

Mathematics Companion

ANSWER BOOK

Marilyn Buchanan, *et al.*

GRADE

9

CAPS

All Terms

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THE
ANSWER
SERIES *Your Key to Exam Success*

Grade 9 **Maths Companion** Answer Book

The Grade 9 Maths Companion Workbooks are comprehensive and creative in their coverage of the CAPS curriculum. They are a valuable tool for both the learner and the teacher. These workbooks help to ensure that all learners are brought up to a common standard, filling all gaps that may have opened in their mathematical content.

Key features:

- Arithmetical concepts move seamlessly into algebraic development
- Suitable as a class workbook and for self-study
- A full set of solutions complete the Companion set, making corrections simple and quick
- Worked examples, notes and exercises guide learners to a thorough understanding
- End-of-unit test assess progress consistently

GRADE

9

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ALL TERMS

Mathematics Companion

ANSWER BOOK

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Also available

GRADE 9
MATHEMATICS 2-in-1

- questions in topics
- examination papers



E-book
available 



Gr 9 Maths Companion - Schedule of work



ANSWER BOOK

TERM 1

UNIT	TOPIC	CAPS TOPIC NR.	WEEKS	PAGE
1	The Number System	1.1	1	1
2	Rate, Ratio and Proportion	1.1	1	10
3	Financial Maths	1.1	1	18
4	Integers	1.3	1	21
5	Common Fraction Revision	1.4	0,5	25
6	Decimals Revision	1.5	0,5	29
7	Algebra: Exponents	1.2	2	32
8	Numeric and Geometric Patterns	2.1	1	40
9	Functions and Relations Part 1	2.2	1	45
10	Algebraic Expressions Part 1	2.3	1	48
11	Equations Part 1	2.4	1	55
			11 weeks	

TERM 2

UNIT	TOPIC	CAPS TOPIC NR.	WEEKS	PAGE
12	Geometry Part 1: Lines and Angles	3.3	2	61
13	Constructions Part 1: Angles and Triangles	3.5	1	66
14	Constructions Part 2: Quadrilaterals	3.5	1	73
15	Congruency	3.1	1	76
16	Similarity	3.1	1	80
17	The Theorem of Pythagoras	4.3	1	84
18	2D Shapes: Perimeter and Area	4.1	1	89
			8 weeks	

TERM 3

UNIT	TOPIC	CAPS TOPIC NR.	WEEKS	PAGE
19	Functions and Relations Part 2	2.2	0,5	95
20	Algebraic Expressions Part 2	2.3	1	97
21	Factorisation	2.3	2	101
22	Equations Part 2	2.4	1	107
23	Graphs	2.5	2,5	111
24	3D Shapes: Surface Area and Volume	4.2	1	122
			8 weeks	

TERM 4

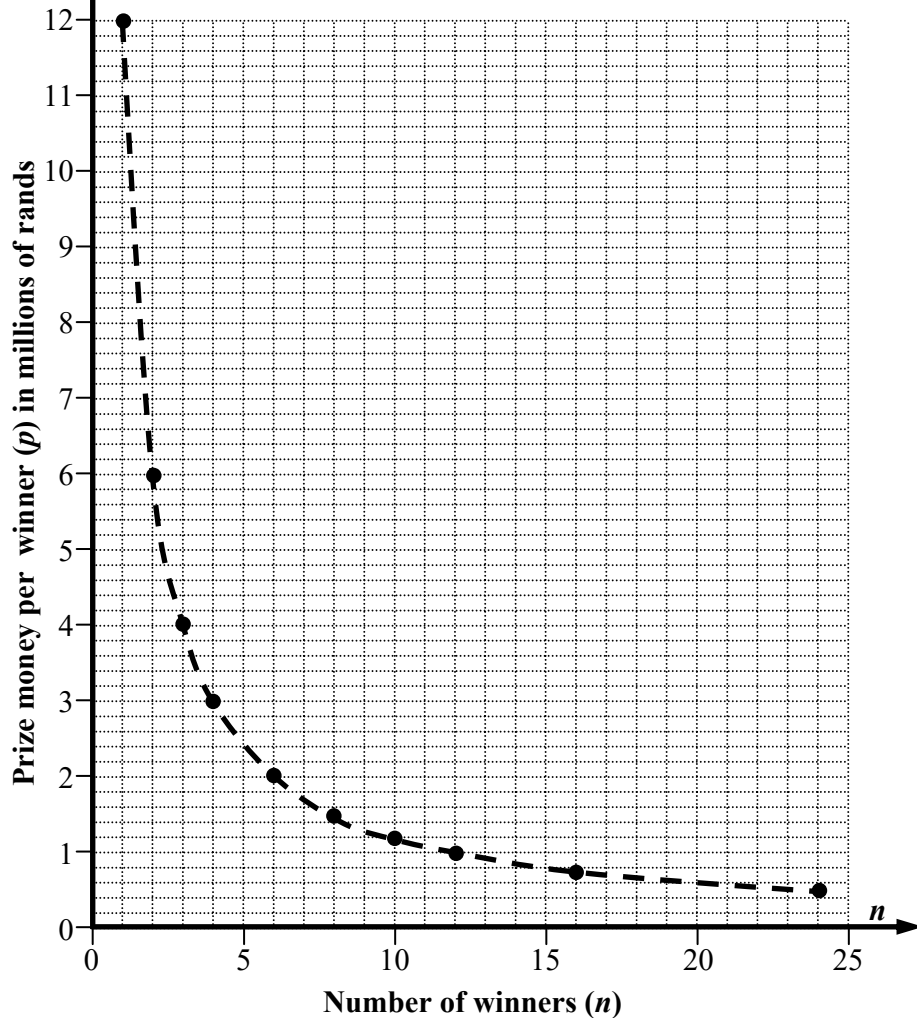
UNIT	TOPIC	CAPS TOPIC NR.	WEEKS	PAGE
25	Transformations: Translations, Reflections and Enlargements	3.4	2	126
26	Geometry of 3D Objects	3.2	1	131
27	Data Handling (Statistics)	5.1, 5.2 & 5.3	2,5	133
28	Probability	5.4	1,5	138
			7 weeks	

EXAM MEMOS

	PAGE
Paper A	M1
Paper B1	M10
Paper B2	M15

3.2 Inversely
Constant product 12 (million)

3.3 Graph of prize money per winner versus
number of winners for a R12 million draw



3.4 No. Can't have a fraction of a winner.

3.5 $p = \frac{12 \text{ million}}{n}$

3.6 2,4 million

3.7 20 winners

4.1 $y = \frac{24}{x}$

4.2 $y = \frac{30}{x}$

END-OF-UNIT 2 TEST

40 marks
40 minutes

QUESTION 1

1.1 chocolate : strawberry = 5 : 4

Number of chocolate = $\frac{5}{9}$ of 180
= 100



Number of strawberry = $\frac{4}{9}$ of 180
= 80

(3)

1.2 chocolate : strawberry
5 : 4
x : 140

$$\frac{x}{140} = \frac{5}{4}$$

$$x = \frac{5}{4} \times 140$$

$$= 175$$

i.e. 175 chocolate lollipops

(3)[6]

QUESTION 2

$$15\ 000 : 25\ 000$$

$$= 3 : 5$$

Sam's share = $\frac{3}{8}$ of 80 000
= R30 000

Ayanda's share = $\frac{5}{8}$ of 80 000
= R50 000



[5]

