Qualification Accredited

OCR
Oxford Cambridge and RSA

GCSE (9–1)

Exemplar Candidate Work

MATHEMATICS

J560
For first teaching in 2015

J560/04

Summer 2017 examination series

Version 1

Contents

Introduction

These exemplar answers have been chosen from the summer 2017 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but do illustrate how the mark scheme has been applied.

Please always refer to the specification (http://www.ocr.org.uk/Images/168982-specification-gcse-mathematics-j560.pdf) for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2017 Examiners' Report to Centres available on the OCR website http://www.ocr.org.uk/qualifications/.

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2018. Until then, they are available on OCR Interchange (school exams officers will have a login for this).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.

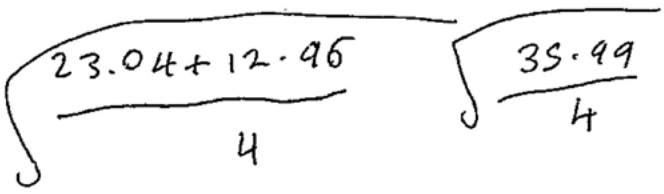
Question 1(a)

Calculate.

(a) $\sqrt{\frac{4.8^2 + 3.6^2}{4}}$

(a) ..... [2]

Mark(s): 0



(a) 2.99958304 [2]

Examiner commentary

Numbers copied from or to calculators often contain transcription or accuracy errors. The candidates were expected to do the complete calculation on the calculators, writing down partial answers to show working, not transcribing whole answers between the two. One mark would have been awarded for the sight of 36 from the numerator or 9 from the division.

Question 1(b)

Calculate.

(b) $\dfrac{1}{(2\times10^{4})+(5\times10^{3})}$

(b) ..... **[2]**

Mark(s): 0

(b) 25000 **[2]**

Examiner commentary

This answer includes an additional zero and the lack of any working means that no marks can be awarded. If they had written 20 000 + 5 000 = 25 000 then B1 could have been awarded for the 25 000.

Candidates need to be encouraged to show their working in case they make a transcription error or get an incorrect final answer.

Question 2

The length, L, of a steel rod is 8.3 m, correct to 1 decimal place.

Complete the error interval for length L.

..... $\leqslant L <$ .....[2]

Mark(s): 1

8.25 $\leqslant L <$ 8.34 [2]

Examiner commentary

8.25 is correct and scores 1 mark.

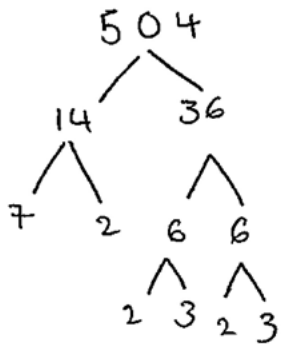
In this topic many candidates assume it is discrete information and not, as in this case, continuous. They need to show the top of the range as 8.35, the 'less than' symbol takes care of any ambiguity.

Question 3(a)

Write 504 as the product of its prime factors.

(a) ..... [3]

Mark(s): 2



~~7 × 2 × 2 × 3 × 2 × 3~~ =

~~7, 2, 2, 3, 2, 3~~

(a) ..... [3]

Examiner commentary

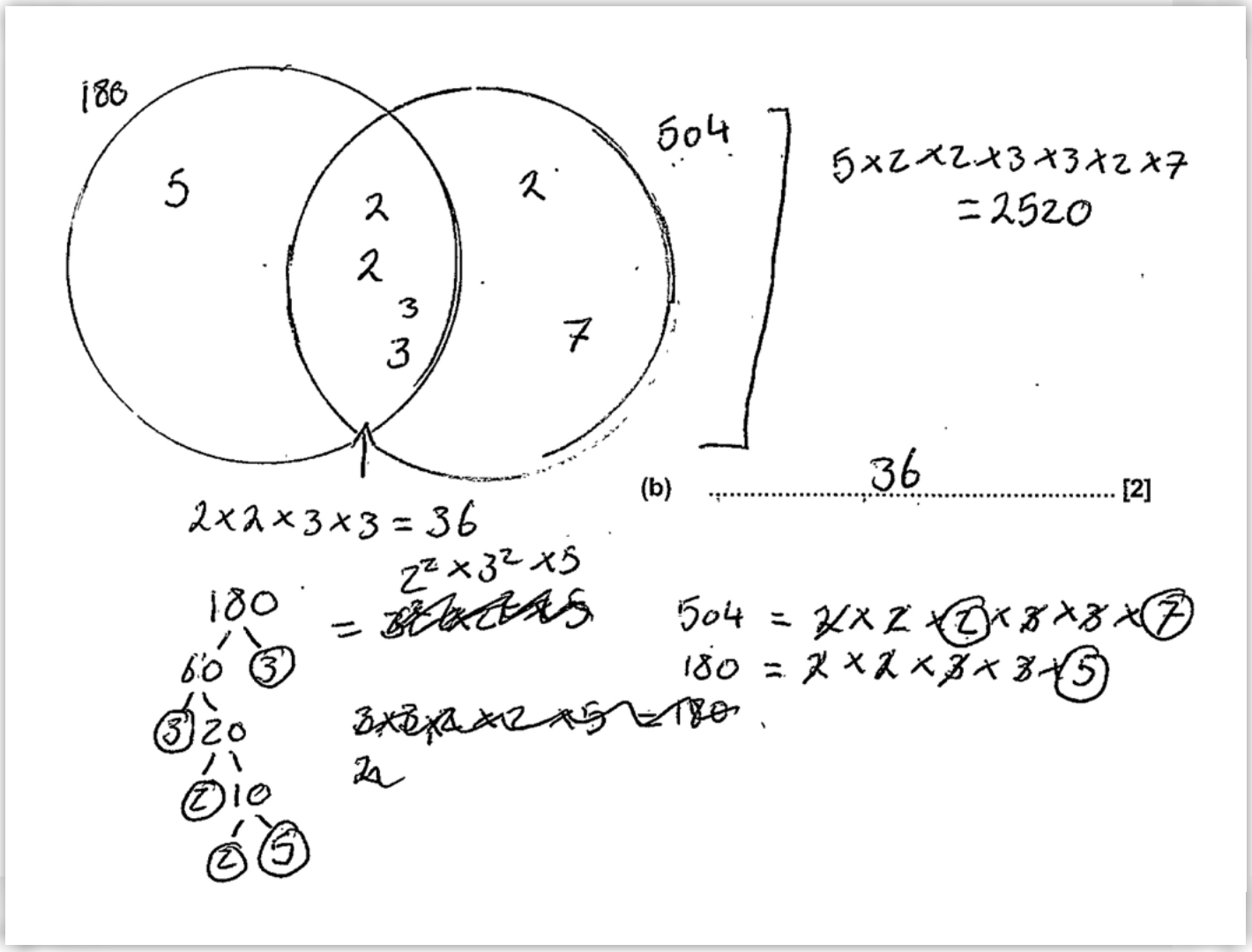
In the factor tree they have the correct answer however the question does ask for the answer to be written 'as the product ….' which has not been done so the method marks are awarded for the prime factors of 7, 2, 2, 3, 2, 3 but not the final mark which needs the multiplication signs between these numbers.

Question 3(b)

Find the lowest common multiple (LCM) of 180 and 504.

(b) ..... [2]

Mark(s): 1



Examiner commentary

A common error was to confuse LCM with HCF as in this case. The candidate has the fully correct method and correct answer in the top right-hand corner but wrote the HCF on the answer line. Here working has been rewarded even though they found a different answer to the one requested. The candidate has the correct factor tree for 180 so earns M1 for getting the correct prime factors of 180.

Question 4

Find the value of s when $u = 12$, $a = 10$ and $t = 4$.

$$s = ut + \frac{1}{2}at^2$$

..... [2]

Mark(s): 1

$s = (12 \times 4) + \frac{1}{2}(10 \times 4)^2$

$= 48 + \frac{1}{2} \times 40^2$

$= 48 + 800$

$= 848$

$s = 848$ ..... [2]

Examiner commentary

A common error was to get the order of operations incorrect and here the candidate has put multiplication before the power of 2. The second bracket should not be there and they should square the 4 then multiply by 10 in that order. The candidate earns M1 for 48 seen in their working.

