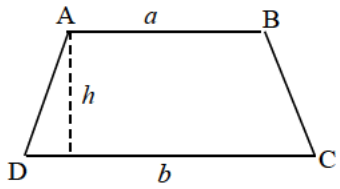
Chapter Summary

1



Area of parallelogram = Base × height

2

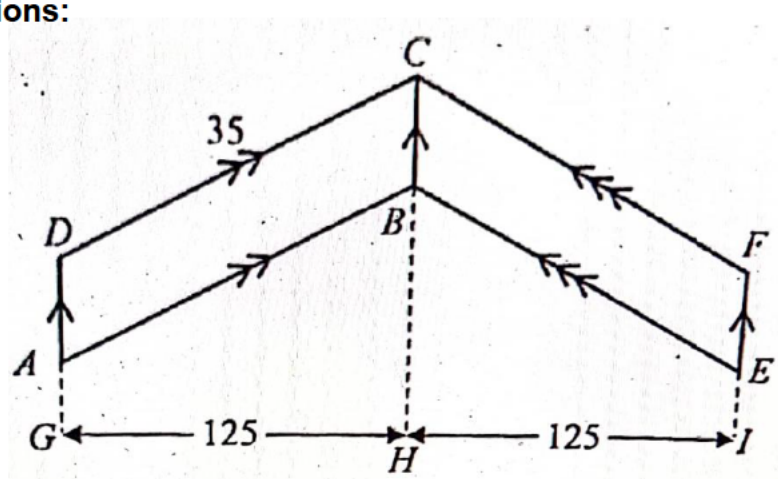


Area of trapezium = $\frac{1}{2}(a+b)(h)$

Perimeter and Area

Exam Questions:

1



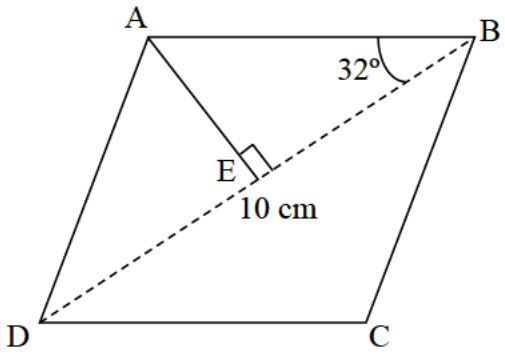
$ABEFCD$ is made up of two identical parallelograms, $ABCD$ and $BEFC$.
$CD = 35$ cm and $GH = HI = 125$ cm. The perimeter of one parallelogram is 110 cm.

Calculate

(i) AD, [2]

(ii) the area of $ABEFCD$. [2]

2 ABCD is a rhombus where BD = 10 cm, angle ABD = 32° and area of the rhombus is 31.2 cm^2.



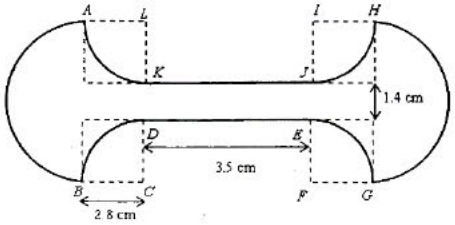
(a) Find angle ADB. [1]

(b) Find AE, the perpendicular distance from point A to BD. [3]

3 In the figure, AB and GH are two semi-circles. Given that $AL = LK = BC = CD = EF = FG = HI = IJ = 2.8$ cm, DE and JK are straight lines of 3.5 cm each and $JE = DK = 1.4$ cm,
Find

(a) the perimeter of the figure,

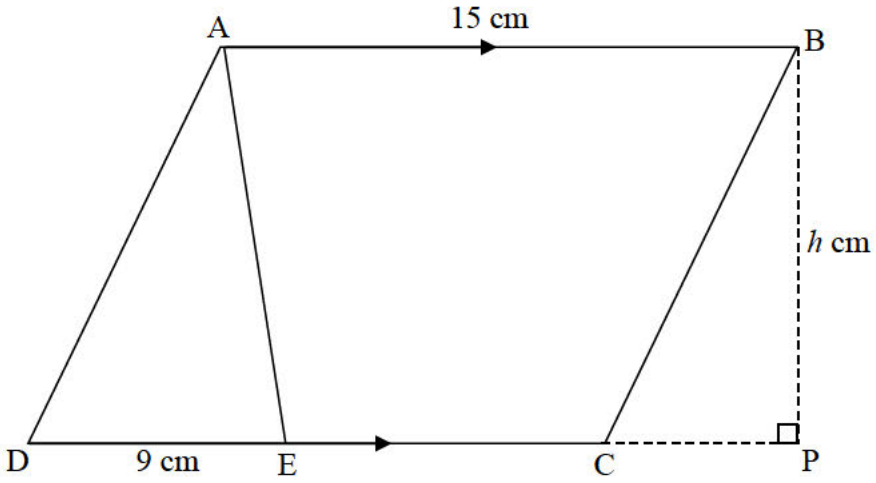
(b) the area of the figure.