QUESTION 3

3.1

x	5	12	24
y	20	48	96

3.2

x	4	3	6
y	12	16	8

(2)(2)
[4]

SUBSTITUTION

EXERCISE 4.3

$$\begin{aligned}
 1.1 \quad ab - c + 2d & \\
 &= (-2)(-3) - (-4) + 2(-5) \\
 &= 6 + 4 - 10 \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 1.3 \quad a - b \times c - d & \\
 &= (-2) - (-3)(-4) - (-5) \\
 &= -2 - 12 + 5 \\
 &= -9
 \end{aligned}$$

$$\begin{aligned}
 1.5 \quad (a - b) \times (c - d) & \\
 &= (-2 - (-3)) \times (-4 - (-5)) \\
 &= (1) \times (1) \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
 1.7 \quad (a - b)(b - c)(c - d) & \\
 &= (-2 - (-3))((-3) - (-4))((-4) - (-5)) \\
 &= (1)(1)(1) \\
 &= 1
 \end{aligned}$$

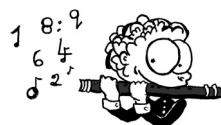
$$\begin{aligned}
 1.8 \quad a(b + c) - b(a + b) & \\
 &= (-2)(-3 + 4) - (-3)(-2 + 3) \\
 &= (-2)(-7) + 3(-5) \\
 &= 14 - 15 \\
 &= -1
 \end{aligned}$$

$$\begin{aligned}
 1.9 \quad \frac{(d - a)(b - d) - c(d - b)}{a(b - c) + d} & \\
 &= \frac{(-5 - (-2))(-3 - (-5)) - (-4)(-5 - (-3))}{(-2)(-3 - (-4)) + (-5)} \\
 &= \frac{(-3)(2) - (-4)(-2)}{(-2)(1) - 5} \\
 &= \frac{-6 - 8}{-7} \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 1.2 \quad a + b \times c + d & \\
 &= (-2) + (-3) \times (-4) + (-5) \\
 &= -2 + 12 - 5 \\
 &= 5
 \end{aligned}$$

$$\begin{aligned}
 1.4 \quad (a - b) \times c - d & \\
 &= (-2 - (-3)) \times (-4) - (-5) \\
 &= (1) \times (-4) + 5 \\
 &= -4 + 5 \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
 1.6 \quad bc - ad & \\
 &= (-3)(-4) - (-2)(-5) \\
 &= 12 - 10 \\
 &= 2
 \end{aligned}$$



$$\begin{aligned}
 1.10 \quad (a - c)(b + d) - a(c + d) & \\
 &= (-2 - (-4))(-3 - 5) - (-2)(-4 - 5) \\
 &= (2)(-8) + 2(-9) \\
 &= -16 - 18 \\
 &= -34
 \end{aligned}$$

$$\begin{aligned}
 2.1 \quad y^2 + z^3 & \\
 &= (-3)^2 + (-2)^3 \\
 &= 9 - 8 \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
 2.3 \quad xy^2 + wz^3 & \\
 &= (-4)(-3)^2 + (-5)(-2)^3 \\
 &= (-4)(9) - 5(-8) \\
 &= -36 + 40 \\
 &= 4
 \end{aligned}$$

$$\begin{aligned}
 2.5 \quad xyz - x(w - y)^2 - (x - z)^3 & \\
 &= (-4)(-3)(-2) - (-4)(-5 + 3)^2 - (-4 + 2)^2 \\
 &= -24 + 4(4) - 4 \\
 &= -12
 \end{aligned}$$

$$\begin{aligned}
 2.6 \quad \sqrt[3]{w^2 - z} - \sqrt{z^2 - w} & \\
 &= \sqrt[3]{25 + 2} - \sqrt{4 + 5} \\
 &= \sqrt[3]{27} - \sqrt{9} \\
 &= 3 - 3 \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 2.7 \quad \sqrt{wx - (y + z)} - \sqrt{xy - x} & \\
 &= \sqrt{20 - (-5)} - \sqrt{12 + 4} \\
 &= \sqrt{25} - \sqrt{16} \\
 &= 5 - 4 \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
 2.9 \quad \sqrt{x(x + y + z)} - \sqrt[3]{x + y - wx} & \\
 &= \sqrt{(-4)(-9)} - \sqrt[3]{-7 - 20} \\
 &= \sqrt{36} - \sqrt[3]{-27} \\
 &= 6 - (-3) \\
 &= 9
 \end{aligned}$$

$$\begin{aligned}
 2.2 \quad w^2 - x^2 - y^2 & \\
 &= (-5)^2 - (-4)^2 - (-3)^2 \\
 &= 25 - 16 - 9 \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 2.4 \quad (w - x)^2 - (y - z)^3 & \\
 &= (-5 + 4)^2 - (-3 + 2)^3 \\
 &= (-1)^2 - (-1)^3 \\
 &= 1 + 1 \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 2.8 \quad \sqrt{1 - xyz} - \sqrt{2 - (x + y)} & \\
 &= \sqrt{1 + 24} - \sqrt{2 - (-7)} \\
 &= \sqrt{25} - \sqrt{9} \\
 &= 5 - 3 \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 2.10 \quad \sqrt{\sqrt{w(y + z)} - \sqrt[3]{wxy + x}} & \\
 &= \sqrt{\sqrt{(-5)(-5)} - \sqrt[3]{-60 - 4}} \\
 &= \sqrt{\sqrt{25} - \sqrt[3]{-64}} \\
 &= \sqrt{5 + 4} \\
 &= \sqrt{9} \\
 &= 3
 \end{aligned}$$





EXERCISE 10.7

$$1. \quad (m^2 + 4m) \div m \\ = m + 4$$

$$3. \quad \frac{6x^3 + 2x^2}{2x} \\ = 3x^2 + x$$

$$5. \quad (8a^2b^3 + 4a^2b - 2ab) \div 2ab \\ = 4ab^2 + 2a - 1$$

$$7. \quad (2a + 4) \div 2 + (3a^2 + 6a) \div 3a - 2a \\ = (a + 2) + (a + 2) - 2a \\ = a + 2 + a + 2 - 2a \\ = 4$$

$$8. \quad (6b^2 - 8b) \div 2b + (15b^3 - 20b^2) \div (-5b^2) \\ = (3b - 4) + (-3b + 4) \\ = 3b - 4 - 3b + 4 \\ = 0$$

$$9. \quad \frac{8m^2 + 12m}{4m} + \frac{6m^2 - 12m^3}{6m^2} \\ = (2m + 3) + (1 - 2m) \\ = 2m + 3 + 1 - 2m \\ = 4$$

$$10. \quad \frac{9n^2 + 21n}{3n} + \frac{8n^3 + 12n^2 + 20n}{-4n} + \frac{4n^2 - 4}{2} \\ = (3n + 7) + (-2n^2 - 3n - 5) + (2n^2 - 2) \\ = 3n + 7 - 2n^2 - 3n - 5 + 2n^2 - 2 \\ = 0$$

$$11. \quad \frac{6p^2 + 10p}{2p} - \frac{9p^3 + 12p^2 + 15p}{3p} + \frac{6p^2 + 2p}{2} \\ = (3p + 5) - (3p^2 + 4p + 5) + (3p^2 + p) \\ = 3p + 5 - 3p^2 - 4p - 5 + 3p^2 + p \\ = 0$$

$$2. \quad (6x^2 + 4x + 8) \div 2 \\ = 3x^2 + 2x + 4$$

$$4. \quad \frac{12a^2 + 6a}{6a} \\ = 2a + 1$$

$$6. \quad \frac{12x^3 + 8x^2 + 6}{6x} \\ = 2x^2 + \frac{4x}{3} + \frac{1}{x}$$

$$12. \quad \frac{5x + 10}{5x} - \frac{8x^2 - 12x + 8}{4x} - \frac{6x - 12}{3} \\ = (1 + \frac{2}{x}) - (2x - 3 + \frac{2}{x}) - (2x - 4) \\ = 1 + \frac{2}{x} - 2x + 3 - \frac{2}{x} - 2x + 4 \\ = 8 - 4x$$