Question 5

Mo's tyre pressure gauge shows a reading which is 12% higher than the actual pressure.

What is the actual pressure when Mo's gauge shows 38.64?

..... [3]

Mark(s): 0

38.64 - 12%

100 - 12 = 88

38.64 × 0.88 = 34.0032

38.64

Bars

10% = 3.864

2% = 0.7728

5% = 1.932

1% = 0.3864

3.864
0.7728
12% = 4.6368

38.64 - 4.6368
= 34.0032

34.0032

..... [3]

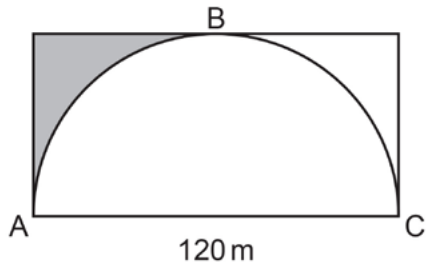
Examiner commentary

The common error was to reduce 38.64 by 12% as shown by this candidate who scored zero marks. The candidate should have realised that 38.64 is 112% of the actual reading and so divided 38.64 by 1.12; writing down this calculation would have earned them M2. If they had only written down 1.12 or 112 they would have earned B1.

Question 6

The diagram shows a semi-circle inside a rectangle of length 120 m.
The semi-circle touches the rectangle at A, B and C.

Not to scale



Calculate the **perimeter** of the shaded region.
Give your answer correct to 3 significant figures.

..... m **[5]**

Mark(s): 3

B1

60m : radius

M1

πD : circumference = 376.99 (2 d.p.)

M1

376·99 + 60 + 60 = 496·99

B is midpoint of rectangle

$\overrightarrow{AD}$ = radius = 60m

$\overrightarrow{DB}$ = $\frac{1}{2}$ circumference = 60m

496·99 m **[5]**

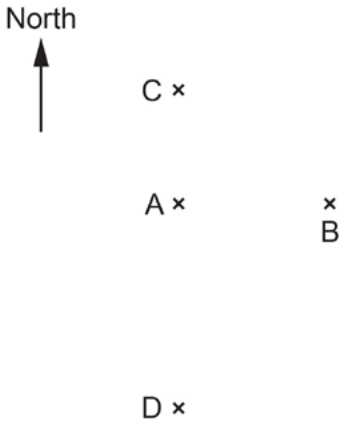
Examiner commentary

In this response, the candidate has correctly worked out the circumference of the circle. It would have helped if they wrote $120 \times \pi$ but the figures copied from their calculator are sufficient for the award of M1. They should have looked at the diagram and realised that it was the circumference of a quadrant they required and divided their circumference by 4. Their next step is correct and they were awarded M1 for $2 \times$ their 60 + their 30 π. The final B1 was not awarded as they have not written their answer correct to three significant figures as requested.

Question 7(a)

A, B, C and D are four towns.

B is 25 kilometres due East of A.
C is 25 kilometres due North of A.
D is 45 kilometres due South of A.



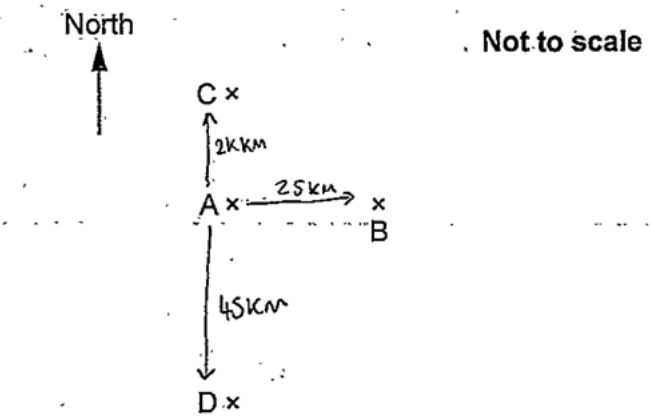
Work out the bearing of B from C.

(a) ..... ° [2]

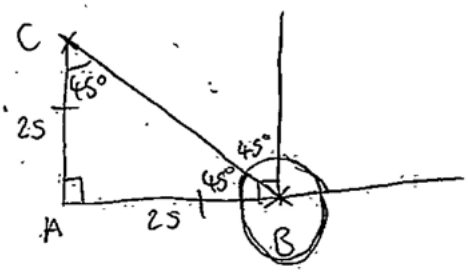
Mark(s): 1

A, B, C and D are four towns.

B is 25 kilometres due East of A.
C is 25 kilometres due North of A.
D is 45 kilometres due South of A.



(a) Work out the bearing of B from C.



180 − 90 = 90
90 ÷ 2 = 45
360 − 45 = 315°

(a) 315 ° [2]

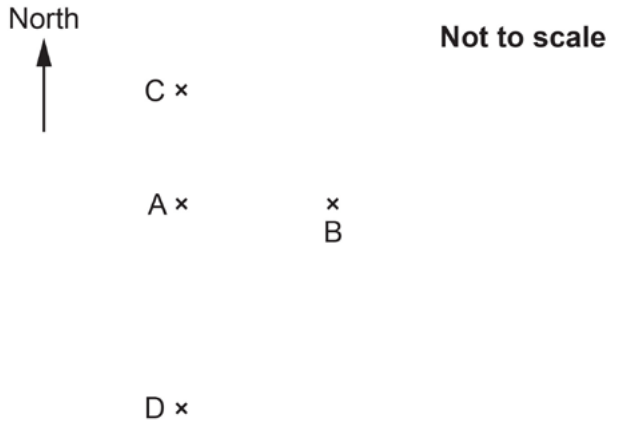
Examiner commentary

This candidate drew a larger drawing of triangle ABC and realised that the triangle was isosceles. They correctly calculated angles ABC and ACB as 45° and earned B1. The bearing of B from C was incorrect as the candidate wrote 360 – 45, rather than 180 – 45 or 90 + 45, so no further marks were earned.

Question 7(b)

A, B, C and D are four towns.

B is 25 kilometres due East of A.
C is 25 kilometres due North of A.
D is 45 kilometres due South of A.



Calculate the bearing of D from B.

(b) ..... ° [4]

Mark(s): 2

Tan x = 25/45

Tan⁻¹ (25/45) = 29.054604 1

(b) 29.054604 1 ° [4]

Examiner commentary

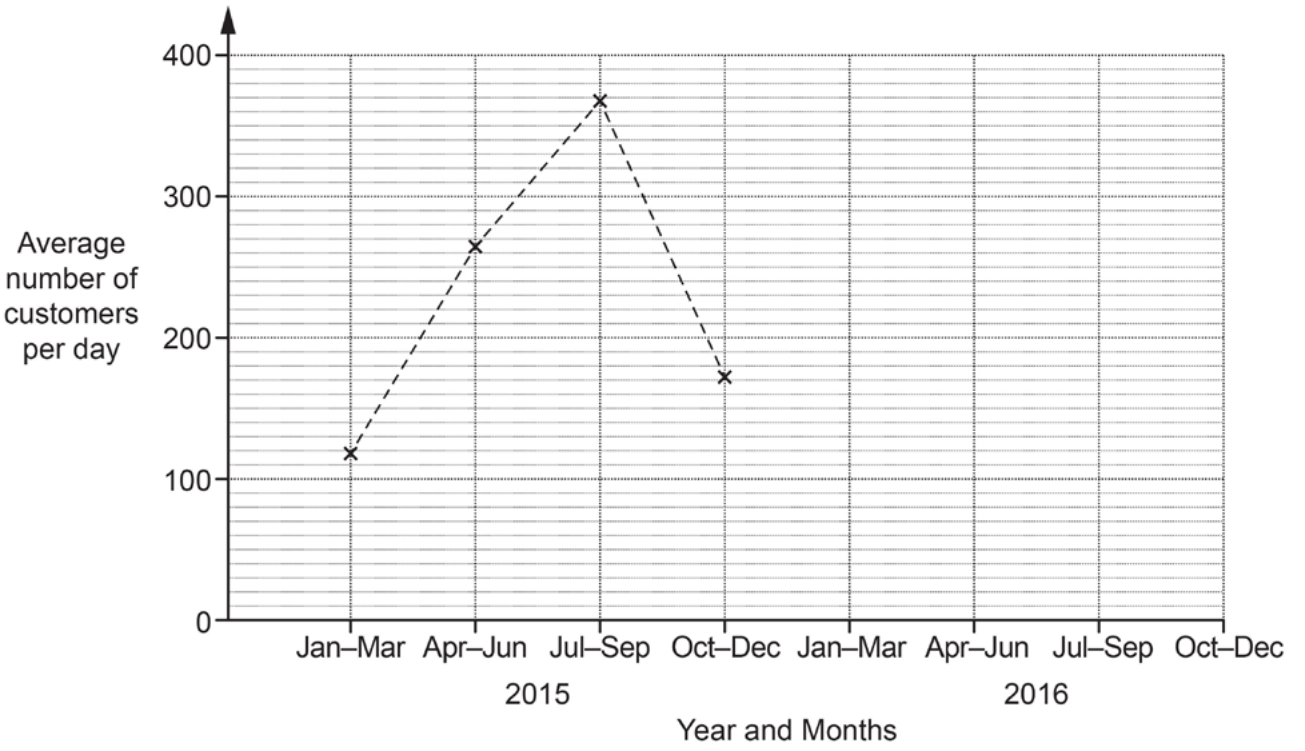
This candidate has correctly calculated angle ADB so they are awarded M2. A larger diagram of triangle ABD would have helped them to see that the bearing is found from the calculation 180 + 29.05[…].

