Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2020

Mathematics

StemUp Model Solution

Unit M3
(With calculator)
Higher Tier



[GMC31]

GMC31

MONDAY 13 JANUARY, 9.15am–11.15am

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twenty-seven** questions.
All working should be clearly shown in the spaces provided. Marks may be awarded for partially correct solutions.
You **may** use a calculator for this paper.

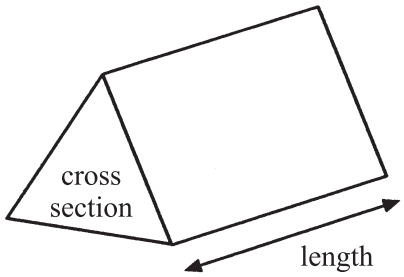
INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You should have a calculator, ruler, compasses and a protractor.
The Formula Sheet is on page 2.

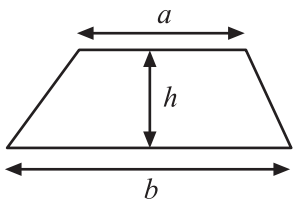
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Formula Sheet

Volume of prism = area of cross section × length

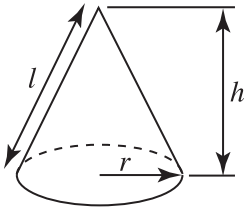


Area of trapezium = $\frac{1}{2}(a+b)h$



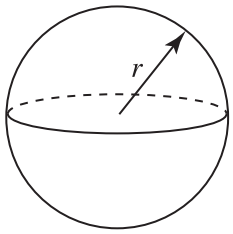
Volume of cone = $\frac{1}{3}\pi r^2 h$

Curved surface area of cone = πrl

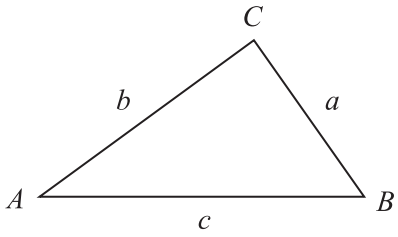


Volume of sphere = $\frac{4}{3}\pi r^3$

Surface area of sphere = $4\pi r^2$



In any triangle *ABC*



Quadratic Equation

The solutions of $ax^2 + bx + c = 0$ where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc\cos A$

Area of triangle = $\frac{1}{2}ab\sin C$

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1

Silverside	costs	£4.90 per kg
Topside	costs	£5.75 per kg
Fillet	costs	£13.00 per kg

Martin buys 4.5 kg of Fillet.

He also buys some Silverside.

The total cost is £92.31

How much Silverside does he buy?

Fillet: 4.5 × 13.00 = £58.50

Silverside: 92.31 − 58.50 = £33.81

33.81 ÷ 4.90 = 6.9 kg

Answer 6.9 kg [4]

[Turn over

2 **(a)** Calculate the value of $\frac{2}{0.4^2}$

$0.4^2 = 0.16$

$2 \div 0.16 = 12.5$

Answer 12.5 [2]

(b) Calculate the cube of 6

$6 \times 6 \times 6 = 216$

Answer 216 [1]

(c)

36	1	19	49	10	39	15	31

From the numbers in the list, write down all the

(i) prime numbers,

Answer 19, 31 [1]

(ii) square numbers.