EXERCISE 10.8

$$1. \quad (x + 3)(x + 4) \\ = x^2 + 4x + 3x + 12 \\ = x^2 + 7x + 12$$

$$3. \quad (x + 1)(x + 12) \\ = x^2 + 12x + x + 12 \\ = x^2 + 13x + 12$$

$$5. \quad (x - 6)(x + 2) \\ = x^2 + 2x - 6x - 12 \\ = x^2 - 4x - 12$$

$$7. \quad (x + 3)(x - 4) \\ = x^2 - 4x + 3x - 12 \\ = x^2 - x - 12$$

$$9. \quad (x + 1)(x - 12) \\ = x^2 - 12x + x - 12 \\ = x^2 - 11x - 12$$

$$11. \quad (x - 6)(x - 2) \\ = x^2 - 2x - 6x + 12 \\ = x^2 - 8x + 12$$

$$13. \quad (x + 6)(x + 6) \\ = x^2 + 6x + 6x + 36 \\ = x^2 + 12x + 36$$

$$2. \quad (x + 6)(x + 2) \\ = x^2 + 2x + 6x + 12 \\ = x^2 + 8x + 12$$

$$4. \quad (x - 3)(x + 4) \\ = x^2 + 4x - 3x - 12 \\ = x^2 + x - 12$$

$$6. \quad (x - 1)(x + 12) \\ = x^2 + 12x - x - 12 \\ = x^2 + 11x - 12$$

$$8. \quad (x + 6)(x - 2) \\ = x^2 - 2x + 6x - 12 \\ = x^2 + 4x - 12$$

$$10. \quad (x - 3)(x - 4) \\ = x^2 - 4x - 3x + 12 \\ = x^2 - 7x + 12$$

$$12. \quad (x - 1)(x - 12) \\ = x^2 - 12x - x + 12 \\ = x^2 - 13x + 12$$

$$14. \quad (x + 5)(x + 7) \\ = x^2 + 7x + 5x + 35 \\ = x^2 + 12x + 35$$

$$10. \quad \frac{2}{3}(x+5) - \frac{3}{4}(x+1) = \frac{1}{2}(x-3)$$

$$\therefore 8(x+5) - 9(x+1) = 6(x-3)$$

$$\therefore 8x + 40 - 9x - 9 = 6x - 18$$

$$\therefore 8x - 9x - 6x = -18 - 40 + 9$$

$$\therefore -7x = -49$$

$$\therefore x = 7$$

EXERCISE 11.4

$$1. \quad \frac{1}{x} + 3 = 5 \quad (x \neq 0)$$

$$\therefore 1 + 3x = 5x$$

$$\therefore 3x - 5x = -1$$

$$\therefore -2x = -1$$

$$\therefore x = \frac{1}{2}$$

$$3. \quad \frac{1}{3x} + \frac{2}{3} = \frac{1}{x} \quad (x \neq 0)$$

$$\therefore 1 + 2x = 3$$

$$\therefore 2x = 2$$

$$\therefore x = 1$$

$$5. \quad \frac{3}{2x} - \frac{1}{4} = 1 - \frac{9}{4x} \quad (x \neq 0)$$

$$\therefore 6 - x = 4x - 9$$

$$\therefore -x - 4x = -9 - 6$$

$$\therefore -5x = -15$$

$$\therefore x = 3$$

$$7. \quad \frac{x-2}{2x} + \frac{1}{x} + \frac{3}{2} = 0 \quad (x \neq 0)$$

$$\therefore x - 2 + 2 + 3x = 0$$

$$\therefore 4x = 0$$

$$\therefore x = 0$$

No solution.

$$2. \quad \frac{1}{x} + \frac{2}{3} = 2 \quad (x \neq 0)$$

$$\therefore 3 + 2x = 6x$$

$$\therefore 2x - 6x = -3$$

$$\therefore -4x = -3$$

$$\therefore x = \frac{3}{4}$$

$$4. \quad \frac{7}{2x} - \frac{2}{3} = \frac{1}{2} \quad (x \neq 0)$$

$$\therefore 21 - 4x = 3x$$

$$\therefore -4x - 3x = -21$$

$$\therefore -7x = -21$$

$$\therefore x = 3$$

$$6. \quad 1 - \frac{2}{3x} + \frac{1}{2x} = \frac{4}{3} \quad (x \neq 0)$$

$$\therefore 6x - 4 + 3 = 8x$$

$$\therefore 6x - 8x = 1$$

$$\therefore -2x = 1$$

$$\therefore x = -\frac{1}{2}$$

$$8. \quad \frac{1}{2x} - \frac{1}{3} = \frac{5}{12x} \quad (x \neq 0)$$

$$\therefore 6 - 4x = 5$$

$$\therefore -4x = -1$$

$$\therefore x = \frac{1}{4}$$

$$9. \quad \frac{1}{3} = \frac{2x-1}{5x} \quad (x \neq 0)$$

$$\therefore 5x = 3(2x-1)$$

$$\therefore 5x = 6x-3$$

$$\therefore 5x-6x = -3$$

$$\therefore -x = -3$$

$$\therefore x = 3 \quad \text{No solution.}$$

$$10. \quad \frac{1}{2} + \frac{3}{x} = \frac{x+3}{x} \quad (x \neq 0)$$

$$\therefore x+6 = 2(x+3)$$

$$\therefore x+6 = 2x+6$$

$$\therefore -x = 0$$

$$\therefore x = 0$$

$$11. \quad \frac{2}{x} = \frac{6}{3x-5} \quad (x \neq 0, x \neq \frac{5}{3})$$

$$\therefore 2(3x-5) = 6x$$

$$\therefore 6x-10 = 6x$$

$$\therefore 0 = 10$$

False statement. No solution.

$$12. \quad \frac{1}{2} + \frac{3}{x} = \frac{x+6}{2x} \quad (x \neq 0)$$

$$\therefore x+6 = x+6$$

Identity: true for all values of x except $x = 0$

$$13. \quad \frac{2}{x} + \frac{2}{x(x-2)} = \frac{1}{x-2} \quad (x \neq 0, x \neq 2)$$

$$\therefore 2(x-2) + 2 = x$$

$$\therefore 2x-4+2 = x$$

$$\therefore 2x-x = 2$$

$$\therefore x = 2$$

No solution.

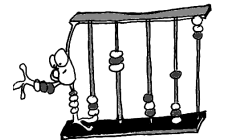
$$14. \quad \frac{3}{x} = \frac{2}{x-1} - \frac{2}{x(x-1)} \quad (x \neq 0, x \neq 1)$$

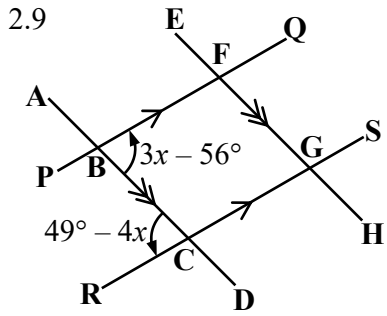
$$\therefore 3(x-1) = 2x-2$$

$$\therefore 3x-3 = 2x-2$$

$$\therefore x = 1$$

No solution.