Question 8(a)

The table shows the average number of customers per day entering a shop.

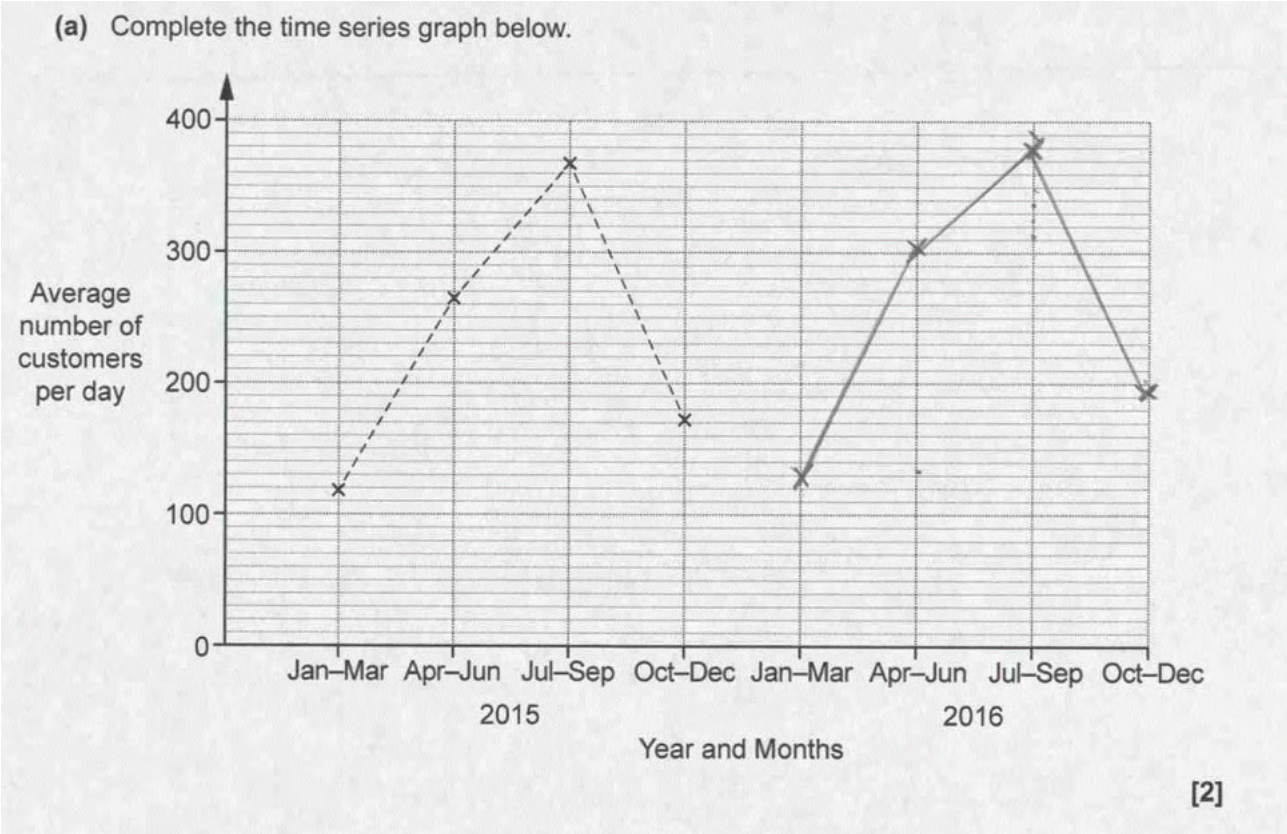
	2015				2016			
Months	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec	Jan-Mar	Apr-Jun	July-Sep	Oct-Dec
Average number of customers per day	119	264	368	172	130	304	381	192

(a) Complete the time series graph below.



[2]

Mark(s): 1



Examiner commentary

Three points are plotted accurately. The point for Jul-Sept should be over 380 to be accurate and the two lines and the centre of the cross are both below 380 so only 1 mark is awarded.

Question 9(a)

Each week Dan drives two routes, route X and route Y.

One week he drives route X three times and route Y twice.
He drives a total of 134 miles that week.

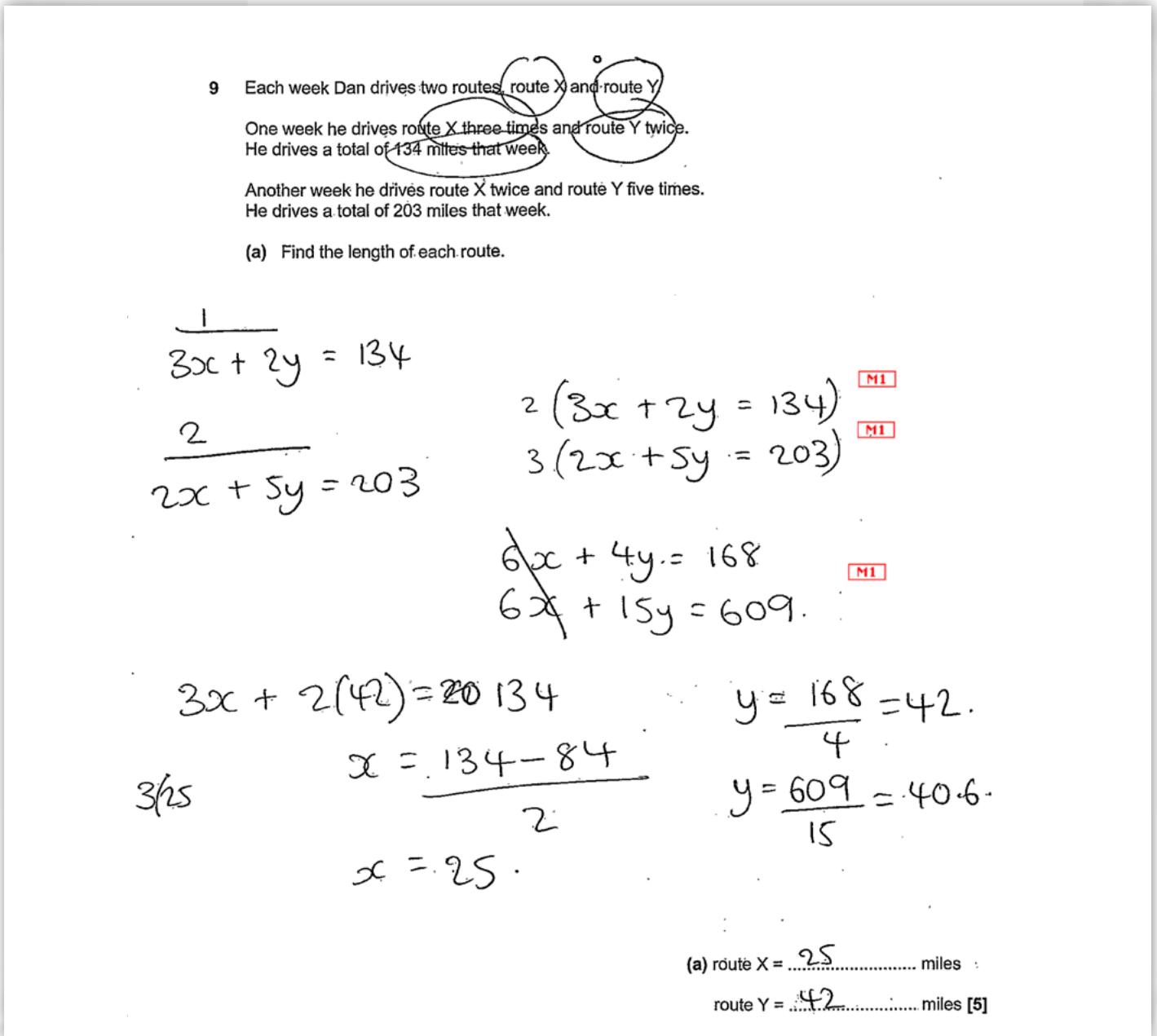
Another week he drives route X twice and route Y five times.
He drives a total of 203 miles that week.

