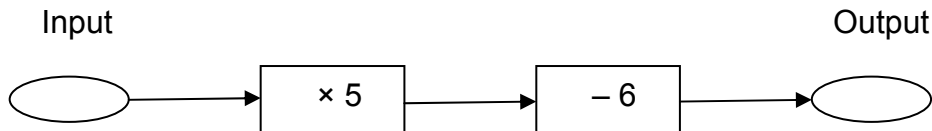


## Unit 2 Number and Algebra - Higher tier (43602H)

## Question 5b

5 (b) Here is a different number machine.



The output is equal to the input.

Work out the input.

(3 marks)

Mark scheme:

<b>5b</b>	$5x - 6 = x$ or $\frac{x + 6}{5} = x$	M1	T&I ... two trials, both correct
	$5x - x = 6$ or $4x = 6$ or $x - 5x = -6$	M1	T&I ... improved correct third trial
	$(x =) 1.5$	A1	oe

This question was targeted at grade D and assessed AO3.

An algebraic approach is the most efficient method, although trial and improvement was a common strategy used.

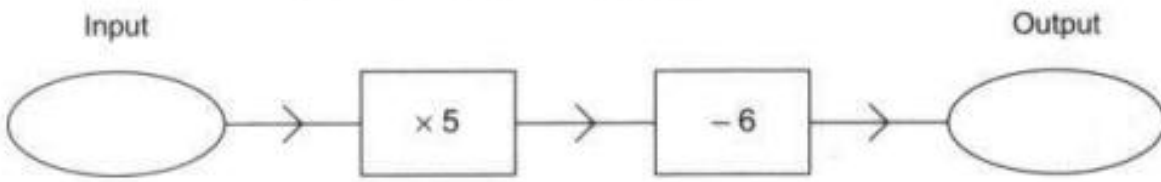
Many candidates who used trial and improvement made arithmetic errors in their calculations.

For example many candidates worked under the number machine and wrote  $-1 \rightarrow -1 \times 5 = -5 \rightarrow -5 - 6 = 1$ . Sometimes, candidates then gave  $-1$  as their answer.

The mean mark was 1.52 out of 3. Although over 40% scored full marks, more than 30% did not score.

**Candidate A**

5 (b) Here is a different number machine.



The output is equal to the input.

Work out the input.

$x \rightarrow 5x - 6 = x$   $6/4 = 1.5$

$-6 = -4x$

Answer ..... 1.5 ..... (3 marks)

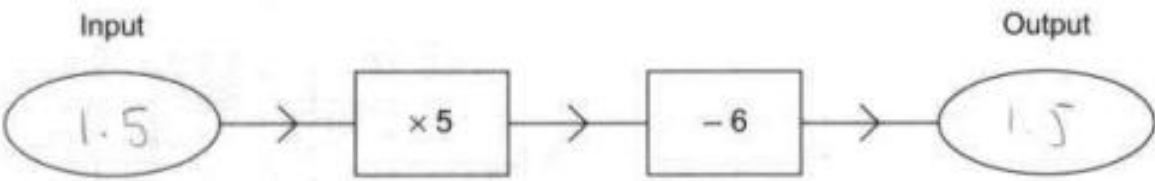
This candidate has used the more efficient algebraic method.

The candidate has set up the equation and solved it.

Mark awarded = 3

**Candidate B**

5 (b) Here is a different number machine.



The output is equal to the input.

Work out the input.

~~$x \times 5 - 6 = x$~~        $2 \times 5 - 6 = 4$

---

~~$x + 6 \div 5 = x$~~        $1.5 \times 5 - 6 = 1.5$

---

~~$-1 + 6 \div 5 = 1 \times$~~

---

Answer ..... 1.5 ..... (3 marks)

The candidate used algebra to form an equation, but solved the equation using trial and improvement. The second equation shown is from working backwards and is equally valid.

The solution is correct and scores full marks.

Mark awarded = 3

**Candidate C**

5 (b) Here is a different number machine.

The output is equal to the input.

Work out the input.

$10 \times 5 = 50 - 6 = 44$       $1.5 \times 5 = 7.5 - 6 = 1.5$   
 $2 \times 5 = 10 - 6 = 4$   
 $1 \times 5 = 5 - 6 = -1$

1.5  
 1.5  
 1.5  
 1.5  
 1.5  
 7.5  
 2

Answer ..... 1 ..... (3 marks)

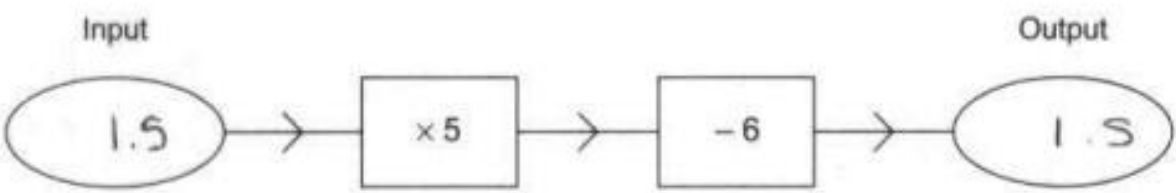
This candidate used trial and improvement, but did not reach the correct final answer. The candidate did not recognise that the input and output were not equal at this stage.