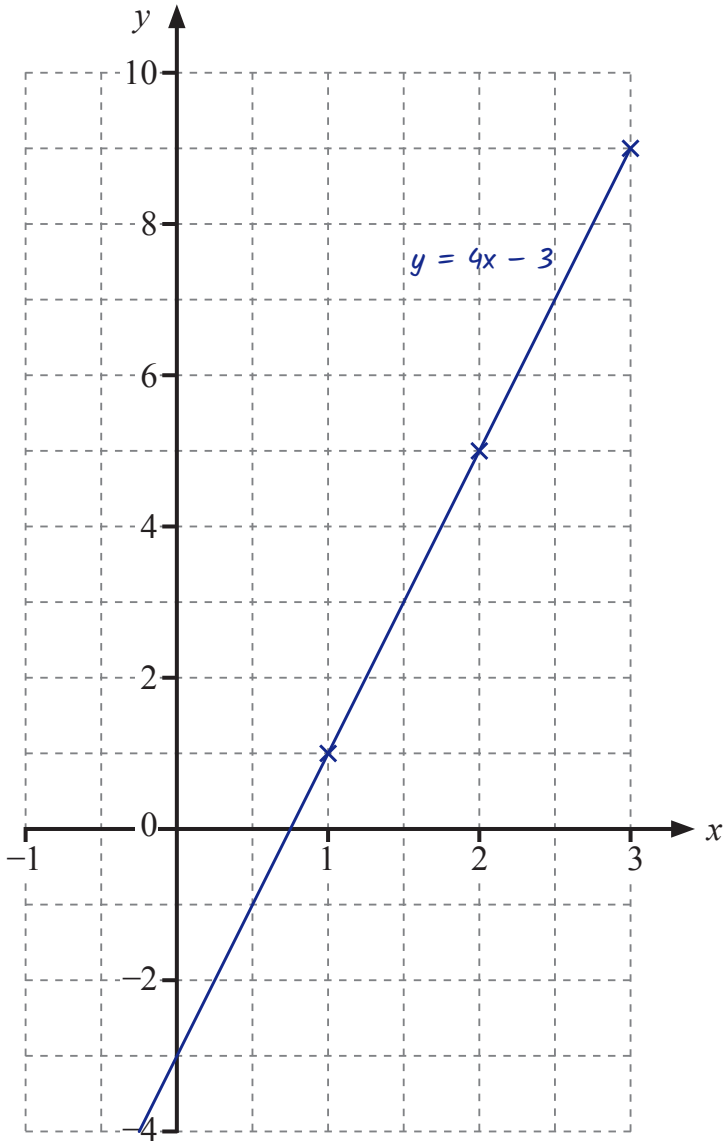
Answer 36, 1, 49 [1]

3 **(a)** Complete the table below for $y = 4x - 3$

x	1	2	3
y	1	5	9

[1]

(b) Draw the line $y = 4x - 3$ on the grid below



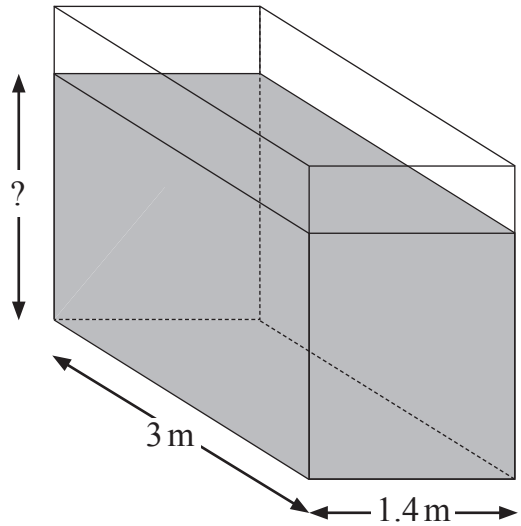
[2]

[Turn over

4 A tank is in the shape of a cuboid, as shown below.

The tank is used to store $11.13\,m^3$ of liquid.

How deep is the liquid in the tank?



Area of base = 3 × 1.4 = 4.2 m^2

Depth = 11.13 ÷ 4.2

= 2.65 m

Answer 2.65 m [3]