Find the length of each route.

(a) route X = ... miles

route Y = ... miles **[5]**

Mark(s): 3



9 Each week Dan drives two routes, route X and route Y.

One week he drives route X three times and route Y twice.
He drives a total of 134 miles that week.

Another week he drives route X twice and route Y five times.
He drives a total of 203 miles that week.

(a) Find the length of each route.

1 $3x + 2y = 134$

2 $2x + 5y = 203$

M1 $2(3x + 2y = 134)$

M1 $3(2x + 5y = 203)$

$6x + 4y = 168$

M1 $6x + 15y = 609$

$3x + 2(42) = 134$

$x = \frac{134 - 84}{2}$

$x = 25$

$y = \frac{168}{4} = 42$

$y = \frac{609}{15} = 40.6$

3/5

(a) route X = 25 miles

route Y = 42 miles **[5]**

Examiner commentary

The candidate has written both equations correctly so they get the first two M1 marks as indicated. They do correctly multiply both equations by a scalar to equate coefficients of x with one error, which the mark scheme allows, so another M1 is awarded. They cross out the x's but they have not subtracted the two equations and so they score M0 for this step and this is as far as they get.

Question 10(b)

On 1st November 2015 there were 4200 trees planted in a wood.
On 1st November 2016, only 3948 of these trees were still alive.

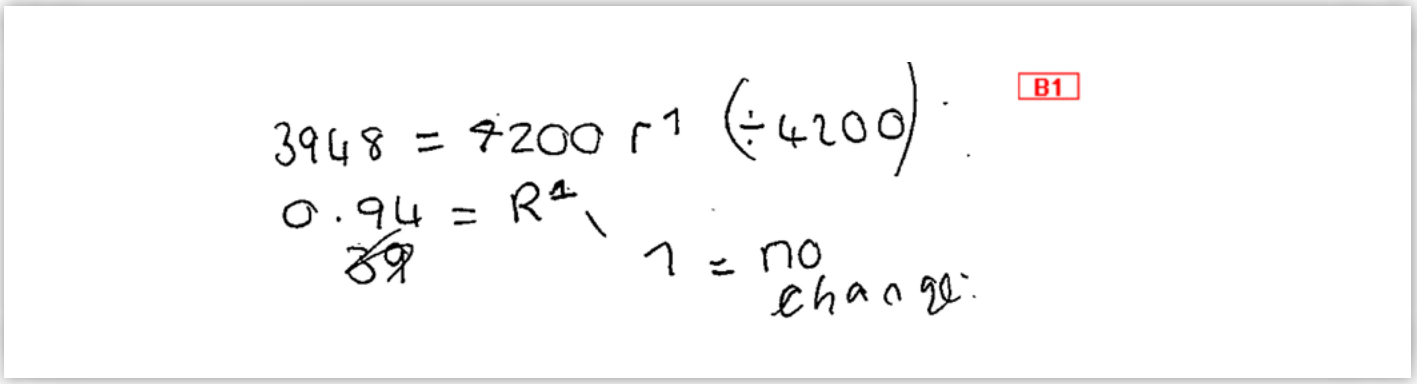
It is assumed that the number of trees still alive is given by

$$N = ar^t$$

where N is the number of trees still alive t years after 1st November 2015.

Show that r is 0.94. **[2]**

Mark(s): 1



Examiner commentary

The first line in this candidate's response is awarded B1. The mark scheme requires that we see 3948 ÷ 4200 for the second B1 and although this response has (÷ 4200) in brackets it is insufficient to earn this mark. In the mark scheme this is a B1 mark so we must see the full line and not implied as it is in this response.

The question is a "Show that……" type question so all of the working must be seen.

Question 10(c)

On 1st November 2015 there were 4200 trees planted in a wood.
On 1st November 2016, only 3948 of these trees were still alive.

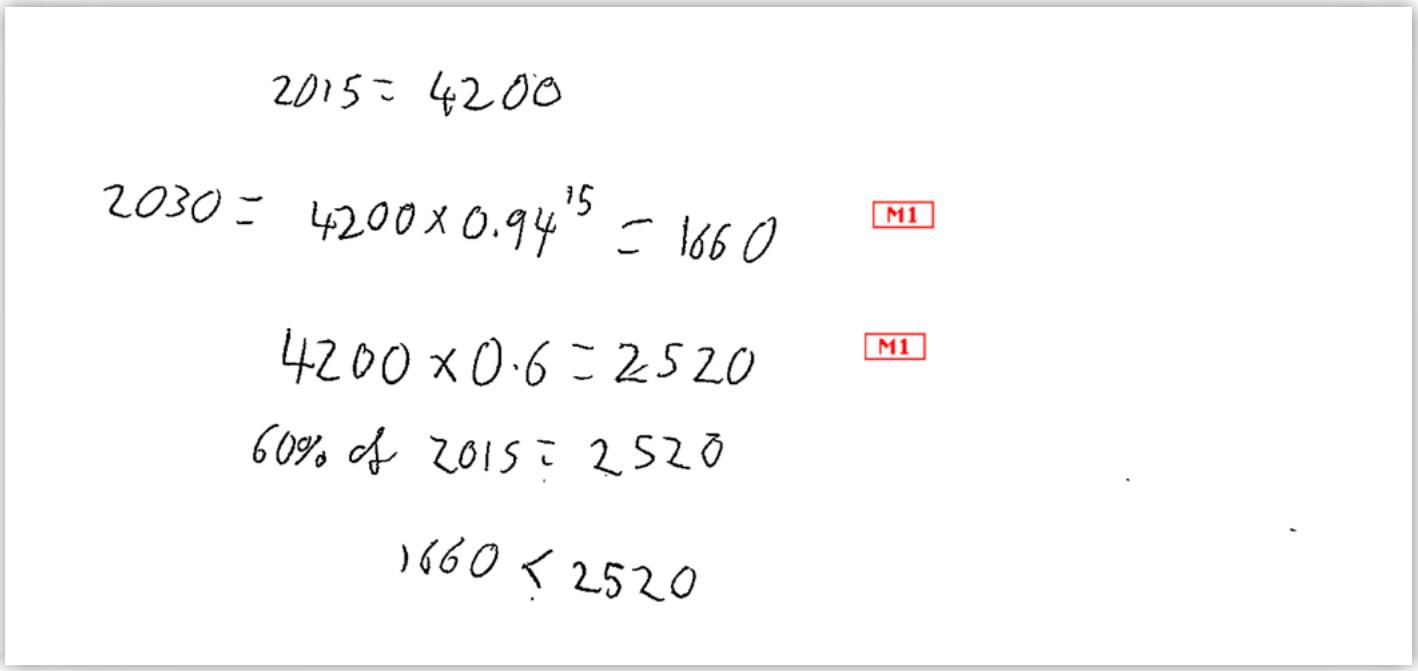
It is assumed that the number of trees still alive is given by

$$N = ar^t$$

where N is the number of trees still alive t years after 1st November 2015.