The method is valid, but candidates are often unsuccessful when the answer is not a whole number.

Mark awarded = 2

**Candidate D**

5 (b) Here is a different number machine.



The output is equal to the input.

Work out the input.

$2 \times 5 - 6 = 4$ ,  $1 \times 5 - 6 = -1$ ,  $1.5 \times 5 - 6 = 1.5$

Answer 1.5 (3 marks)

This candidate used trial and improvement and was successful, trying 2, then 1 and finally 1.5.

Mark awarded = 3

## Question 8

- 8\* Martha sells jars of jam at a Farmer's market.  
 She has 80 jars to sell at £3 each.  
 She sells 50 jars and then reduces the price by 40%.  
 Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam.  
 Her target is to make a profit of at least £100.

Does she meet her target?  
 You **must** show your working.

(5 marks)

Mark scheme:

8	$50 \times 3$ or 150	B1	or $150 - 95$ or 55
	$\frac{60}{100} \times 3$ or 1.8(0)	M1	oe eg. $3 - (\frac{40}{100} \times 3)$
	$(30 \times \text{their } 1.8(0) \text{ or } 54) +$ their 150 - 95	M1	
	109	A1	
	their 150 + their 54 – 95 with their 54 coming from 40% or 60% correctly evaluated <b>and</b> a decision based on their answer	Q1	(iii) SC4 for (£)91 and No ... from using 40% = £120 instead of 60% = £1.80

This question was targeted at grade C and assessed AO2, functional elements and quality of written communication.

It was a common question with the Foundation paper and responses were generally successful at the Higher tier and reasonably successful at Foundation level.

The mean marks were 3.38 / 5 on Higher and 1.49 / 5 on Foundation.

On both papers there were very few candidates who did not attempt the question, which proved to be a good discriminator.

The standard of arithmetic, particularly on the percentage calculation but also on the multiplication was often poor.

**Candidate E**

\*8 Martha sells jars of jam at a farmers' market. She has 80 jars to sell at £3 each. She sells 50 jars and then reduces the price by 40%. Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam. Her target is to make a profit of at least £100.

Does she meet her target?  
You **must** show your working.

87

$$50 \times 3 = 150 - 95 = £55$$

$$£3 \div 10 = 30p \times 4 = £1.20 \quad £3 - 1.20 =$$

$$£1.80 \times 30 = £54$$

$$£1.80 \times 30 = £54$$

$$55 + 32.40 = 87.40$$

No she doesn't make the profit

This candidate shows working as required by the question. The way it was presented lacked some detail and style, but the essential information is there.

The arithmetic error of  $£1.80 \times 30 = £54$  was quite common.

This candidate subtracts £95 at an early stage. Many candidates chose to do this step last and some omitted the step.

This scores 4 marks out of 5 because the conclusion they offer is correct from their working. This question was assessing strand (iii) of the quality of written communication requirement.

Mark awarded = 4

**Candidate F**

\*8 Martha sells jars of jam at a farmers' market.  
 She has 80 jars to sell at £3 each.  
 She sells 50 jars and then reduces the price by 40%.  
 Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam.  
 Her target is to make a profit of at least £100.

Does she meet her target?  
 You **must** show your working.

50 jars  $\times$  £3 = £150  
 80 - 50 jars = 30 jars (she has 30 jars  
 to sell at 40% reduction price.  
 10% of £3 = 30p  $\therefore$  40% of £3 = £1.20  
 reduction price is £3 - £1.20 = £1.80  
 profit from reduced price jars: £1.80  $\times$  30  
 = £54 30  $\times$  £1.80 = 54  
 total money = £150 + £54 = £204  
 profit = £204 - 95 = £109  
 yes she meets her target

(5 marks)

This candidate has given a good solution, showing correct arithmetic and a well explained answer. Importantly, the conclusion is clearly stated.

Mark awarded = 5

Candidate G

\*8 Martha sells jars of jam at a farmers' market.  
 She has 80 jars to sell at £3 each.  
 She sells 50 jars and then reduces the price by 40%.  
 Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam.  
 Her target is to make a profit of at least £100.

Does she meet her target?  
 You **must** show your working.

$80 - 50 = 30$        $30 \times £3 = £90$       ~~30 jars~~  
 $50 \times £3 = £150$        $40\% \text{ of } £3 =$   
 $80 - 50 = 30$        $10\% \text{ of } £3 = £0.3$   
                           $£0.3 \times 4 = £1.2$   
 $30 \times £1.2 = £36$        $£150 + £36 = £186$   
 $£186 - £95 = £91$   
 $\begin{array}{r} 186 \\ - 95 \\ \hline 91 \end{array}$       Didn't meet the target  
                          Missed by £9

(5 marks)

This solution was typical of many seen.  
 This candidate correctly worked out the amount raised from 50 jars but then reduced the price to 40% of the original price instead of taking 40% off the original price.  
 This is the candidate's only error.  
 Mark awarded = 4

Candidate H

\*8 Martha sells jars of jam at a farmers' market. She has 80 jars to sell at £3 each. She sells 50 jars and then reduces the price by 40%. Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam. Her target is to make a profit of at least £100.