5 Work out the size of the angle marked x in the diagram below.

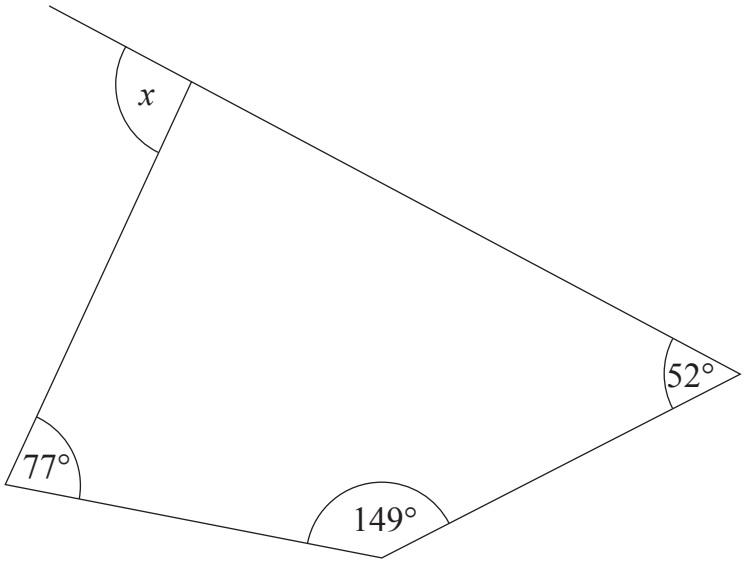


diagram not
drawn accurately

Angles in a quadrilateral add to 360°

360 − (77 + 149 + 52) = 360 − 278 = 82°

Angles on a straight line add to 180°

x = 180 − 82 = 98°

Answer 98 ° [3]

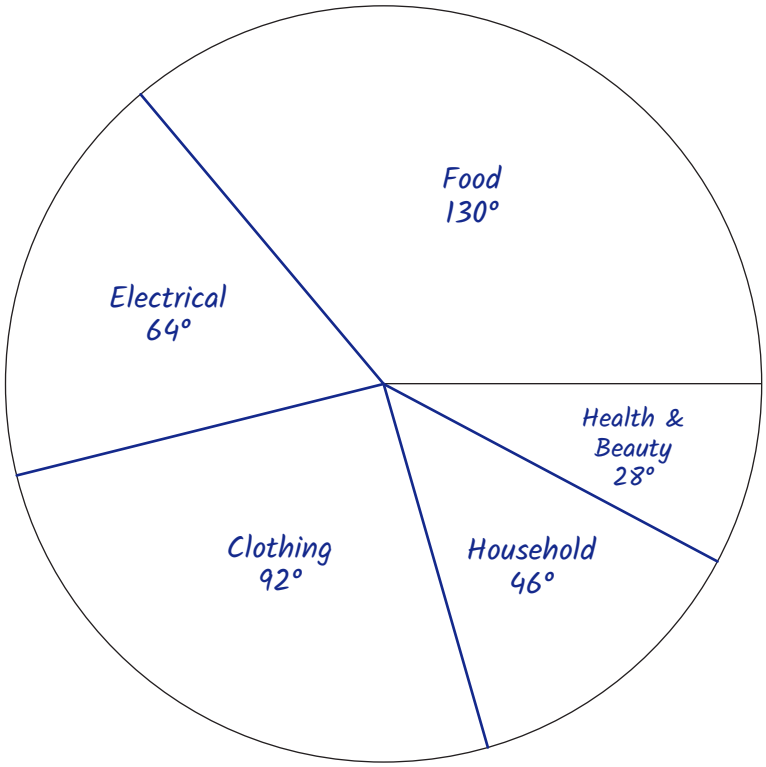
[Turn over

6 The total sales figures for a supermarket one month are shown below.

Department	Total Sales (£1000s)	Angle
Food	65	65 × 2 = 130°
Electrical	32	32 × 2 = 64°
Clothing	46	46 × 2 = 92°
Household	23	23 × 2 = 46°
Health & Beauty	14	14 × 2 = 28°

Draw a pie chart to show this information.

Total = 180, 360 ÷ 180 = 2° per £1000



[4]

7 A hotel has single, twin and family rooms.

It offers room only, bed and breakfast (B&B) or half board.

On Saturday night, all the rooms in the hotel were booked.

Some information is shown in this two-way table.

	Room only	**B&B**	**Half board**	
Single	2	1	*1*	4
Twin	*4*	4	3	*11*
Family	1	*3*	6	10
	7	*8*	*10*	*25*

How many rooms are in the hotel?

Total rooms = 4 + 11 + 10 = 25

Answer *25* [3]

[Turn over

8 Streetwise Youth Club has 86 members.

59 of the members attended last week.

What percentage attended last week?