Show that on 1st November 2030 the number of trees still alive is predicted to have decreased by over 60% compared with 1st November 2015. **[3]**

Mark(s): 2

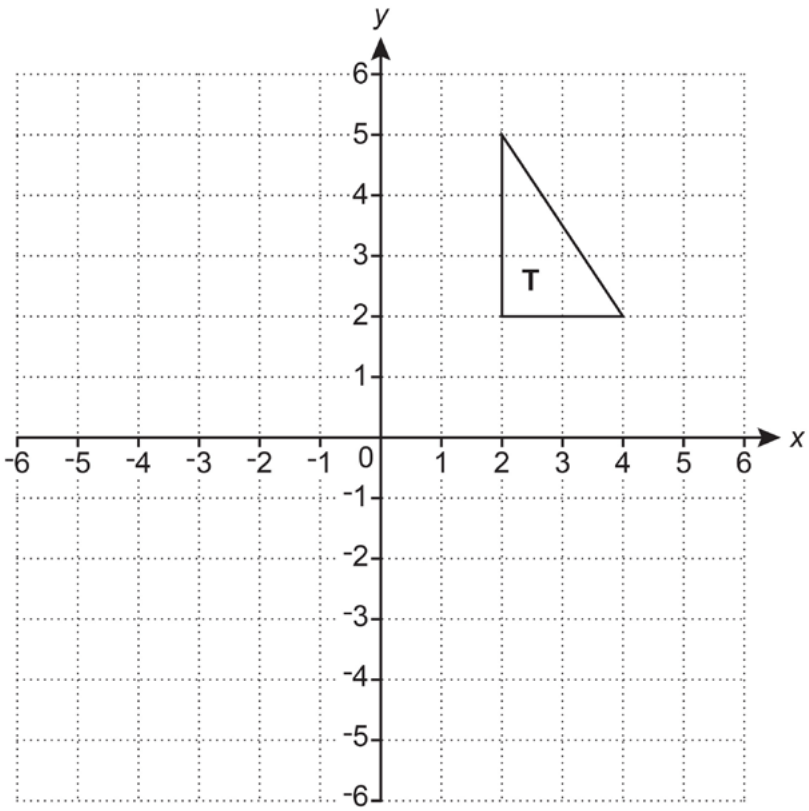


Examiner commentary

This candidate has correctly calculated the number of trees still surviving in 2030 to be 1660 which is sufficiently accurate and they are awarded the second M1. Now this is an alternative method and they calculate 60% of 4200 as 2520 so they are awarded another M1 as this is similar to the first M1 in the mark scheme. The comparison is invalid as the 2520 is the number it decreases by and so the figure they need to compare with 1660 is 4200 – 2520 (= 1680).

Question 11(a)

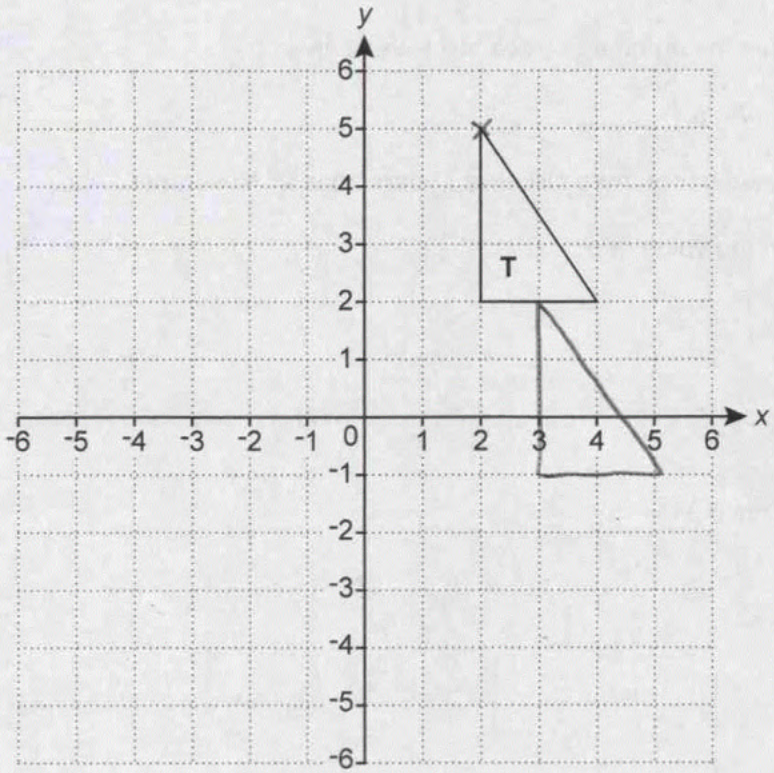
Triangle **T** is drawn on a coordinate grid.



Translate triangle **T** using the vector $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$. **[2]**

Mark(s): 0

11 Triangle **T** is drawn on a coordinate grid.



(a) Translate triangle **T** using the vector $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$. [2]

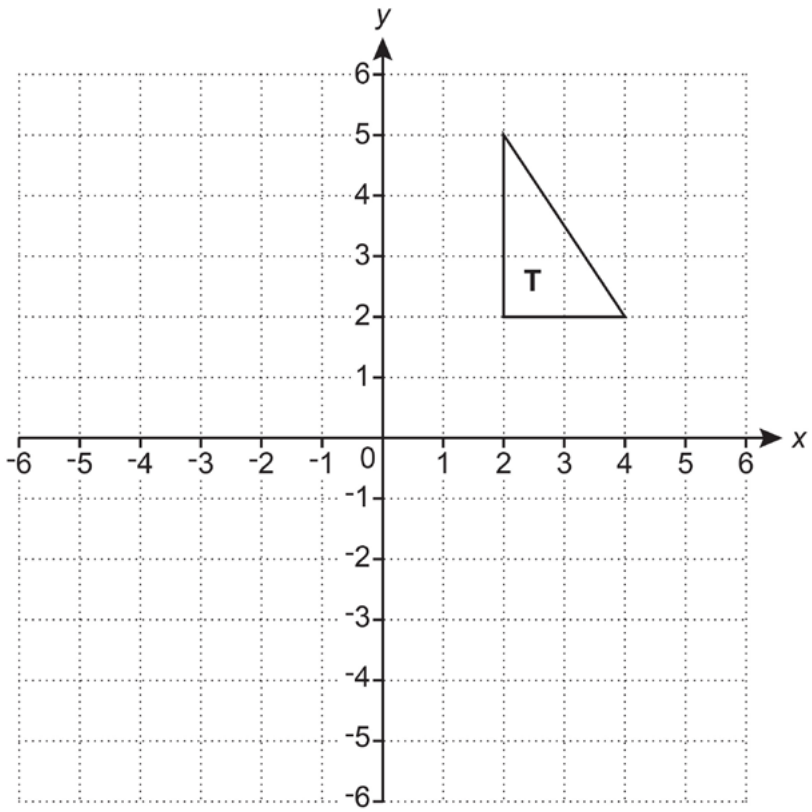
Examiner commentary

The candidate has confused the two components of the vector and translated the triangle 3 down and 1 to the right, so no marks were scored.

The mark scheme awarded B1 for a correct horizontal translation or a correct vertical translation.

Question 11(b)(i)

Triangle **T** is drawn on a coordinate grid.



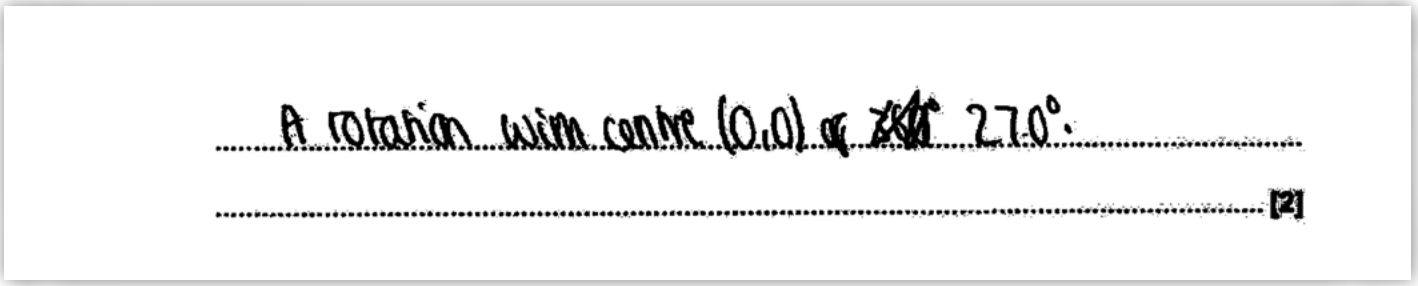
Describe fully the **single** transformation that represents the following.