Does she meet her target? You **must** show your working.

work out how much is earned by selling 50 jars at £3  $50 \times £3 = \cancel{150} £150$

work out 60% of £3.00 as this is ~~the~~ the percentage of the price left after the reduction.

$$10\% \text{ of } £3.00 = 30p$$

$$\therefore 60\% \text{ of } £3.00 = 10\% \times 6 = 30p \times 6 = 180p = £1.80$$

reduced price = £1.80

30 jars are left  $\rightarrow$  work out how much is earned by selling 30 jars at £1.80

$$30 \times £1.80 = £54$$

(5 marks)

all together she has made  $£150 + £54$

$$= £204 \text{ for profit } \Rightarrow £204 - £95 = £109$$

This is an example of a perfect solution as far as the working and explanation are concerned.

However, the question that was asked has not been answered as no conclusion is given.

Mark awarded = 4

**Candidate 1**

\*8 Martha sells jars of jam at a farmers' market. She has 80 jars to sell at £3 each. She sells 50 jars and then reduces the price by 40%. Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam. Her target is to make a profit of at least £100.

Does she meet her target?  
You **must** show your working.

80 jars x £3 = £240  
(80 x 3 = 240)

50 x £3 = £150

300 ÷ 10 = 30  
(£3) (30p)

30 x 4 = 120  
(£1.20)

there's 30 remaining jars.

30 x 120 = 3600  
(£360)

yes she reaches her target  
she makes £186 all together

(5 marks)

This candidate worked out the cost of 80 jars at £3. The question is then restarted correctly using 50 jars.

40% of £3 is correctly calculated, but the candidate did not subtract £1.20 from £3. Having obtained a total of £186 is obtained. There is no attempt to subtract £95.

To summarise, the cost of 50 jars is correct, the incorrect reduced price is then used and the money received is used instead of profit.

Mark awarded = 1

Candidate J

\*8 Martha sells jars of jam at a farmers' market.  
 She has 80 jars to sell at £3 each.  
 She sells 50 jars and then reduces the price by 40%.  
 Martha then sells the remaining jars at the reduced price.

It costs her £95 to make the jars of jam.  
 Her target is to make a profit of at least £100.

Does she meet her target?  
 You **must** show your working.

$$50 \times £3 = £150.$$

$$£3 \cdot 50\% = £1.50 \quad 50\% + 10\% = £1.80$$

$$1\% = £0.03$$

$$10\% = £0.30$$

$$30 \times £1.80 =$$

$$3 \times 1 = 3$$

$$3 \times 8 = 24$$

$$£54.00$$

$$£150 + £54 = £204$$

yes martha meets her target.

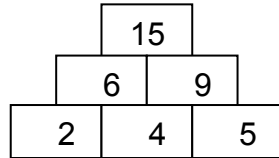
(5 marks)

This candidate correctly calculates the cost of the 50 jars, the 30 jars and totals them correctly. The cost of making the jam, £95, is not used in the solution.

Mark awarded = 2

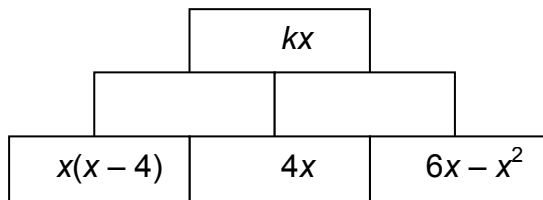
### Question 10

10 Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

(4 marks)

Mark scheme:

<b>10</b>	$x^2 - 4x$ seen	B1	oe
	their $(x^2 - 4x) + 4x$	M1	oe
	$4x + 6x - x^2$	M1	oe $x^2 - 4x + 4x + 4x + 6x - x^2 = (kx)$ scores B1 M1 M1
	$(k =) 10$ or $10x$ seen	A1	Accept substitution of a non-zero number leading to $k = 10$

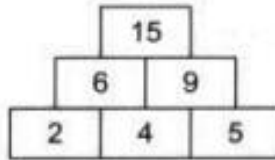
This question was targeted at grade C and assessed AO2.

With a mean mark of 2.32 out of 4 this proved to be a good discriminator. The marks were well spread out - 36% scored 4 marks, 14% 3 marks, 17% 2 marks, 14% 1 mark - with very few candidates making no-attempt.

The quality and presentation of the algebra was variable with terms often omitted.

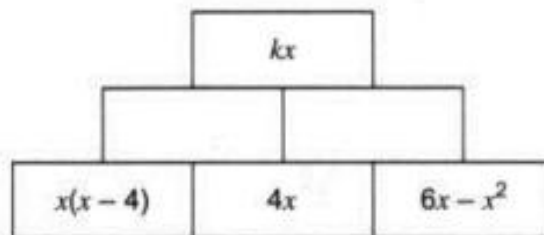
Candidate K

10 Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

~~$x(x-4) + 4x + 4x + 6x - x^2 = kx$~~   
 $x(x-4) + 4x + 4x + 6x - x^2 = kx$   
 $x^2 - 4x + 4x + 4x + 6x - x^2 = kx$   
 $2x^2 + 10x = kx$   
 $k = \frac{2x^2 + 10x}{x} \quad \frac{2x^2 \times 2x^2}{?x}$   
 Answer  $k = \frac{2x^2 + 10x}{x}$  (4 marks)

This candidate set up the identity correctly on the first and second lines.