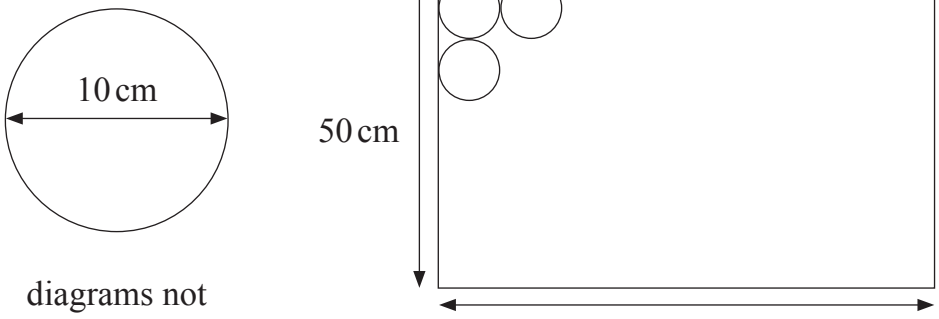
Give your answer to 1 decimal place.

$\frac{59}{86} \times 100 = 68.604...$

$= 68.6\%$ (1 d.p.)

Answer 68.6 % [3]

9 Circles with diameter 10 cm are cut from a sheet of plastic as shown below.



diagrams not drawn accurately

(a) Calculate the area of each circle.

radius = 10 ÷ 2 = 5 cm
π × 5^2 = 78.5398... = 78.54 cm^2

Answer 78.54 cm^2 [2]

(b) How many circles can be cut from the sheet of plastic?

1 m = 100 cm: 100 ÷ 10 = 10 across, 50 ÷ 10 = 5 down
10 × 5 = 50 circles

Answer 50 [2]

(c) What is the area of the plastic left over after the maximum number of circles have been cut out?

Sheet = 100 × 50 = 5000 cm^2
Circles = 50 × 78.5398... = 3926.99 cm^2
5000 − 3926.99 = 1073.009... cm^2

Answer 1073.01 cm^2 [3]

[Turn over

10 Julie works on a market stall.
One Saturday she has 42 boxes of candles to sell.
Each box cost her £2.40
There are 18 candles in each box.

During the day she sells 34 boxes at £3.60 each.
In the last hour she starts to sell the remaining candles individually at 35p each.

At the end of the day she has only 12 candles left.
Calculate the profit she made that day.

Cost: 42 × £2.40 = £100.80

Boxes sold: 34 × £3.60 = £122.40

Candles left: (42 − 34) × 18 = 8 × 18 = 144

Candles sold individually: 144 − 12 = 132

132 × 35p = 4620p = £46.20

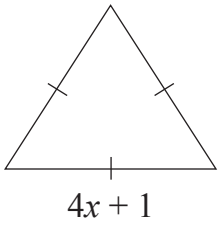
Takings: 122.40 + 46.20 = £168.60

Profit: 168.60 − 100.80 = £67.80

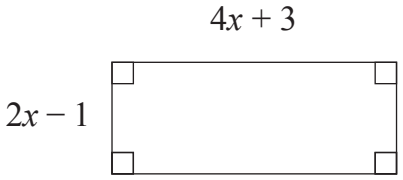
Answer £ 67.80 [6]

11 Which of these shapes has the greatest perimeter?

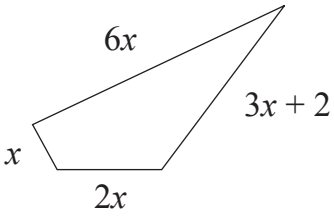
Show all your working.



Shape A



Shape B



Shape C

Shape A: $3 \times (4x + 1) = 12x + 3$

Shape B: $2(4x + 3) + 2(2x - 1)$

$= 8x + 6 + 4x - 2 = 12x + 4$

Shape C: $6x + 3x + 2 + 2x + x = 12x + 2$

$12x + 4 > 12x + 3 > 12x + 2$

so Shape B has the greatest perimeter

Answer Shape _____B_____ [4]

[Turn over

12 A shop sells 80 gift vouchers valued at £5, £10, £20, £50 or £100
The table shows the number of each sold one weekend.

Price of gift voucher	Number of vouchers sold	Price × Number
£5	34	5 × 34 = 170
£10	26	10 × 26 = 260
£20	9	20 × 9 = 180
£50	7	50 × 7 = 350
£100	4	100 × 4 = 400

The shopkeeper states "on average people spend at least £15 on a gift voucher".

By finding all three averages (mode, median, mean), which average makes her statement correct?