(i) A rotation with centre (0, 0) of 180° followed by a rotation with centre (0, 0) of 90° clockwise.

.....

..... **[2]**

Mark(s): 1

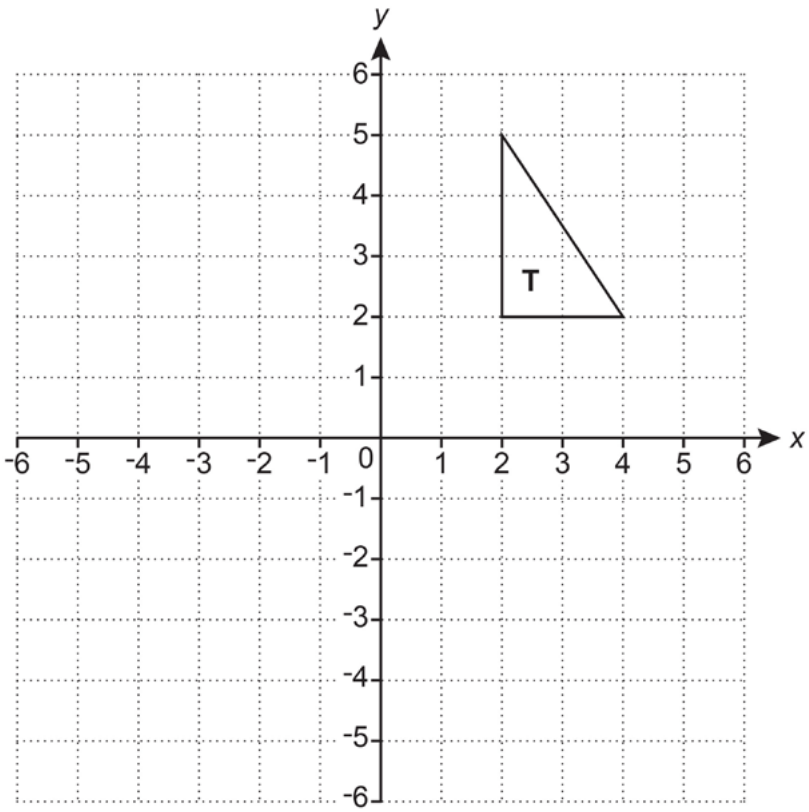


Examiner commentary

This candidate earns B1 for rotation and (0, 0). The 270° is correct but to be awarded the second B1 it needs direction (clockwise).

Question 11(b)(ii)

Triangle **T** is drawn on a coordinate grid.



Describe fully the **single** transformation that represents the following.

(ii) A reflection in the *x*-axis followed by a reflection in the *y*-axis.

.....

..... **[3]**

Mark(s): 2

180° rotation on centre 180°

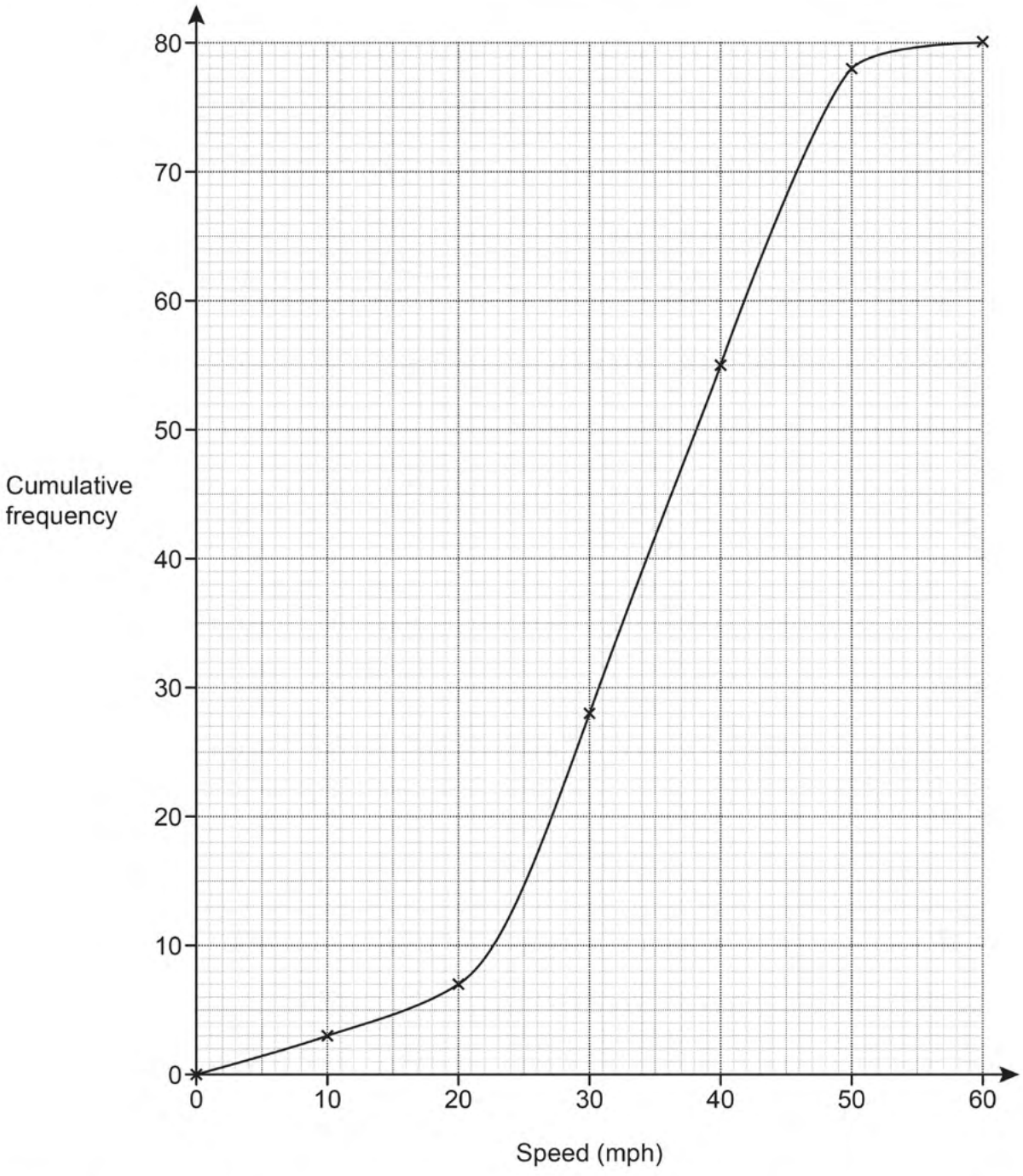
..... [3]

Examiner commentary

This response scores B1 for rotation and B1 for 180° which does not need a direction. The third mark is not awarded because the centre is referred to but not given and should have been (0, 0).

Question 12

The cumulative frequency graph shows the speeds, in miles per hour (mph), of vehicles passing a 40 mph speed limit sign on a road.