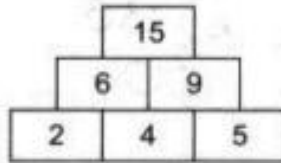
Instead of cancelling the  $x^2$  terms, they have been collected together as  $2x^2$ , providing an incorrect final answer.

Mark awarded = 3

Candidate L

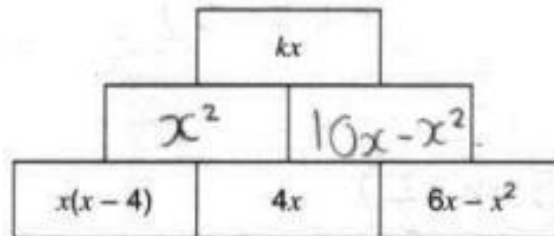
10

Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

$$x^2 - 4x + 4x = x^2$$

$$4x + 6x - x^2$$

$$10x - x^2$$

$$x^2 + 10x - x^2 = kx$$

$$10x = kx \quad \div x$$

$$10 = k$$

Answer  $k = 10$  (4 marks)

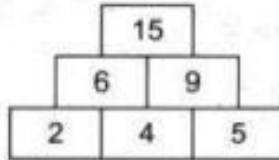
This candidate has given a well presented fully correct answer. Both parts of the initial expansion and addition can be clearly seen.

Mark awarded = 4

Candidate M

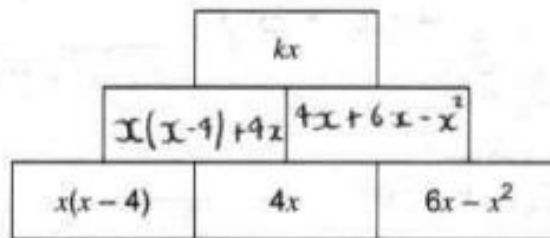
10

Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

$$\begin{aligned}
 kx &= x(x-4) + 4x + 6x - x^2 \\
 &= kx = x^2 - 4x + 4x + 6x - x^2 \\
 &= kx = 2x^2 + 6x \quad [ \div x ] \\
 k &= 2x + 6 \\
 k &= 2x \quad k = 2(x+3)
 \end{aligned}$$

Answer  $k = \dots 2x \dots + 6 \dots$  (4 marks)

This candidate has completed the boxes on the diagram correctly, but has omitted a  $4x$  term in the identity. The  $x^2$  terms have then been collected incorrectly.

Mark awarded = 2

Candidate N

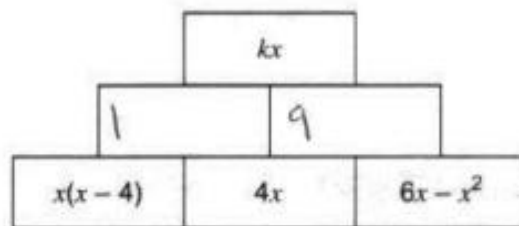
10

Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

$$x=1 \rightarrow x(x-4) + 4x$$

$$1 - 4 + 4 = 1$$

$$\rightarrow 6x - x^2 + 4x$$

$$6 - 1 + 4 = 9$$

$$1 + 9 = 10$$

$$10 \times 1 = 10$$

~~$$x=2 \rightarrow x(x-4) + 4x$$~~

~~$$4 - 8 + 8 = 4$$~~

~~$$\rightarrow 6x - x^2 + 4x$$~~

~~$$12 - 144 + 8 =$$~~

$$12 \times 10 =$$

$$120$$

$$12$$

$$12$$

Answer  $k = 10$

(4 marks)

This candidate has used a value for  $x$ , which is a valid method.

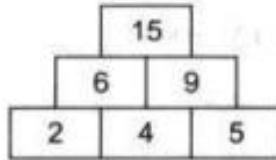
Since the result is independent of  $x$ , substitution of any value for  $x$  will lead to a correct value of  $k$ .

This candidate takes full advantage of this fact and uses  $x = 1$  to gain full marks.

Mark awarded = 4

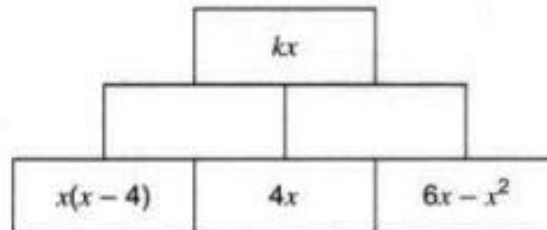
Candidate O

10 Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

$$x(x-4) + 4x \qquad 4x + 6x - x^2$$

$$kx = x(x-4) + 4x + 4x + 6x - x^2$$

$$kx = x^2 - 4x + 4x + 4x + 6x - x^2$$

$$kx = 10x \quad (\text{other terms cancel out})$$

$$k = \frac{10x}{x}$$

$$\therefore k = \frac{10}{x}$$

Answer  $k = \frac{10}{x}$  (4 marks)

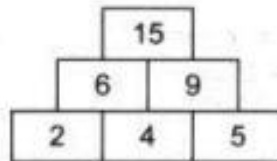
The candidate showed correct working in the first four lines. However, the stated value of  $k$  is incorrect.