Mode = £5 (most vouchers sold)

Median: 80 values, so the 40th and 41st values

34 are £5, 35th to 60th are £10, so median = £10

Mean = (170 + 260 + 180 + 350 + 400) ÷ 80

= 1360 ÷ 80 = £17

£5 < £15, £10 < £15, £17 ≥ £15

Answer Mean because mean = £17 which is at least £15, mode = £5 and median = £10 are both less than £15 [5]

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13 BMI (Body Mass Index) is calculated using the formula

$$\text{BMI} = \frac{w}{h^2}$$

where w = weight in kilograms and h = height in metres.

Mark has a BMI of 22
His height is 1.83 m.

Calculate his weight.

$22 = \frac{w}{1.83^2}$

$w = 22 \times 1.83^2 = 73.6758 = 73.7$ kg

Answer 73.7 kg [2]

14 Solve $5(3x - 2) = 7x + 4$

$15x - 10 = 7x + 4$

$15x - 7x = 4 + 10$

$8x = 14$

$x = 14 \div 8 = 1.75$

Answer $x =$ 1.75 [3]

[Turn over

15 A badge is made from a triangle and three-quarters of a circle as shown.

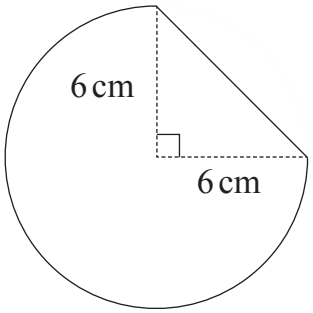


diagram not drawn accurately

Work out the perimeter of the badge.

Circumference of full circle = $2 \times \pi \times 6 = 37.699...$

Three-quarters: $\frac{3}{4} \times 37.699... = 28.274...$ cm

Hypotenuse: $6^2 + 6^2 = 72$

$\sqrt{72} = 8.485...$ cm

Perimeter = $28.274... + 8.485...$

$= 36.759... = 36.76$ cm

Answer 36.76 cm [6]

16 Write down two numbers, greater than 1, which have a lowest common multiple (LCM) of 48

Answer 16 , 3 [2]

17 Expand and simplify $(p - 6)(p + 2)$

$p^2 + 2p - 6p - 12$

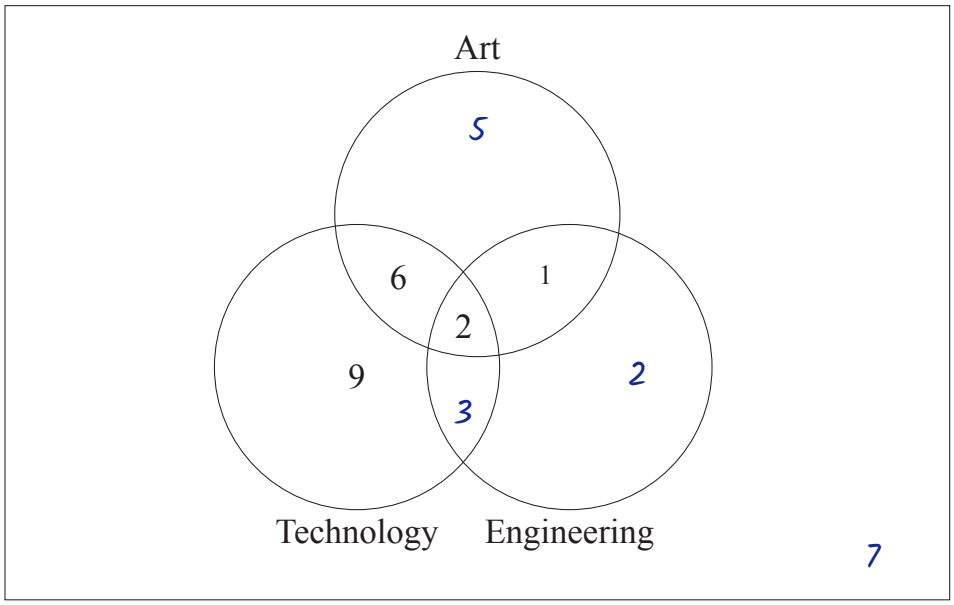
$= p^2 - 4p - 12$

Answer $p^2 - 4p - 12$ [2]

[Turn over

18 There are 35 students in a Form Class.
Some students study Art, some study Technology, some study Engineering and some study a combination of these subjects.
Some study none of these subjects.