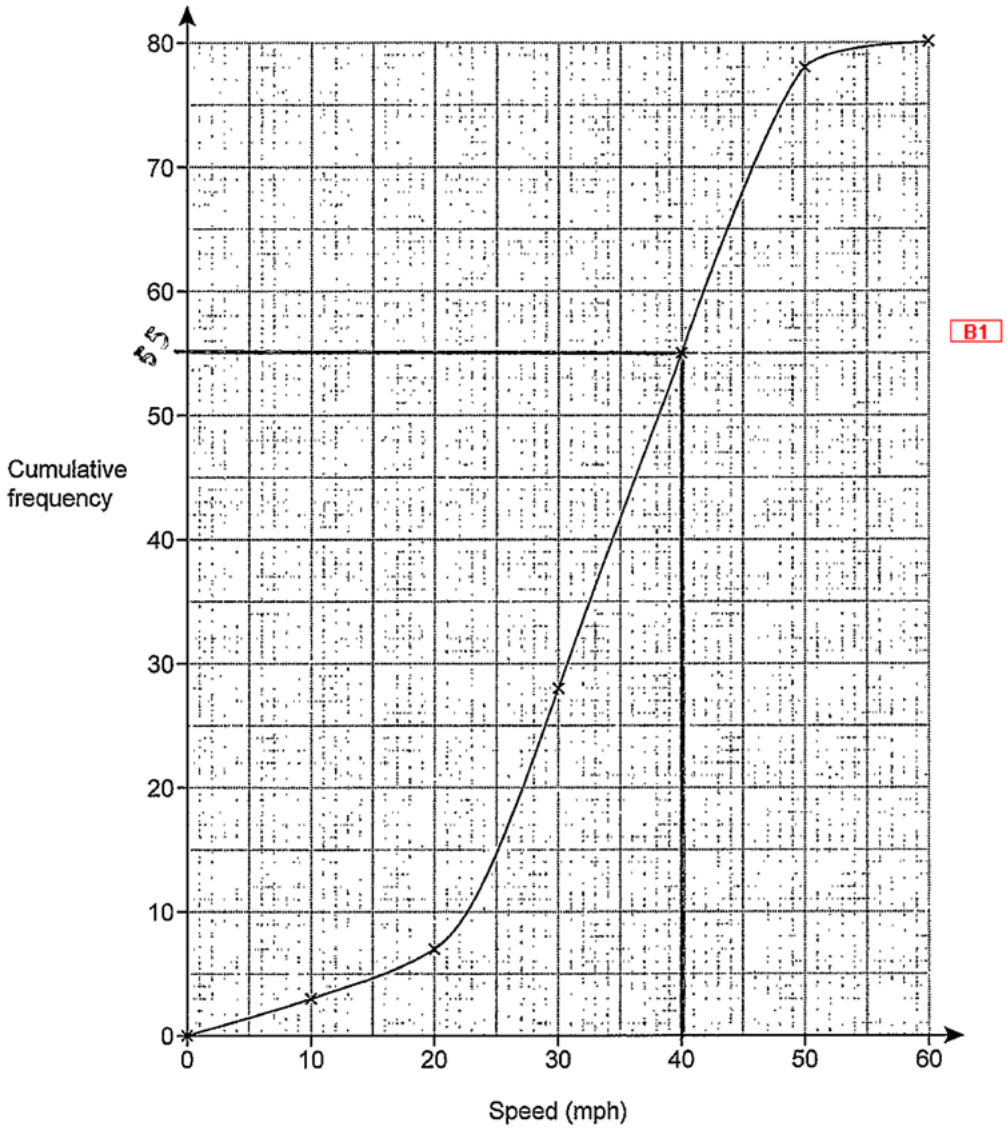


A speed camera will be installed if more than 30% of vehicles go over the speed limit of 40 mph.

Use information from the graph to decide if a speed camera should be installed. **[4]**

Mark(s): 2

12 The cumulative frequency graph shows the speeds, in miles per hour (mph), of vehicles passing a 40 mph speed limit sign on a road.



A speed camera will be installed if more than 30% of vehicles go over the speed limit of 40 mph.

Use information from the graph to decide if a speed camera should be installed. **[4]**

M1

$\frac{55}{80} \times 100 = 68.75\%$

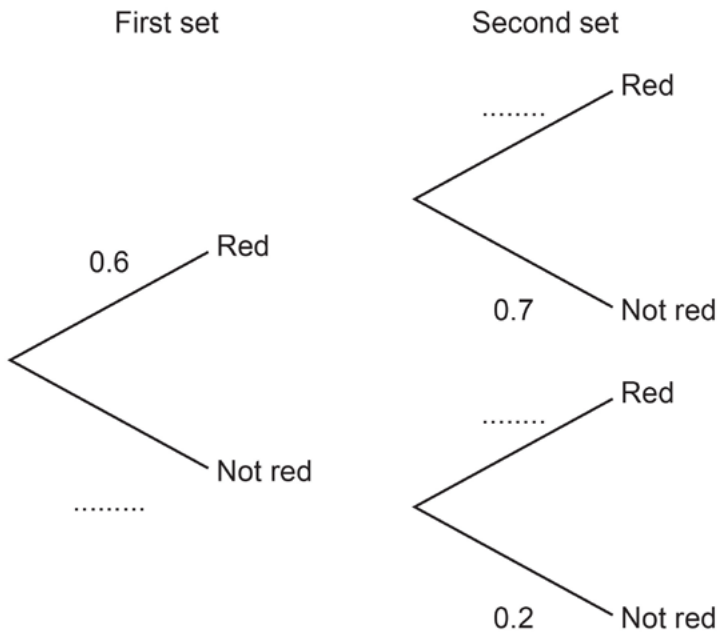
Yes the speed camera should be installed

Examiner commentary

This is an alternative method and scores B1 for 55. It then scores M1 for using percentages, in this case changing 55 to a percentage of 80 or 68.75. It does not get the other M1 which would have been for 100 – 68.75 = 31.25 in this example and then the A1 would also have been awarded if they had made the correct decision (Yes).

Question 13(d)

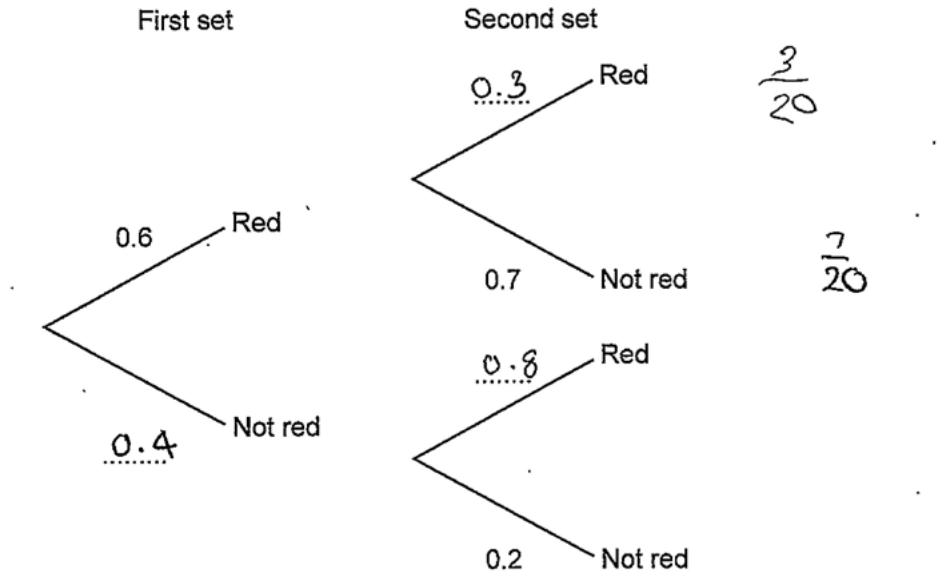
Rashid drives his car along a road passing through two sets of traffic lights.
The tree diagram shows the probabilities of the lights being **red** when he reaches them.



Work out the probability that both sets are **not red**.

(d) ..... **[2]**

Mark(s): 0



(d) Work out the probability that both sets are **not red.**

$\frac{4}{10} + \frac{2}{10} = \frac{6}{10}$

(d) $\frac{6}{10}$ **[2]**

Examiner commentary

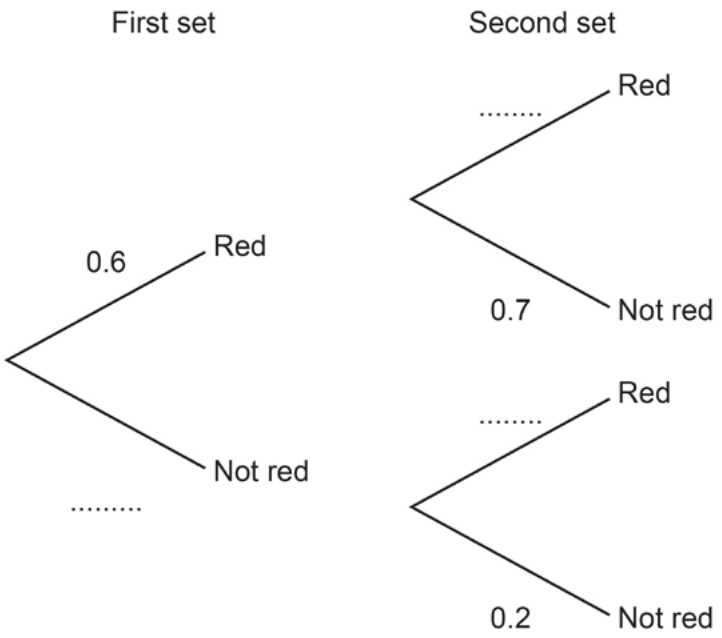
The candidate has selected the correct branch but they added the probabilities rather than multiplying them and therefore scored no marks.