Mark awarded = 3

Candidate P

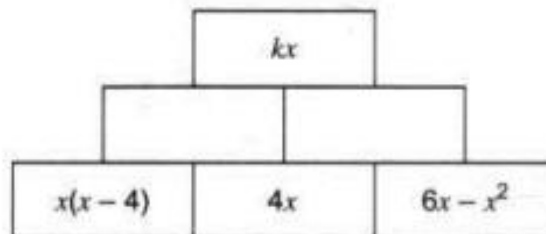
10

Here is an addition pyramid.



Each number is the sum of the two numbers below it.

Here is an algebraic addition pyramid.



Work out the value of  $k$ .

$$x(x-4) + 4x \quad 4x + 6x - x^2$$

$$x^2 - 4 + 4x + 10x - x^2$$

$$-4 + 10x = kx \quad \div x$$

$$-4 + 10 = k \quad -4 = k$$

$$6 = k$$

Answer  $k = \dots 6 \dots$  (4 marks)

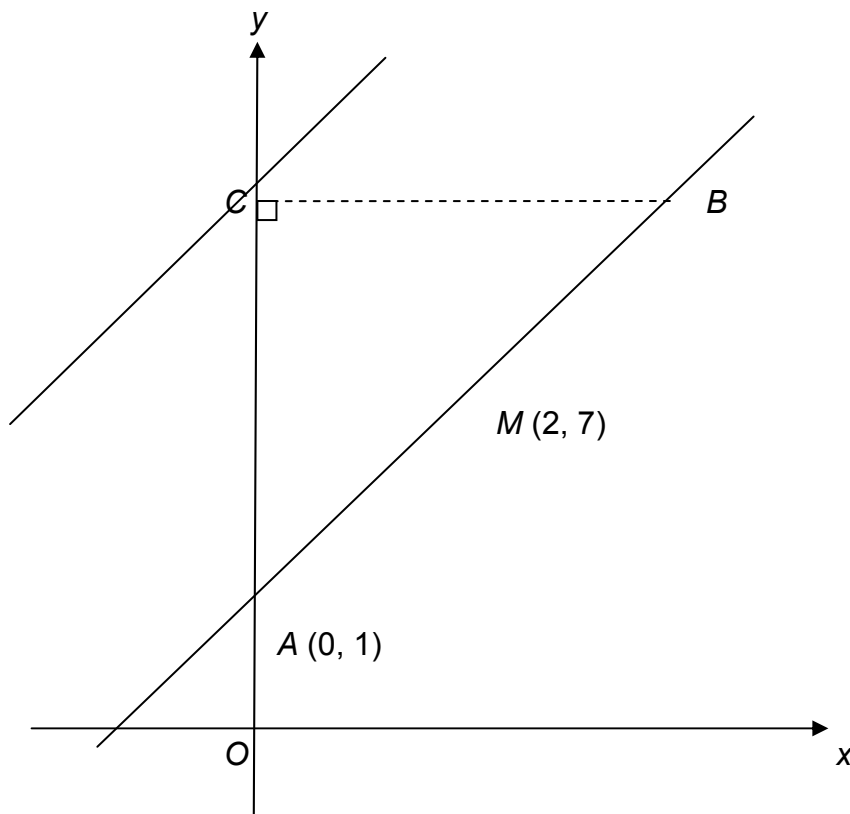
This candidate has correctly written down the missing expressions, but in expanding the bracket has made an error.

The candidate clearly knows the correct method for working out  $k$ .

Mark awarded = 2

**Question 16**

- 16 On the grid  $A$  is the point  $(0, 1)$   
 The midpoint,  $M$ , of  $AB$  is  $(2, 7)$   
 The gradient of  $AB$  is 3.



Not drawn accurately

Work out the equation of the line through  $C$  that is parallel to  $AB$ . (3 marks)

Mark scheme:

16	7 + 6 or 1 + 12	M1	oe
	13	A1	$B = (4, 13)$ or $C = (0, 13)$ seen is M1 A1
	$y = 3x + 13$	A1	SC1 $y = 3x + c$ if $c \neq 0$ and $c \neq 1$ but not $c = 1$ $C = 3x + c$ $c \neq 13$ scores no marks SC2 for $C = 3x + 13$

This question was targeted at grade A and assessed AO3.

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This question was generally quite challenging for all but the most able candidates.