The Venn diagram shows some information about the number of students studying the subjects.



5 students study Technology and Engineering.
14 students study Art.
8 students study Engineering.

(a) Use this information to complete the Venn diagram. [4]

(b) Use the Venn diagram to calculate what percentage of Technology students also study Art but not Engineering.

Technology = 9 + 6 + 2 + 3 = 20

$\frac{6}{20} \times 100 = 30\%$

Answer 30 % [2]

19 Work out the midpoint of the line PQ joining P(4, −6) and Q(8, 2).

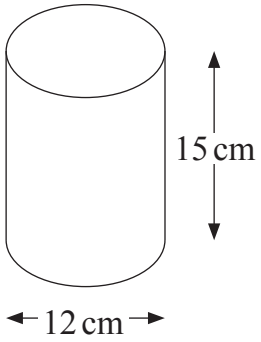
x: (4 + 8) ÷ 2 = 6

y: (−6 + 2) ÷ 2 = −2

Answer (6 , −2) [2]

20 Calculate the volume of a cylinder with diameter 12 cm and height 15 cm.

Include units with your answer.



radius = 6 cm

$V = \pi \times 6^2 \times 15 = 1696.460... \text{ cm}^3$

Answer 1696.46 cm^3 [3]

[Turn over

21 A restaurant bill, including 15% service charge, was £98.90
How much was the service charge?

115% = £98.90

1% = 98.90 ÷ 115 = £0.86

100% = £86

Service charge = 98.90 − 86 = £12.90

Answer £ 12.90 [3]

22 Simplify $\frac{x^2 - 2x}{3} \times \frac{6}{x^2 + 2x - 8}$

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

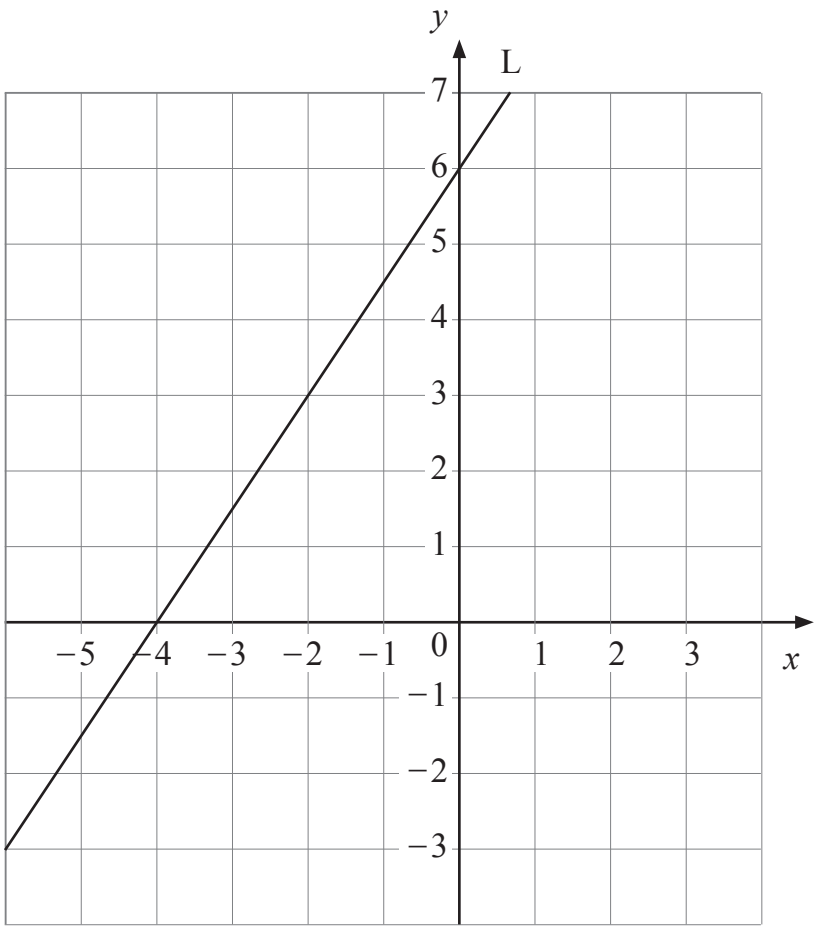
$= \frac{6x}{3(x + 4)} = \frac{2x}{x + 4}$

2x/(x + 4)

Answer _____ [3]

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23



(a) Write down the equation of the line L shown.