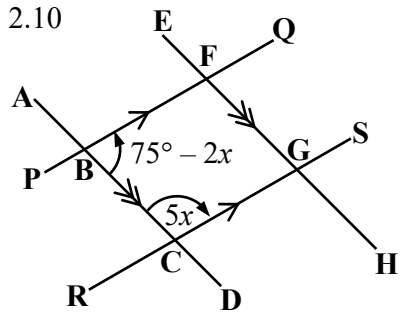
$$3x - 56^\circ = 49^\circ - 4x$$

$$\therefore 3x + 4x = 49^\circ + 56^\circ$$

$$\therefore 7x = 105^\circ$$

$$\therefore x = 15^\circ$$

(alt. \angle 's,
PQ \parallel RS)



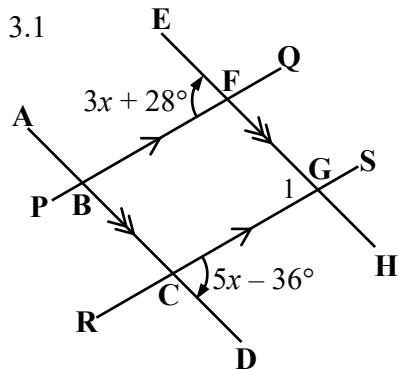
$$75^\circ - 2x + 5x = 180^\circ$$

$$\therefore 3x = 180^\circ - 75^\circ$$

$$\therefore 3x = 105^\circ$$

$$\therefore x = 35^\circ$$

(co-int. \angle 's,
PQ \parallel RS)



$$\hat{G}_1 = 3x + 28^\circ$$

$$\therefore 3x + 28^\circ = 5x - 36^\circ$$

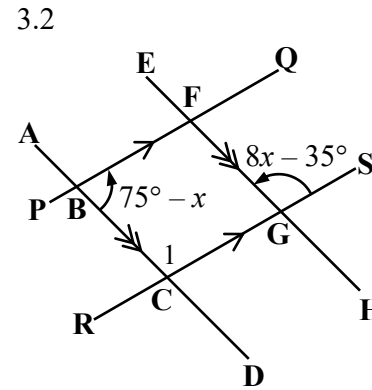
$$\therefore 28^\circ + 36^\circ = 5x - 3x$$

$$\therefore 64^\circ = 2x$$

$$\therefore x = 32^\circ$$

(corresp. \angle 's,
PQ \parallel RS)

(alt. \angle 's,
EH \parallel AD)



$$\hat{C}_1 = 180^\circ - (75^\circ - x) \text{ (co-int. } \angle\text{'s, PQ } \parallel\text{ RS)}$$

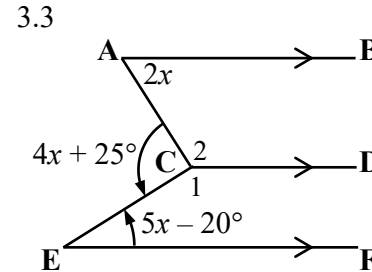
$$= 105^\circ + x$$

$$\therefore 105^\circ + x = 8x - 35^\circ \text{ (corresp. } \angle\text{'s, AD } \parallel\text{ EH)}$$

$$\therefore 105^\circ + 35^\circ = 8x - x$$

$$\therefore 140^\circ = 7x$$

$$\therefore x = 20^\circ$$



$$\hat{C}_1 = 180^\circ - (5x - 20^\circ) \text{ (co-int. } \angle\text{'s, CD } \parallel\text{ EF)}$$

$$\hat{C}_2 = 180^\circ - 2x \text{ (co-int. } \angle\text{'s, AB } \parallel\text{ CD)}$$

$$\therefore 4x + 25^\circ + 180^\circ - 5x + 20^\circ + 180^\circ - 2x = 360^\circ \text{ (adj. } \angle\text{'s around point C)}$$

$$\therefore -3x = -45^\circ$$

$$\therefore x = 15^\circ$$

END-OF-UNIT 12 TEST

40 marks
40 minutes

QUESTION 1

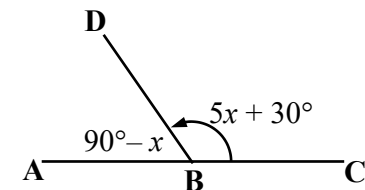
1.1 $90^\circ - x + 5x + 30^\circ = 180^\circ$

$$\therefore 4x + 120^\circ = 180^\circ$$

$$\therefore 4x = 60^\circ$$

$$\therefore x = 15^\circ$$

(adj. \angle 's on straight line AC)

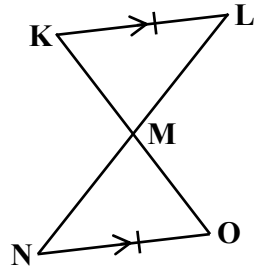


(4)

QUESTION 2

2.1 In $\triangle KLM$ and $\triangle ONM$

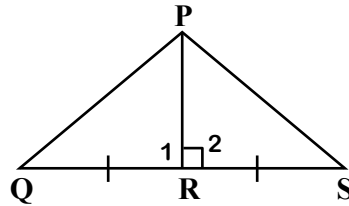
1. $KL = NO$ given
 2. $\hat{K} = \hat{O}$ alt. \angle s, $KL \parallel NO$
 3. $\hat{L} = \hat{N}$ alt. \angle s, $KL \parallel NO$
- $\therefore \triangle KLM \equiv \triangle ONM$ SAA



(4)

2.2 In $\triangle PQR$ and $\triangle PSR$

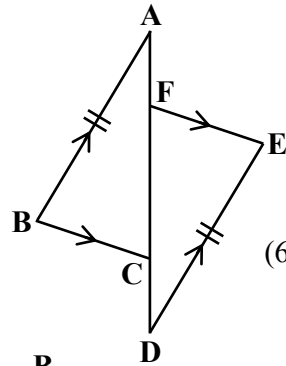
1. PR is common
 2. $\hat{R}_1 = \hat{R}_2 = 90^\circ$ given
 3. $QR = RS$ given
- $\therefore \triangle PQR \equiv \triangle PSR$ SAS



(4)

2.3 In $\triangle ABC$ and $\triangle DEF$

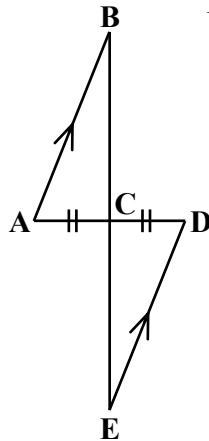
1. $AB = DE$ given
 2. $\hat{A} = \hat{D}$ alt. \angle s, $AB \parallel ED$
 3. $\hat{BCA} = \hat{EFD}$ alt. \angle s, $BC \parallel FE$
- $\therefore \triangle ABC \equiv \triangle DEF$ SAA
- $\therefore BC = EF$ $\triangle ABC \equiv \triangle DEF$



(6)