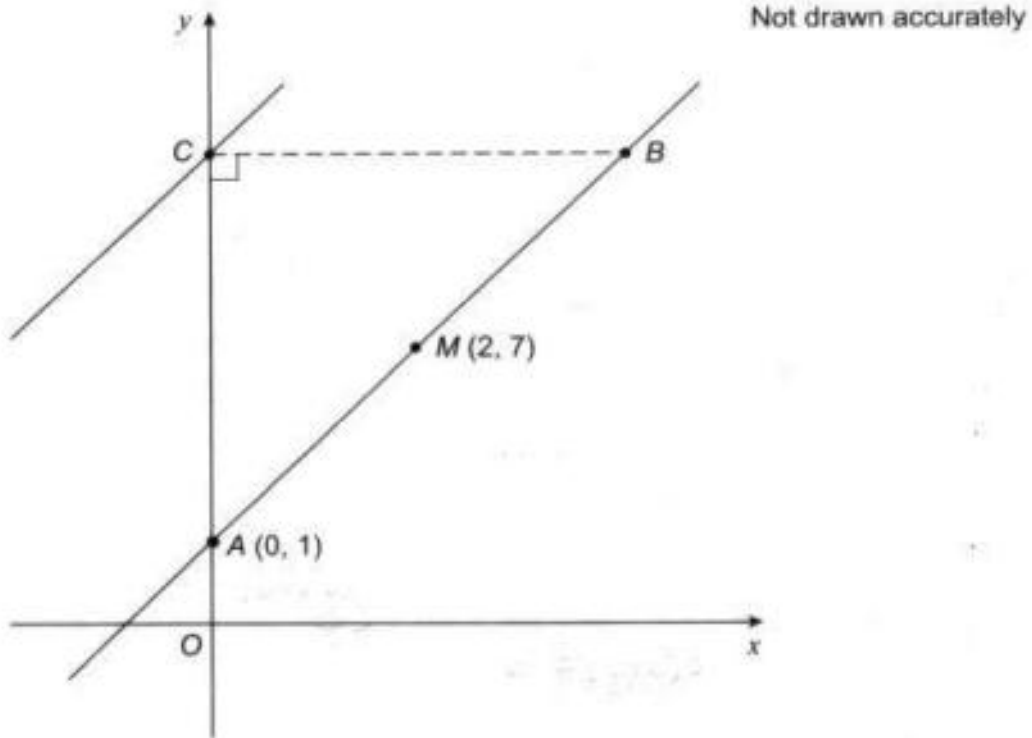
The mean mark was 0.73 out of 4.

The logical sequence was to identify  $B$  as  $(4, 13)$  then  $C$  as  $(0, 13)$  which gained the first 2 marks. Some candidates who obtained these points did not give their final answer as an equation, omitting the “ $y =$ ”.

**Candidate Q**

16

On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.



Work out the equation of the line through C that is parallel to AB.

$C=3x+13$

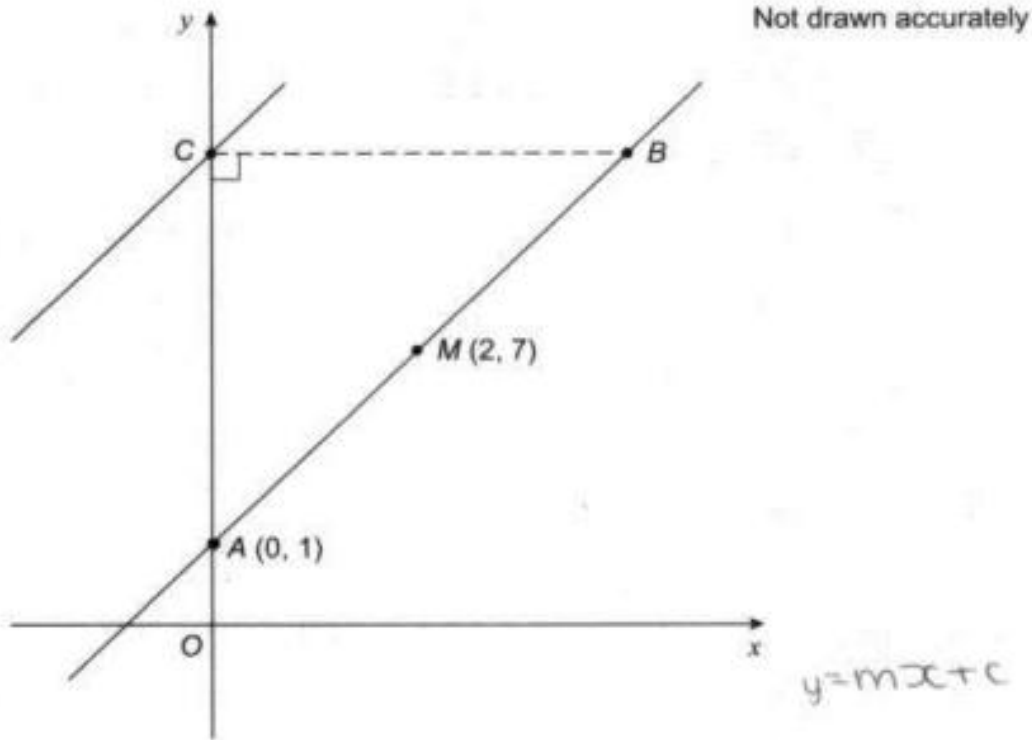
Answer  $C=3x+13$  (3 marks)

This candidate correctly stated the expression  $3x + 13$ , but did not put it into a correct equation.