4 ABCD is a parallelogram with height BP = h cm.
AD is a straight line.
AB = 15 cm, DE = 9 cm.
Find

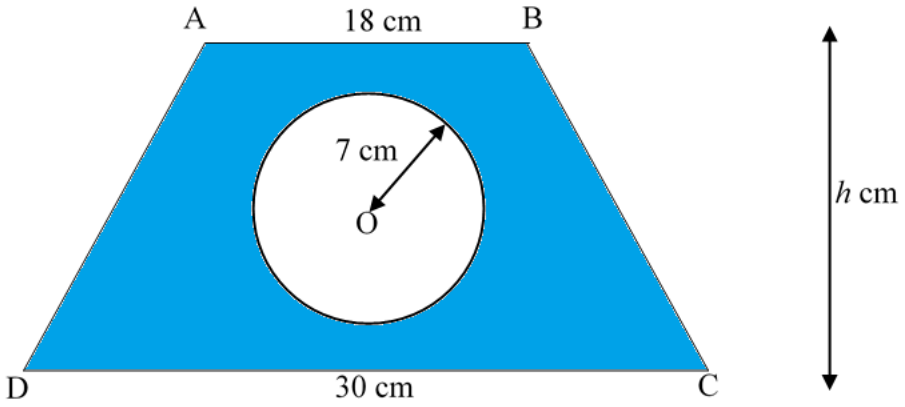
(a) EC, [1]

(b) $\dfrac{\text{area of ABCE}}{\text{area of ABCD}}$ [3]



5 In the diagram below, a circle with centre O and a radius of 7 cm is removed from the trapezium ABCD. AB is 18 cm, DC is 30 cm and the perpendicular distance from DC to AB is h cm.

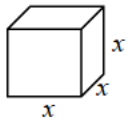
Given that the area of the shaded region is 330 cm^2, find the value of h. [4]



Surface Area and Volume

Chapter Summary

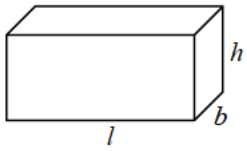
1



Volume = x^3

Total surface area = $6x^2$

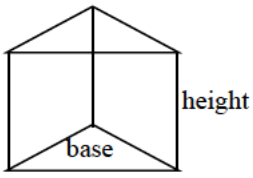
2



Volume = lbh

Total surface area = $2(lb + bh + lh)$

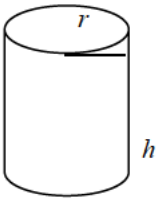
3



Volume = base area × height

Total surface area = base perimeter × height + 2 × base area

4



Volume = $\pi r^2 h$

Total surface area = $2\pi rh + 2\pi r^2$

5 Unit conversion :

$1\ m^2 = 10\ 000\ cm^2$

$1\ m^3 = 1\ 000\ 000\ cm^3$

Surface Area and Volume

Exam Questions:

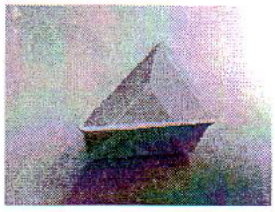
1 An ice-cream seller wants to sell his ice-cream in containers. He has two designs to choose from. Both the containers have open tops.

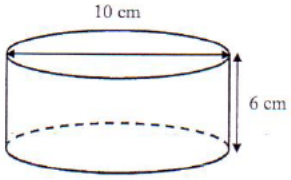
(a) Find the volume of ice-cream needed to completely fill Container 1.

(b) Find the volume of ice-cream needed to completely fill Container 2.

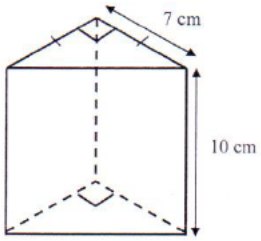
(c) The seller wants to put wrapping over the sides and bottom of the container. Find the area of wrapping that he will need for Container 1.