2.4 In $\triangle ACB$ and $\triangle DCE$

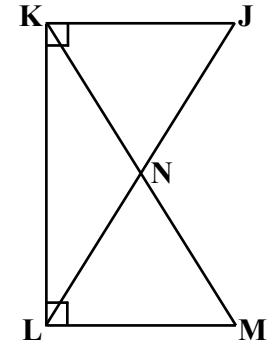
1. $AC = CD$ given
 2. $\hat{A} = \hat{D}$ alt. \angle s, $AB \parallel ED$
 3. $\hat{B} = \hat{E}$ alt. \angle s, $AB \parallel ED$
- $\therefore \triangle ACB \equiv \triangle DEC$ SAA
- $\therefore BC = EC$ $\triangle ACB \equiv \triangle DEC$



(6)

2.5 In $\triangle JKL$ and $\triangle MLK$

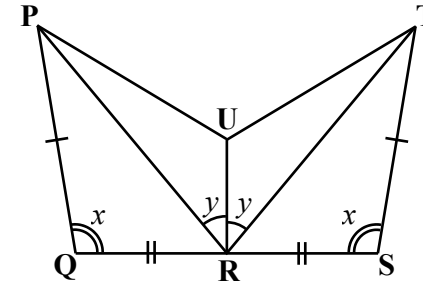
1. $\hat{JKL} = \hat{MLK} = 90^\circ$ given
 2. $JL = MK$ given
 3. KL is common
- $\therefore \triangle JKL \equiv \triangle MLK$ 90° HS
- $\therefore JK = ML$ $\triangle JKL \equiv \triangle MLK$



(6)

[26]

QUESTION 3



3.1 In $\triangle PQR$ and $\triangle TSR$

1. $PQ = TS$ given
 2. $\hat{Q} = \hat{S} = x$ given
 3. $QR = SR$ given
- $\therefore \triangle PQR \equiv \triangle TSR$ SAS

(4)

3.2 $PR = TR$ $\triangle PQR \equiv \triangle TSR$

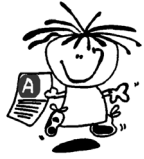
In $\triangle PRU$ and $\triangle TRU$

1. $PR = TR$ Proven
 2. $\hat{PRU} = \hat{TRU} = y$ given
 3. UR is common
- $\therefore \triangle PRU \equiv \triangle TRU$ SAS
- $\therefore PU = TU$ $\triangle PRU \equiv \triangle TRU$

(7)

[11]

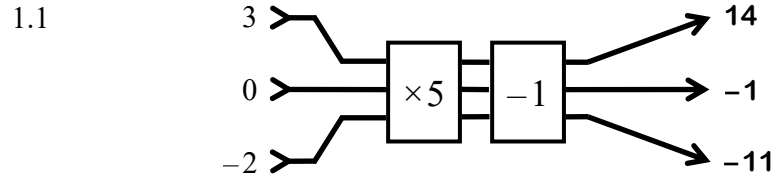
TOTAL: [40]



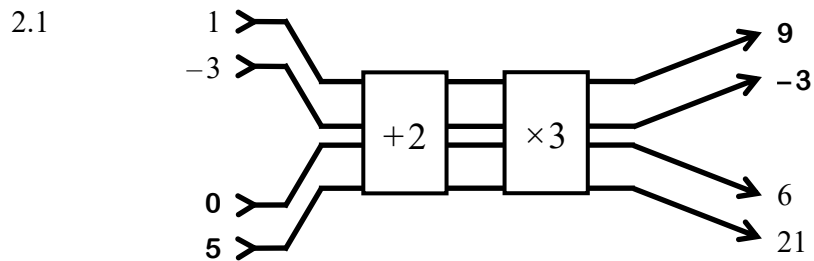
UNIT 19 FUNCTIONS AND RELATIONS PART 2



EXERCISE 19.1



1.2 $y = 5x - 1$



2.2 $y = 3(x + 2)$ | 2.3 $x = \frac{y}{3} - 2$ | 2.4 $(-3; -3)$

3.1 25 | 3.2 6

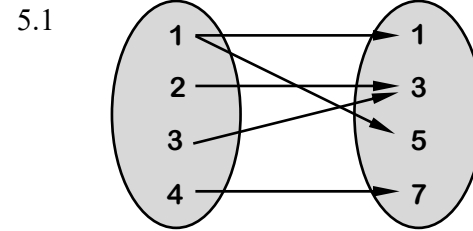
3.3

Input	-3	-2	-1	0	1	2	3	5	10	19
Output	-10	-5	0	5	10	15	20	30	55	95

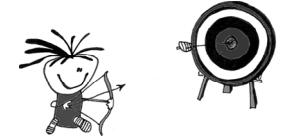
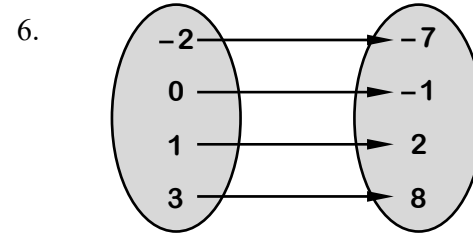
3.4.1 $y = 5(x + 1)$ | 3.4.2 $x = \frac{y}{5} - 1$

4.1 $\{(-3; 3), (0; 0), (1; -1), (5; -5)\}$

4.2 $\{-3; 0; 1; 5\}$ | 4.3 $y = -x$



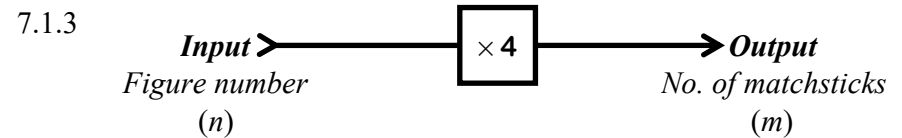
5.2 $\{1; 2; 3; 4\}$



7.1.1

Figure number (n)	1	2	3	4
No. of matchsticks (m)	4	8	12	16

7.1.2 The number of matchsticks is 4 times the figure number.

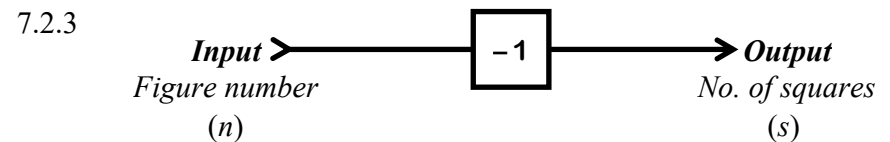


7.1.4 $m = 4n$ | 7.1.5 100 | 7.1.6 $n = \frac{m}{4}$ | 7.1.7 30

7.2.1

Figure number (n)	1	2	3	4
No. of squares (s)	0	1	2	3

7.2.2 The number of squares is one fewer than the figure number.



7.2.4 $s = n - 1$ | 7.2.5 24 | 7.2.6 $n = s + 1$ | 7.2.7 50

$$\begin{aligned}
 1.5 \quad & (2x - 3)(4x + 3) \\
 &= 8x^2 + 6x - 12x - 9 \\
 &= 8x^2 - 6x - 9
 \end{aligned}$$

$$\begin{aligned}
 1.7 \quad & (a - 3)(a + 3) \\
 &= a^2 - 9
 \end{aligned}$$

$$\begin{aligned}
 1.9 \quad & (3x + 2)(3x - 2) \\
 &= 9x^2 - 4
 \end{aligned}$$

$$\begin{aligned}
 1.11 \quad & (2x - 3y)(2x + 3y) \\
 &= 4x^2 - 9y^2
 \end{aligned}$$