Mark awarded = 2

Candidate R

16 On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.



Work out the equation of the line through C that is parallel to AB.

$2 - 0$  &  $7 - 1 \Rightarrow 2$  &  $6$

$\frac{6}{2} = 3$  - gradient = 3

x increase  $\rightarrow 2$  y increase  $\rightarrow 6$   $2 + 2 = 4$   $7 + 6 = 13$

b  $\rightarrow 6, 13$

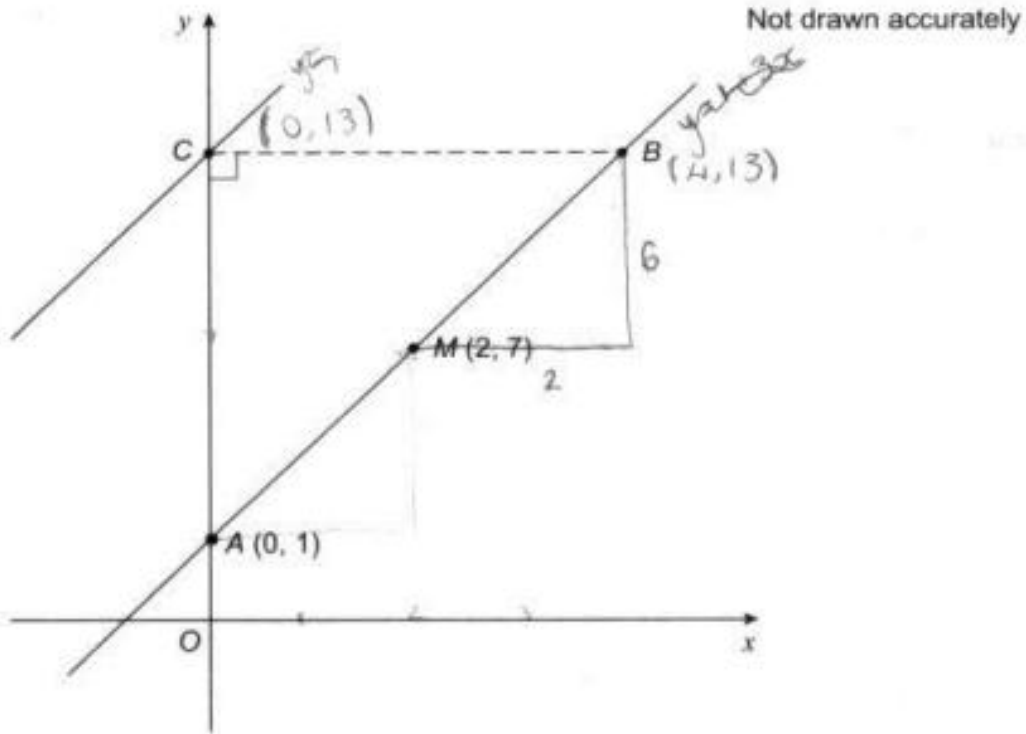
Answer  $y = 3x + 13$  (3 marks)

This candidate gives a fully correct solution. The gradient of 3 is clearly shown and the steps from A to M to B are explained as increase in x of 2 and increase in y of 6.

Mark awarded = 3

Candidate S

16 On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.



Work out the equation of the line through C that is parallel to AB.

$C =$  .....  $B = (4, 13)$   
 $C = 13x$  .....  $= 4 < 13$   
 .....  $= x < y$   
 .....

Answer  $C = 13x$  ..... (3 marks)

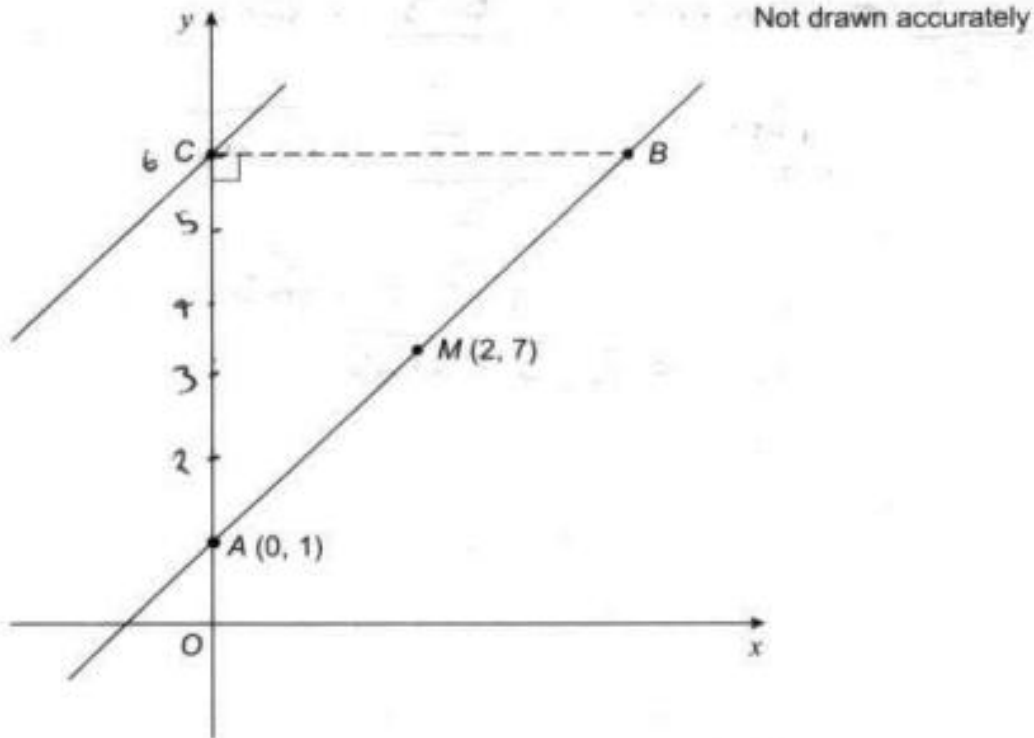
This candidate works on the diagram, showing  $B = (4, 13)$  and  $C = (0, 13)$ . The equation given is incorrect.