(d) The amount of wrapper needed for Container 2 is approximately 263 cm^2. The ice-cream seller intends to sell each container at a fixed price of \$8. Which container should he choose so that he can earn the most profit?



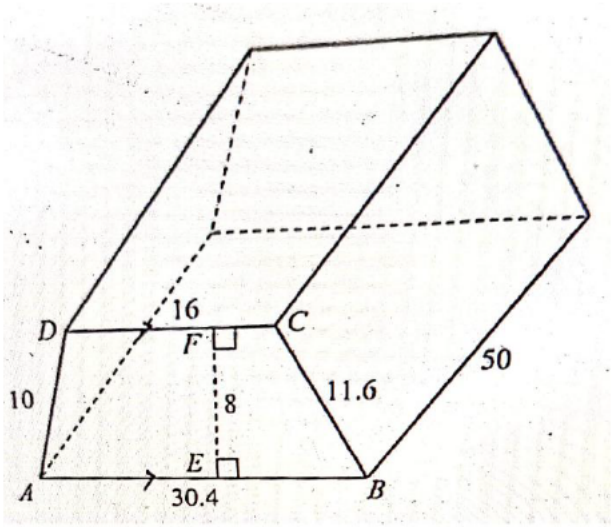


Container 1



Container 2

2



The diagram shows a prism whose cross-section is a trapezium, $ABCD$.
$AB = 30.4$ cm, $BC = 11.6$ cm, $CD = 16$ cm, $AD = 10$ cm and $EF = 8$ cm.
The length of the prism is 50 cm.

Calculate the

(i) volume of the prism, [2]

(ii) surface area of the prism. [3]

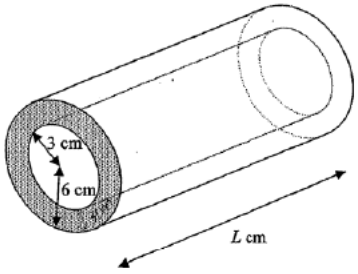
3 The diagram shows a metal cylindrical tube with a circular hollow that runs through the entire length, L cm, of the tube. The circular hollow has a radius of 3 cm and the tube has a radius of 6 cm measured from the center of the cylindrical tube. The metal cylindrical tube has a volume of 702π cm^3.

(a) Find, leaving your answer in terms of π, the area of the shaded cross-sectional area of the tube.

(b) Calculate the value of L cm.

(c) Calculate the total surface area of the tube (including the curved surface area of the circular hollow). Leave your answer to the nearest whole number.

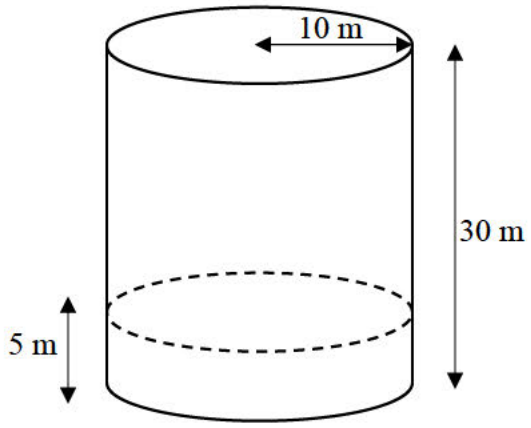
(d) The metal cylindrical tube is now melted down and recast to form solid metal cubes of sides 9 cm. Find the maximum number of completed solid metal cubes formed.



4 The diagram below shows a cylindrical water tank containing water to a depth of 5 m. The radius of the circular base is 10 m and the height of the tank is 30 m.

(a) Find the total surface area of the tank in contact with the water. [3]

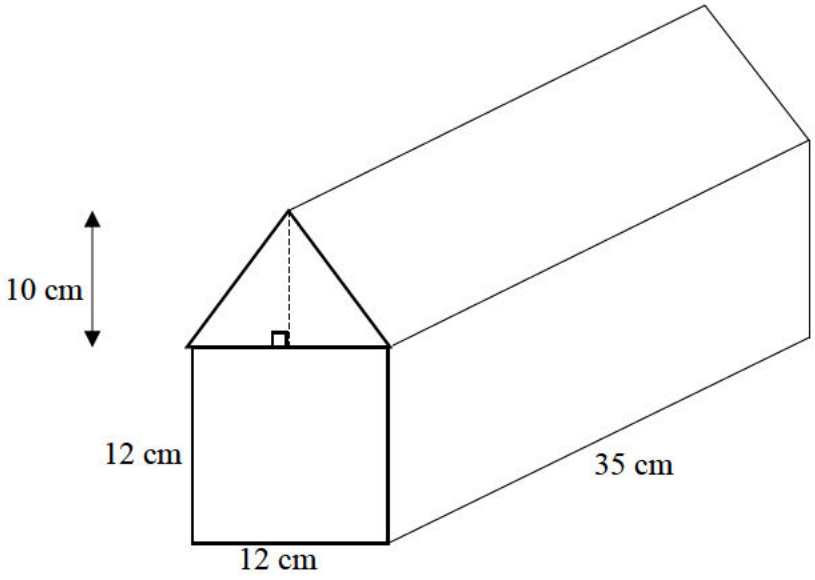
(b) x m^3 of water is now poured into the tank. The height of the water level increased by 90%. Calculate the value of x. [3]