$$\begin{aligned}
 1.13 \quad & (x + y)(x + y) \\
 &= x^2 + xy + xy + y^2 \\
 &= x^2 + 2xy + y^2
 \end{aligned}$$

$$\begin{aligned}
 1.15 \quad & (a + 3)^2 \\
 &= (a + 3)(a + 3) \\
 &= a^2 + 3a + 3a + 9 \\
 &= a^2 + 6a + 9
 \end{aligned}$$

$$\begin{aligned}
 1.17 \quad & (x - 7)^2 \\
 &= x^2 - 14x + 49
 \end{aligned}$$

$$\begin{aligned}
 1.19 \quad & (5x + 3)^2 \\
 &= 25x^2 + 30x + 9
 \end{aligned}$$

$$\begin{aligned}
 2.1 \quad & (3x + 2)(x - 1) - 3x(x + 1) \\
 &= 3x^2 - x - 2 - 3x^2 - 3x \\
 &= -4x - 2
 \end{aligned}$$

$$\begin{aligned}
 2.2 \quad & (5p + 3)(p - 2) - p(2p - 7) \\
 &= 5p^2 - 7p - 6 - 2p^2 + 7p \\
 &= 3p^2 - 6
 \end{aligned}$$

$$\begin{aligned}
 1.6 \quad & \left(x + \frac{1}{2}\right)\left(2x - \frac{1}{2}\right) \\
 &= 2x^2 - \frac{x}{2} + x - \frac{1}{4} \\
 &= 2x^2 + \frac{x}{2} - \frac{1}{4}
 \end{aligned}$$

$$\begin{aligned}
 1.8 \quad & (k + 5)(k - 5) \\
 &= k^2 - 25
 \end{aligned}$$

$$\begin{aligned}
 1.10 \quad & (4p - 3)(4p + 3) \\
 &= 16p^2 - 9
 \end{aligned}$$

$$\begin{aligned}
 1.12 \quad & (3x + 5y)(3x - 5y) \\
 &= 9x^2 - 25y^2
 \end{aligned}$$

$$\begin{aligned}
 1.14 \quad & (3x - 2)(3x - 2) \\
 &= 9x^2 - 6x - 6x + 4 \\
 &= 9x^2 - 12x + 4
 \end{aligned}$$

$$\begin{aligned}
 1.16 \quad & (a + 5)^2 \\
 &= a^2 + 10a + 25
 \end{aligned}$$

$$\begin{aligned}
 1.18 \quad & (2x - 1)^2 \\
 &= 4x^2 - 4x + 1
 \end{aligned}$$

$$\begin{aligned}
 1.20 \quad & (2a + 5b)^2 \\
 &= 4a^2 + 20ab + 25b^2
 \end{aligned}$$

$$\begin{aligned}
 2.3 \quad & (x + y)^2 - x(x - y) \\
 &= x^2 + 2xy + y^2 - x^2 + xy \\
 &= 3xy + y^2
 \end{aligned}$$

$$\begin{aligned}
 2.4 \quad & (3x + 2y)^2 - (3x + 2y)(3x - 2y) \\
 &= 9x^2 + 12xy + 4y^2 - (9x^2 - 4y^2) \\
 &= 9x^2 + 12xy + 4y^2 - 9x^2 + 4y^2 \\
 &= 12xy + 8y^2
 \end{aligned}$$

$$\begin{aligned}
 2.5 \quad & 3(x + 1)(x + 2) - (x - 1)^2 \\
 &= 3(x^2 + 3x + 2) - (x^2 - 2x + 1) \\
 &= 3x^2 + 9x + 6 - x^2 + 2x - 1 \\
 &= 2x^2 + 11x + 5
 \end{aligned}$$

$$\begin{aligned}
 2.6 \quad & 2(x - 3)(x + 3) + 5(x + 2)^2 \\
 &= 2(x^2 - 9) + 5(x^2 + 4x + 4) \\
 &= 2x^2 - 18 + 5x^2 + 20x + 20 \\
 &= 7x^2 + 20x + 2
 \end{aligned}$$

$$\begin{aligned}
 2.7 \quad & (x + 1)(x + 2)(x + 3) \\
 &= (x^2 + 3x + 2)(x + 3) \\
 &= x^3 + 3x^2 + 2x + 3x^2 + 9x + 6 \\
 &= x^3 + 6x^2 + 11x + 6
 \end{aligned}$$

$$\begin{aligned}
 2.8 \quad & (2a - 1)(3a + 2)(a - 5) \\
 &= (6a^2 + a - 2)(a - 5) \\
 &= 6a^3 + a^2 - 2a - 30a^2 - 5a + 10 \\
 &= 6a^3 - 29a^2 - 7a + 10
 \end{aligned}$$

$$\begin{aligned}
 2.9 \quad & (2x - y)^2 - (x + 2y)^2 \\
 &= 4x^2 - 4xy + y^2 - (x^2 + 4xy + 4y^2) \\
 &= 4x^2 - 4xy + y^2 - x^2 - 4xy - 4y^2 \\
 &= 3x^2 - 8xy - 3y^2
 \end{aligned}$$

$$\begin{aligned}
 2.10 \quad & 3(5x - 1)^2 + (2x + 3)(2x - 3) \\
 &= 3(25x^2 - 10x + 1) + 4x^2 - 9 \\
 &= 75x^2 - 30x + 3 + 4x^2 - 9 \\
 &= 79x^2 - 30x - 6
 \end{aligned}$$