Mark awarded = 2

Candidate T

16

On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.



Work out the equation of the line through C that is parallel to AB.

C intercepts at 6  
it is parallel to line AB and therefore  
has the same gradient. so for line  
C  $y = 3x + 6$   
Answer  $y = 3x + 6$  (3 marks)

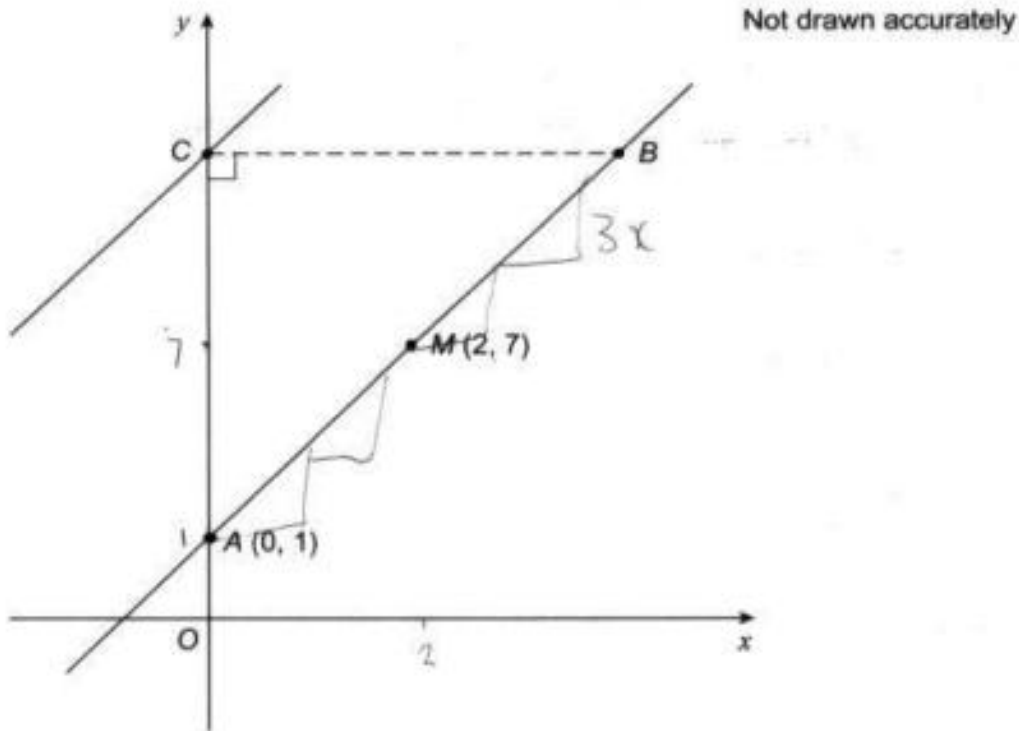
This candidate has correctly calculated the gradient of 3 but then uses the diagram as a scale drawing using the point (0, 1) to work out the y value for C.

Using the gradient of 3 to write an equation in the correct form is awarded 1 mark.

Mark awarded = 1

Candidate U

16 On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.



Work out the equation of the line through C that is parallel to AB.

..... gradient will be 3x .....  $7-1=6$   
 ..... C = positive correlation .....  $7+6=13$   
 ..... y intercept = +13 .....  
 .....  
 Answer .....  $3x+13$  ..... (3 marks)

This candidate has identified the y-intercept as 13 and gradient as 3, but has not expressed them as an equation.

Mark awarded = 2

Candidate V

16 On the grid, A is the point (0, 1).  
The midpoint, M, of AB is (2, 7).  
The gradient of AB is 3.

Not drawn accurately

Work out the equation of the line through C that is parallel to AB.

line c:  $y = 3x + 11$   $A \rightarrow M = 6$   $\therefore 7 + 6 = 11$

$y = 11$

$y = 3x + 11$

Answer 3  $y = 3x + 11$  (3 marks)

This candidate has made an arithmetic error in working out  $7 + 6$ . This is the candidate's only error.

Mark awarded = 2