5 The diagram shows a solid in its upright position. It is made from a cuboid and a triangular prism.

(a) Calculate the volume of the solid. [3]

(b) A rectangular box has a length of 360 cm, breadth of 200 cm and a height of 22 cm. Find the maximum number of the solids in (a) that can be packed upright in the rectangular box. [2]



Data Handling

Chapter Summary

1 Methods of collecting data

(i) taking measurements in experiments

(ii) observing outcomes of events

(iii) conducting surveys

(iv) reading statistical publications

2 Steps in organizing data

(i) dividing the raw data into several non-overlapping classes

(ii) constructing a frequency table

(iii) completing the table by tallying

3 Presentation of data

(i) Pictographs --- attractive to the public, not accurate for analysis

(ii) Bar graphs --- easy to draw, read scale and compare classes

(iii) Line graphs ---- suitable for time-related data, can show the trend of data

(iv) Pie charts --- can show the relative size of a part in relation to the whole.

4 Use of statistical graphs

(i) provide visual impression of data

(ii) can be used for analysis, prediction and inference

5 Misuse of statistical graphs

We should observe

(i) whether the vertical axis starts from zero

(ii) the scales on both axes

(iii) whether the graphics are proportional to the data

Data Handling

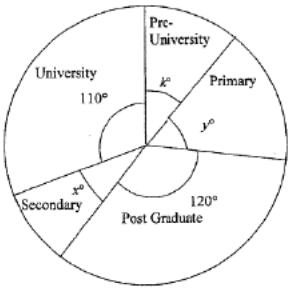
Exam Questions:

1 (a) The pie chart shows the highest educational qualifications of employees in a particular company. The angles represent the number of employees whose highest educational qualifications is Primary, Secondary, Pre-University, University and Post Graduate education respectively.

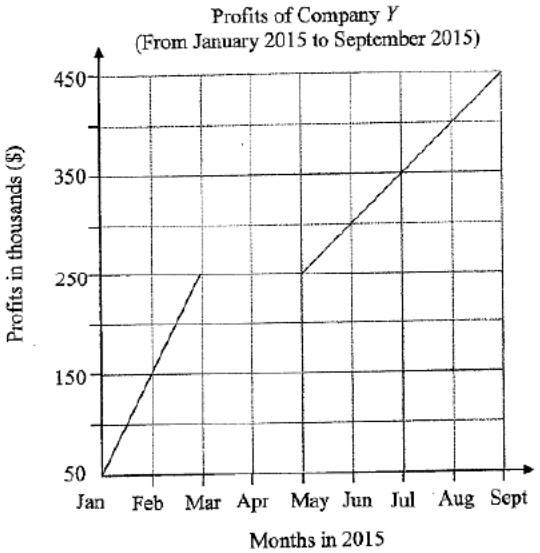
There are 198 employees whose highest qualification is University education. The ratio of $x : k : y$ is 3:4:6.

(i) Calculate the number of employees whose highest educational qualification is Post Graduate education.

(ii) Find the value of x.



(b) The line graph shows the profits of Company Y over a period of 9 months in the year 2015. Describe the trend of the profits of Company Y over the period of 9 months from January 2015 to September 2015.



2 The list shows the number of people staying in 20 households.

5	3	3	4	3
4	1	5	2	1
4	2	4	4	4
6	3	6	3	5

(a) Complete the table below.