EXERCISE 21.7

$$1.1 \quad x^2 + 3x + 2 \\ = (x + 1)(x + 2)$$

$$1.3 \quad x^2 + 5x + 4 \\ = (x + 1)(x + 4)$$

$$1.5 \quad x^2 + 7x + 12 \\ = (x + 3)(x + 4)$$

$$1.7 \quad x^2 + 4x + 4 \\ = (x + 2)(x + 2) \\ = (x + 2)^2$$

$$2.1 \quad x^2 - 3x + 2 \\ = (x - 1)(x - 2)$$

$$2.3 \quad x^2 - 5x + 4 \\ = (x - 1)(x - 4)$$

$$2.5 \quad x^2 - 7x + 12 \\ = (x - 3)(x - 4)$$

$$2.7 \quad x^2 - 4x + 4 \\ = (x - 2)(x - 2) \\ = (x - 2)^2$$

$$1.2 \quad x^2 + 4x + 3 \\ = (x + 1)(x + 3)$$

$$1.4 \quad x^2 + 13x + 12 \\ = (x + 1)(x + 12)$$

$$1.6 \quad x^2 + 8x + 12 \\ = (x + 2)(x + 6)$$

$$1.8 \quad x^2 + 8x + 16 \\ = (x + 4)(x + 4) \\ = (x + 4)^2$$

$$2.2 \quad x^2 - 4x + 3 \\ = (x - 1)(x - 3)$$

$$2.4 \quad x^2 - 13x + 12 \\ = (x - 1)(x - 12)$$

$$2.6 \quad x^2 - 8x + 12 \\ = (x - 2)(x - 6)$$

$$2.8 \quad x^2 - 8x + 16 \\ = (x - 4)(x - 4) \\ = (x - 4)^2$$

EXERCISE 21.8

$$1. \quad x^2 - x - 2 \\ = (x + 1)(x - 2)$$

$$3. \quad x^2 - 2x - 3 \\ = (x + 1)(x - 3)$$

$$5. \quad x^2 - 3x - 4 \\ = (x + 1)(x - 4)$$

$$2. \quad x^2 + x - 2 \\ = (x + 2)(x - 1)$$

$$4. \quad x^2 + 2x - 3 \\ = (x + 3)(x - 1)$$

$$6. \quad x^2 + 3x - 4 \\ = (x + 4)(x - 1)$$

$$7. \quad x^2 - 4x - 5 \\ = (x + 1)(x - 5)$$

$$9. \quad x^2 - 5x - 6 \\ = (x + 1)(x - 6)$$

$$11. \quad x^2 - x - 6 \\ = (x + 2)(x - 3)$$

$$13. \quad x^2 - 11x - 12 \\ = (x + 1)(x - 12)$$

$$15. \quad x^2 - x - 12 \\ = (x + 3)(x - 4)$$

$$17. \quad x^2 - 4x - 12 \\ = (x + 2)(x - 6)$$

$$8. \quad x^2 + 4x - 5 \\ = (x + 5)(x - 1)$$

$$10. \quad x^2 + 5x - 6 \\ = (x + 6)(x - 1)$$

$$12. \quad x^2 + x - 6 \\ = (x + 3)(x - 2)$$

$$14. \quad x^2 + 11x - 12 \\ = (x + 12)(x - 1)$$

$$16. \quad x^2 + x - 12 \\ = (x + 4)(x - 3)$$

$$18. \quad x^2 + 4x - 12 \\ = (x + 6)(x - 2)$$

EXERCISE 21.9

$$1. \quad a^2 - 2a - 8 \\ = (a + 2)(a - 4)$$

$$3. \quad m^2 - 7m - 8 \\ = (m + 1)(m - 8)$$

$$5. \quad p^2 + 6p + 8 \\ = (p + 2)(p + 4)$$

$$7. \quad x^2 + 13x + 12 \\ = (x + 1)(x + 12)$$

$$9. \quad a^2 + 8a + 12 \\ = (a + 2)(a + 6)$$

$$11. \quad m^2 - 11m + 24 \\ = (m - 3)(m - 8)$$

$$13. \quad p^2 - 2p - 24 \\ = (p + 4)(p - 6)$$

$$2. \quad b^2 + 2b - 8 \\ = (b + 4)(b - 2)$$

$$4. \quad n^2 + 7n - 8 \\ = (n + 8)(n - 1)$$

$$6. \quad q^2 - 7q + 12 \\ = (q - 3)(q - 4)$$

$$8. \quad y^2 - 13y + 12 \\ = (y - 1)(y - 12)$$

$$10. \quad b^2 - 8b + 12 \\ = (b - 2)(b - 6)$$

$$12. \quad n^2 + 11n + 24 \\ = (n + 3)(n + 8)$$

$$14. \quad q^2 + 2q - 24 \\ = (q + 6)(q - 4)$$



UNIT 22

EQUATIONS PART 2



EXERCISE 22.1

$$1.1 \quad 6x - 4 = 26$$

$$\therefore 6x = 30$$

$$\therefore x = 5$$

$$1.3 \quad 3x - 2 = x + 6$$

$$\therefore 2x = 8$$

$$\therefore x = 4$$

$$1.5 \quad \frac{x}{2} + \frac{1}{4} = \frac{3}{4}$$

$$\therefore \frac{x}{2} = \frac{1}{2}$$

$$\therefore x = 1$$

$$1.7 \quad \frac{x+1}{12} + \frac{3x-2}{4} = \frac{4x-1}{3}$$

$$\therefore x+1+3(3x-2) = 4(4x-1)$$

$$\therefore x+1+9x-6 = 16x-4$$

$$\therefore 10x-5 = 16x-4$$

$$\therefore -6x = 1$$

$$\therefore x = -\frac{1}{6}$$

$$1.9 \quad 4(x+1) = 3(x+5)$$

$$\therefore 4x+4 = 3x+15$$

$$\therefore x = 11$$

$$1.2 \quad 20 - 4x = 12$$

$$\therefore -4x = -8$$

$$\therefore x = 2$$

$$1.4 \quad 7x + 1 = x + 5$$

$$\therefore 6x = 4$$

$$\therefore x = \frac{2}{3}$$

$$1.6 \quad \frac{2x}{5} + 10 = 12$$

$$\therefore \frac{2x}{5} = 2$$

$$\therefore x = 2 \times \frac{5}{2}$$

$$= 5$$

$$1.8 \quad \frac{x}{4} + 3 = \frac{2-x}{3}$$

$$\therefore 3x + 36 = 4(2-x)$$

$$\therefore 3x + 36 = 8 - 4x$$

$$\therefore 7x = -28$$

$$\therefore x = -4$$

$$1.10 \quad 4(x+1) = 5 - 2(x-3)$$

$$\therefore 4x+4 = 5 - 2x+6$$

$$\therefore 6x = 11 - 4$$

$$\therefore 6x = 7$$

$$\therefore x = \frac{7}{6}$$

$$2.1 \quad 4(x+3) - 2 = 1 - 5(x-2)$$

$$\therefore 4x + 12 - 2 = 1 - 5x + 10$$

$$\therefore 4x + 10 = -5x + 11$$

$$\therefore 9x = 1$$

$$\therefore x = \frac{1}{9}$$

$$2.3 \quad 7(x+1) - 2 = 5(1-x)$$

$$\therefore 7x + 7 - 2 = 5 - 5x$$

$$\therefore 7x + 5 = 5 - 5x$$

$$\therefore 12x = 0$$

$$\therefore x = 0$$

$$2.5 \quad 2x + 3(x-2) = 5(x+1) - 2$$

$$\therefore 2x + 3x - 6 = 5x + 5 - 2$$

$$\therefore 5x - 6 = 5x + 3$$

$$\therefore 0x = 9$$

$$\therefore \text{No solution.}$$

$$2.7 \quad \frac{3}{x-2} - \frac{x}{x-2} = -4$$

$$\therefore \frac{3-x}{x-2} = \frac{-4(x-2)}{x-2}, x \neq 2$$

$$\times (x-2): \quad \therefore 3-x = -4x+8$$

$$\therefore 3x = 5$$

$$\therefore x = \frac{5}{3}$$

$$2.8 \quad \frac{2}{x} + \frac{2}{x(x-2)} = \frac{1}{x-2}$$

$$\therefore \frac{2(x-2)+2}{x(x-2)} = \frac{x}{x(x-2)} \quad x \neq 0; x \neq 2$$

$$\times x(x-2): \quad \therefore 2x-4+2 = x$$

$$\therefore x = 2 \quad \text{Not valid.}$$

$$\therefore \text{No Solution.}$$

$$2.2 \quad 7(x+1) - 2 = 5(x-3)$$

$$\therefore 7x + 7 - 2 = 5x - 15$$

$$\therefore 7x + 5 = 5x - 15$$

$$\therefore 2x = -20$$

$$\therefore x = -10$$

$$2.4 \quad 3(x+2) - 1 = 3(x+1) + 2$$

$$\therefore 3x + 6 - 1 = 3x + 3 + 2$$

$$\therefore 3x + 5 = 3x + 5$$

$$\therefore 0x = 0$$

$$\therefore x \in \mathbb{R}$$

$$2.6 \quad \frac{2}{x} + \frac{1}{4x} = 9, x \neq 0$$

$$\therefore 4x \times \frac{2}{x} + 4x \times \frac{1}{4x} = 4x \times 9$$

$$\therefore 8 + 1 = 36x$$

$$\therefore 36x = 9$$

$$\therefore x = \frac{1}{4}$$



3. Vol of new object = $8 \times$ Vol of original object

4. $k = 5$

5. New volume = 10 Old Volume

$$(kx)^3 = 10x^3$$

$$k^3 = 10$$

$$k = \sqrt[3]{10}$$

$$\approx 2,15$$

6. New volume = 2 Old Volume

$$\pi(kr)^2 H = 2\pi r^2 H$$

$$k^2 = 2$$

$$k = \sqrt{2}$$

$$\approx 1,41$$



END-OF-UNIT 24 TEST

40 marks

40 minutes

QUESTION 1

1.1.1 $6 \times 3,5^2$
= $73,5 \text{ cm}^2$

1.1.2 $3,5^3$
= $42,875 \text{ cm}^3$ (2)(2)