$m = 6 \div 4 = 1.5, \quad c = 6$

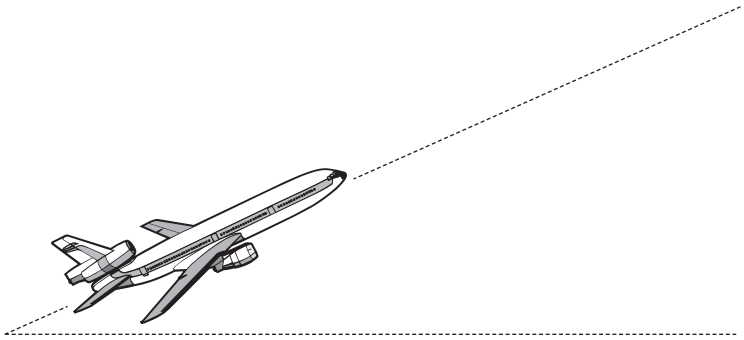
Answer $y = 1.5x + 6$ [3]

(b) Write down the equation of any line parallel to line L.

Answer $y = 1.5x + 2$ [1]

[Turn over

24 After take-off, an aircraft flies for 16 km at an angle of 24° to the horizontal.



Calculate the height it reaches.

$\sin 24° = h \div 16$

$h = 16 \times \sin 24°$

$= 6.5077... = 6.51$ km

Answer 6.51 km [3]

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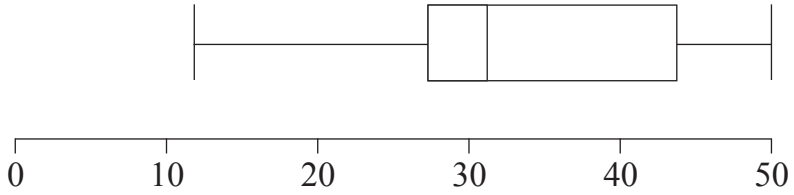
25 The test marks for 35 students are displayed in two different ways.

Stem and leaf

1	2 2 2 3 4
2	0 4 5 8 8 8 8
3	0 0 0 1 1 2 3 4 5 7 8 9 9
4	2 4 5 5 6 7 8 9 9
5	0

KEY: 4 | 6 = 46

Box plot



(a) Give one advantage of the information being displayed in the stem and leaf diagram.

All the raw data (every test mark) can still be seen. [1]

(b) Give one advantage of the information being displayed in the box plot.

The median and quartiles can be seen clearly. [1]

[Turn over

26 **(a)** Write 84 and 154 as a product of their prime factors.

$84 = 2 \times 42 = 2 \times 2 \times 21 = 2 \times 2 \times 3 \times 7$

$154 = 2 \times 77 = 2 \times 7 \times 11$

Answer 84 = $2^2 \times 3 \times 7$ 154 = $2 \times 7 \times 11$ [2]

(b) Hence, or otherwise, find the highest common factor (HCF) of 84 and 154

Common prime factors: 2 and 7

HCF = $2 \times 7 = 14$

Answer 14 [2]

27 Rory has x golf balls.

Graham has one less than Rory.

Darren has one less than Graham.

After a round of golf, Rory still has x golf balls but Graham has lost half of his golf balls and Darren has lost two-thirds of his golf balls.

They **now** have a total of 74 golf balls between them.

Set up a linear equation and solve it to find how many golf balls each player now has.

A solution by trial and improvement will not be accepted.

Rory = x, Graham = x − 1, Darren = x − 2

After the round:

$$x + \frac{x-1}{2} + \frac{x-2}{3} = 74$$

× 6: $6x + 3(x-1) + 2(x-2) = 444$

$6x + 3x - 3 + 2x - 4 = 444$

$11x - 7 = 444$

$11x = 451$

$x = 41$

Rory 41, Graham $(41-1) \div 2 = 20$, Darren $(41-2) \div 3 = 13$

Check: $41 + 20 + 13 = 74$

Answer Rory 41 Graham 20 Darren 13 [5]

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For Examiner's use only	
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Examiner Number

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