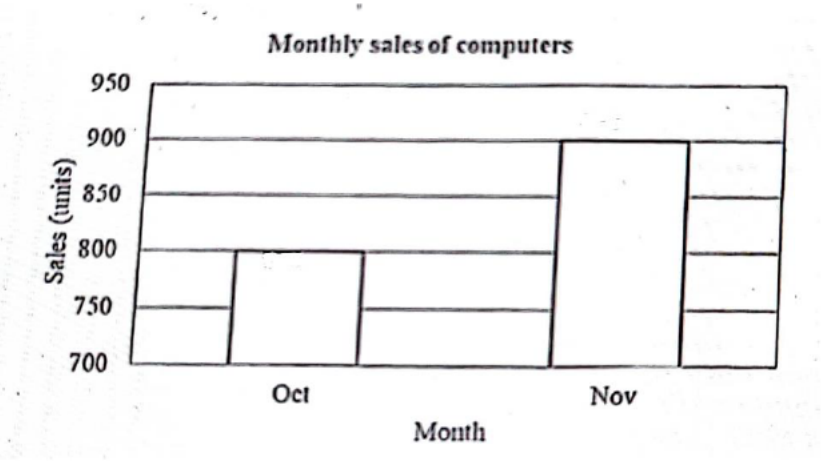
Number of people	Tally	Frequency
1		
2		
3		
4		
5		
6		

(b) (i) Find the fraction of households with 6 people.

(ii) Find the ratio of the number of house holds with 3 or less people to the number of households with 4 or more people.

(iii) Which statistical graph, line graph or pie chart, would be more appropriate to represent the data? Explain your answer.

3



The graph shows the monthly sales of computer from October to November. The manager claimed that the number of sales in November is doubled that of the number of sales in October. Explain why this statement is wrong. [2]

4 Alex, Christine, Eric and Monti are the finalists of AHS Got Talent Competition. The following lists the votes received by the four finalists from thirty teachers in the school.

Alex	Christine	Monti	Monti	Christine
Eric	Monti	Alex	Alex	Christine
Monti	Alex	Monti	Christine	Eric
Christine	Monti	Eric	Monti	Monti
Monti	Christine	Christine	Monti	Alex
Eric	Eric	Monti	Alex	Monti

(a) Fill in the frequency table below that represents the data given.

Name	Alex	Christine	Eric	Monti
Number of votes		7	5	

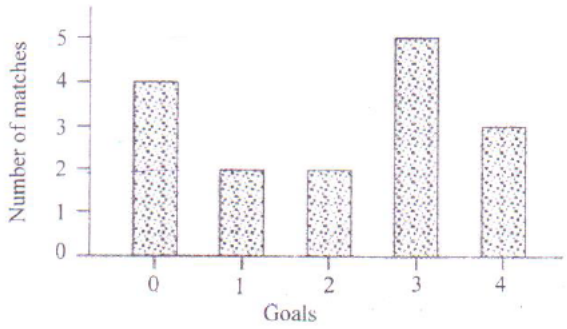
(b) Represent the data on a bar graph.

Y-axis represents the number of votes.

X-axis represents the finalist.

(c) Who won the competition?

5 The graph shows the number of goals scored by United soccer team in its matches over a season.



(a) Find the total number of matches throughout the season.

(b) Find the total number of goals throughout the season.

(c) A pie chart is drawn to represent the data distribution. Find the angle of the sector representing the goal score of 4.

Applications of Maths in life

Exam Questions:

1 The table below summarises the subscription options provided by two telephone companies namely, SongHub and MoonTel.

	SongHub			MoonTel		
	Plan A	Plan B	Plan C	Plan A	Plan B	Plan C
Local Data	400 MB	4 GB	5 GB	200 MB	4 GB	5 GB
Incoming calls	Free			Free		
Outgoing calls	100 min	250 min	350 min	100 min	350 min	400 min
Local SMS/MMS	500	1000	1200	500	1200	1400
Monthly Subscription **(before 7% GST)**	$29.90	$43.90	$65.90	$29.90	$55.90	$74.90
Terms and Conditions	• Excess local data charges at $0.0107 per MB (1 GB = 1000 MB) • Excess call charges at $0.05 per min • Excess SMS/MMS charges at $0.025 per SMS/MMS					

John subscribes to SongHub Plan A. In the month of September, he used 1 GB of local data, 250 minutes of incoming calls, 80 minutes of outgoing calls and 450 SMS.

(a) Find the total amount, inclusive of GST, that he has to pay for the month of September. Give your answer to the nearest cent. [3]

John is considering switching plans to either MoonTel Plan B or Plan C or SongHub Plan B or Plan C as his new expected monthly usage is as follows.