1.2 T.S.A. = $6x^2 = 1,5 \text{ m}^2$

$$x^2 = 0,25$$

$$x = 0,5 \text{ m}$$

$$\text{Vol} = x^3 = 0,5^3$$

$$= 0,125 \text{ m}^3$$
 (5)

1.3.1 $2 \times 20 = 40 \text{ cm}^3$

1.3.2 $8 \times 20 = 160 \text{ cm}^3$ (1)(1)
[11]

QUESTION 2

2.1 $\frac{1}{2} \times 150 \times 80 \times 750$
= $4\,500\,000 \text{ cm}^3$
= $4,5 \text{ m}^3$

2.2 $ST^2 = 150^2 + 80^2$
= $28\,900$
ST = 170 cm (4)(2)

2.3 $2 \times \frac{1}{2} \times 1,5 \times 0,8 + 7,5(1,5 + 0,8 + 1,7)$
= $31,2 \text{ m}^2$ (5)
[11]

QUESTION 3

Vol = $2^2 \times 12 - \pi(0,9)^2 \times 12$
= $48 - 30,53628 \dots$
= $17,4637 \dots$
 $\approx 17 \text{ m}^3$ [6]

QUESTION 4

4.1 80% of 3 = $2,4 \text{ m}$

4.2 $\pi \times 1^2 \times 2,4$
= $7,5398 \dots \text{ m}^3$ (2)(2)

4.3.1 Vol = $1,2 \times 0,5 \times 1$
= $0,6 \text{ m}^3 = 0,6 \text{ k}\ell$
= 600ℓ

4.3.2 $600 \ell \div 7$
= $85,71 \ell$ per day (3)(2)

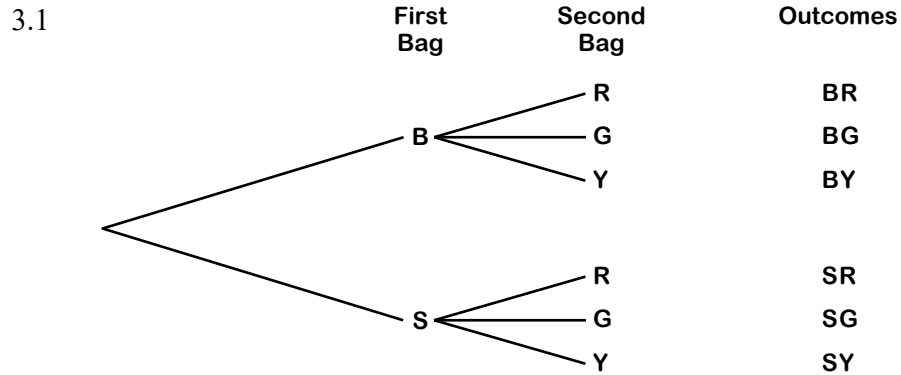
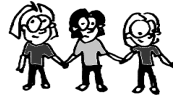
4.3.3 $7,5398 \div 0,6$
= $12,566$
i.e. In 13th week (3)

[12]

TOTAL: [40]

2.2.1 $\frac{1}{9}$ 2.2.2 $\frac{2}{9}$ 2.2.3 $\frac{6}{9} = \frac{2}{3}$
 2.2.4 $\frac{3}{9} = \frac{1}{3}$ 2.2.5 $\frac{5}{9}$

4.2.1 $\frac{1}{8}$ 4.2.2 $\frac{3}{8}$
 4.2.3 $\frac{4}{8} = \frac{1}{2}$ 4.2.4 $\frac{6}{8} = \frac{3}{4}$



EXERCISE 28.4

1.1 36

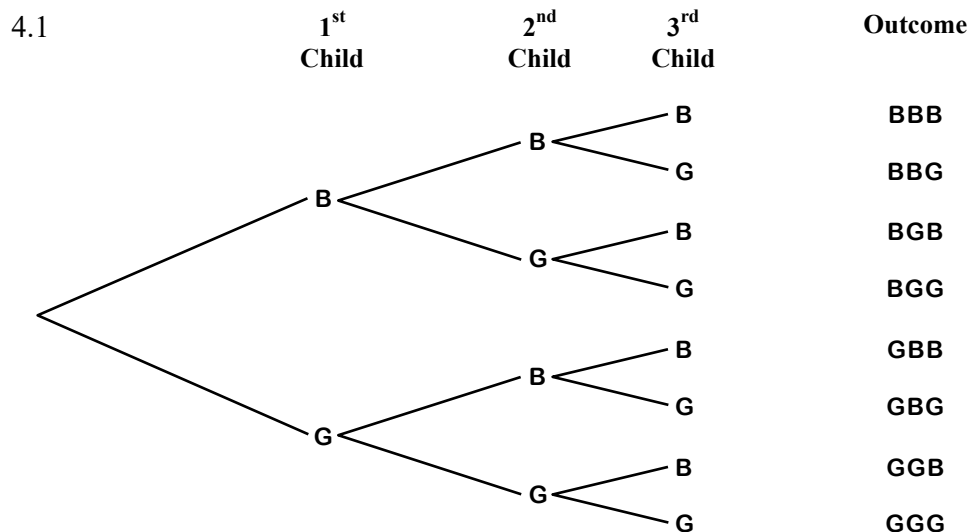
1.2.1 $\frac{3}{9} \times 100 = 33,3\%$ 1.2.2 $\frac{5}{18} \times 100 = 27,78\%$

1.2.3 $\frac{6}{27} \times 100 = 22,22\%$ 1.2.4 $\frac{7}{36} \times 100 = 19,44\%$

1.3 $\frac{1}{6} = 16,67\%$

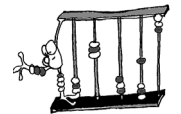
1.4 When a few trials (e.g. 9 rolls) are done, it is possible for the relative frequency to differ significantly from the theoretical probability. However, as more rolls were included, the relative frequency approached the theoretical order.

3.2.1 $\frac{3}{6} = \frac{1}{2}$ 3.2.2 $\frac{1}{6}$ 3.2.3 $\frac{2}{6} = \frac{1}{3}$
 3.2.4 $\frac{5}{6}$ 3.2.5 0



2.1.1 sum relative frequency (as a percentage)

9 $\frac{6}{36} \times 100 = 16,67\%$



2.1.2 $\frac{4}{36} \times 100 = 11,11\%$

2.1.3 It can be risky making prediction using results of only 36 trials.

2.2.1 Yes

2.2.2 the sum for 11 as relative frequency of 0 differs more from the theoretical probability of 5,56%