- 5 GB of local data
- 400 minutes of outgoing calls
- 1400 SMS/MMS

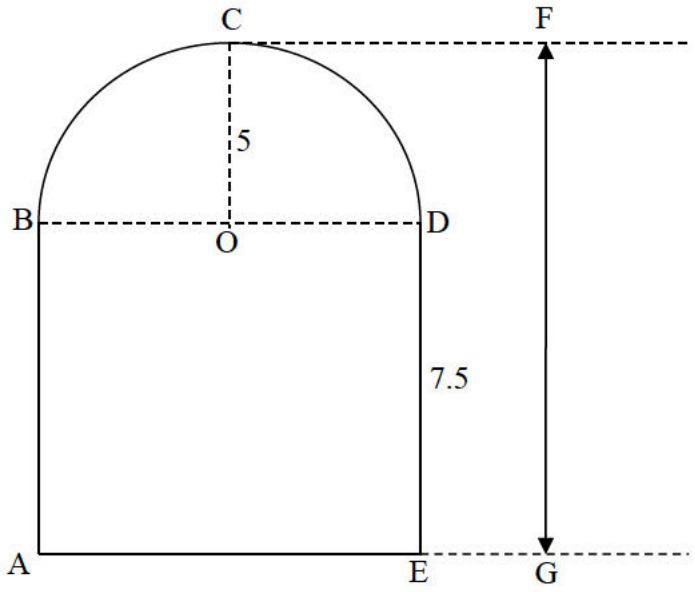
(b) Recommend which subscription plan John should take up.
Justify the decision you make and show your calculations clearly. [6]

2 A uniform cross section of a fun ride tunnel ABCDE is shown below.

ABCDE is made up of a semi-circle BCD with centre O and a rectangle ABDE.

It is given that DE = 7.5 m and OC = 5 m.

The fun ride train can only be safe if its vertical height is not more than 70% of the vertical height FG of the tunnel.



(a) Can a fun ride train with a vertical height of 8 m be safe enough to enter the tunnel? Justify your answer with necessary working. [3]

It is given that the tunnel is 0.45 km long.

(b) A 64-metre long train travels at 25 m/s through the tunnel.

Calculate the time taken for the train to pass completely through the tunnel. Express your answer to the nearest second. [3]

(c) How much soil, in cubic metres, will be excavated for the construction of the tunnel? [2]

(d) The budget in the construction of the tunnel is \$400 000. It costs \$10.50 to excavate 1 m^3 of soil to construct the tunnel. Determine whether the construction of this tunnel is shown above or below the budget. [2]

3 Chris lives in Kembangan and is a student of Pasir Ris Secondary School.

In his usual route, he travels to school by bus and Mass Rapid Transit (MRT) using his Student EZ-Link Card.

He takes a bus from his home to Kembangan MRT Station, then take the MRT from Kembangan to Tampines and walks to school.

Information that Chris needs to calculate his travel fare is at the next page.

(a) Explain why his total fare from home to school is $0.58. [1]

One morning, the MRT broke down.

Chris took a bus from his home to Kembangan MRT Station, then took another bus from Kembangan MRT Station to Tampines Interchange and walked to school.

(b) Calculate his total fare from home to school that morning. [1]

(c) Suggest a possible reason why in his usual route, he does not travel by the bus only. [1]

On another morning, Chris did not bring his Student EZ-Link Card.

He took the usual route to school and paid both his bus and MRT fares in cash.

(d) (i) How much did he have to pay in cash? [2]

(ii) Find the percentage increase in his transport fare as compared to (a). [2]

LOCAL PUBLIC TRANSPORT INFORMATION AND RATES

All commuters are charged a fare based on the total distance travelled (whether on the bus or train). Fares are computed on a journey basis, without a boarding charge being imposed for every transfer trip that makes up along the journey.

To fully enjoy the benefits of Distance Fares, all fares must be paid with an EZ-Link or NETS Flashpay stored value card. For example, if a student travelled a total distance of 3.8 km by bus and then by MRT, he will only pay a total of 42 cents.

If students are using cash, they do not enjoy any benefits.

LOCAL PUBLIC TRANSPORT RATES

Distance	MRT Fare Per Ride (cent)		BUS Fare Per Ride (cent)	
	Student		Student	
	Card	Cash	Card	Cash
Up to 3.2 km	37	140	37	65
3.3 km – 4.2 km	42	160	42	65
4.3 km – 5.2 km	47	160	47	65
5.3 km – 6.2 km	52	160	52	65
6.3 km – 7.2 km	55	180	55	85
7.3 km – 8.2 km	58	180	58	85
8.3 km – 9.2 km	58	180	58	85