The multiplication 0.4×0.2, or equivalent, would score M1 even if followed by an incorrect answer.

It was common to see the correct working and despite having calculators, candidates then giving an incorrect answer.

Question 13(e)

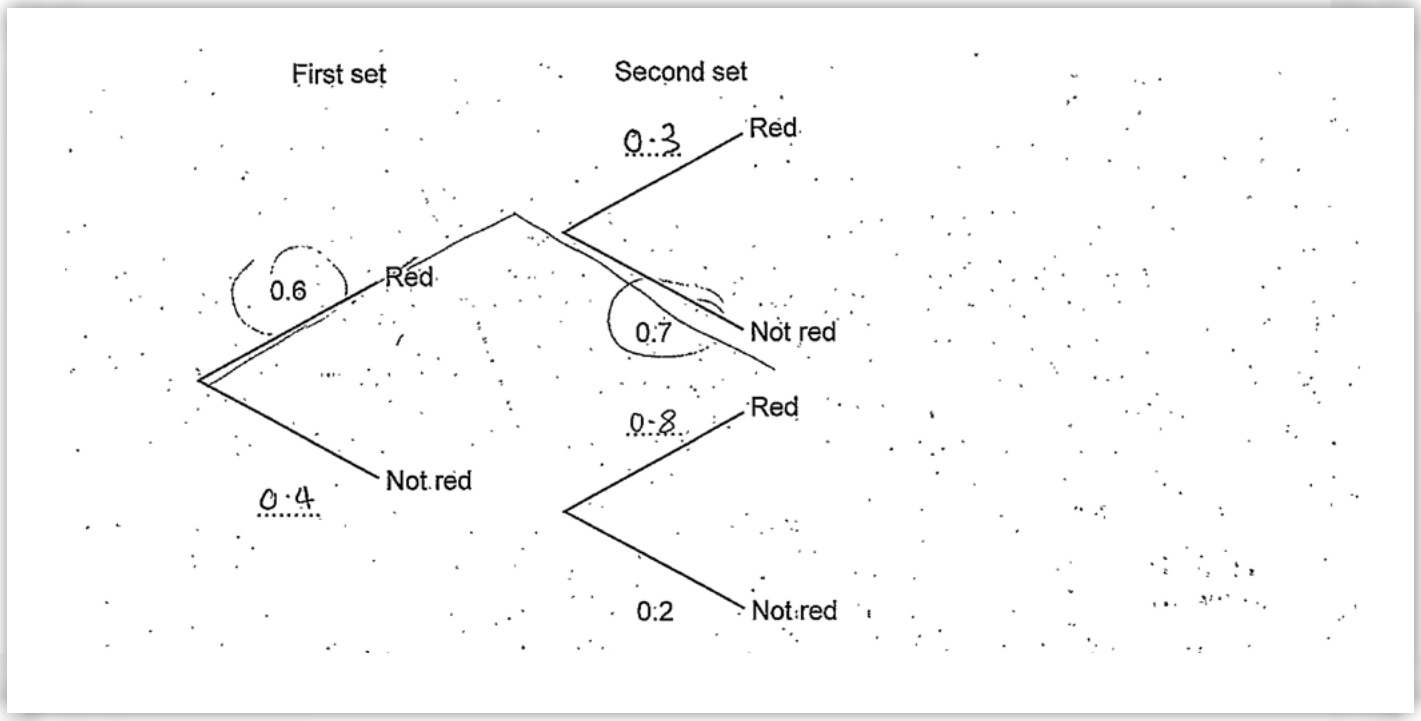
Rashid drives his car along a road passing through two sets of traffic lights.
The tree diagram shows the probabilities of the lights being **red** when he reaches them.

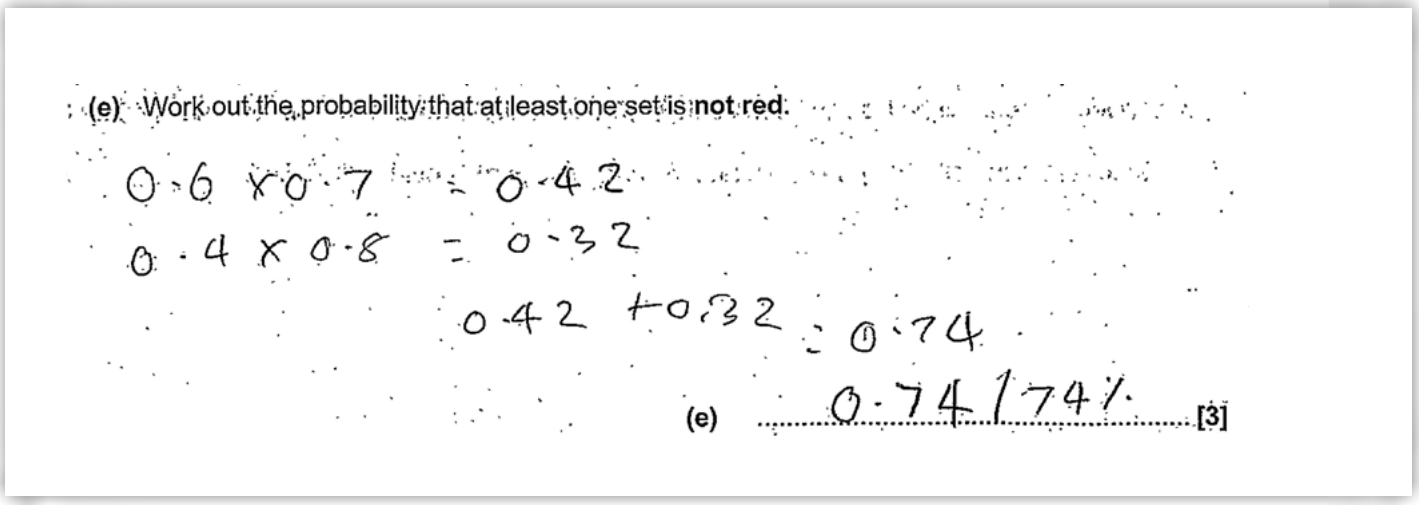


Work out the probability that at least one set is **not red**.

(e) ..... **[3]**

Mark(s): 1



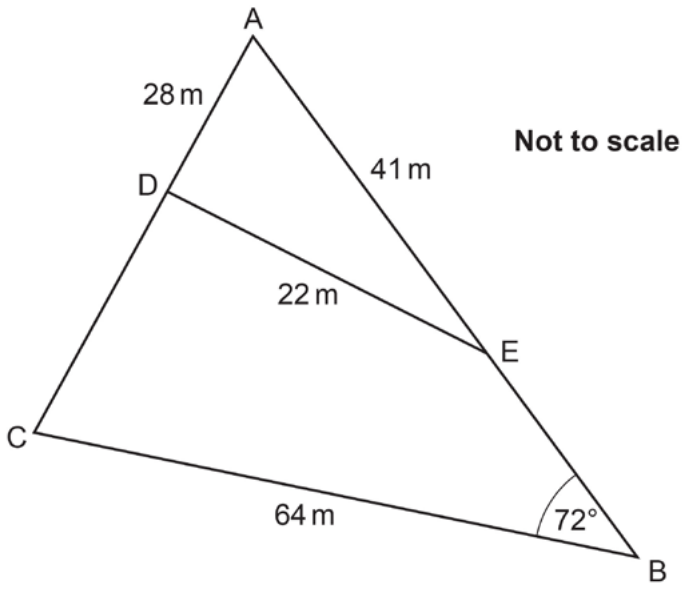


Examiner commentary

This response has been awarded M1 for considering 2 correct branches; if they had also considered the third branch, 0.4 × 0.2, then it would have been M2.

Question 14

The diagram shows triangle ABC with D on AC and E on AB.
DE is a straight line.



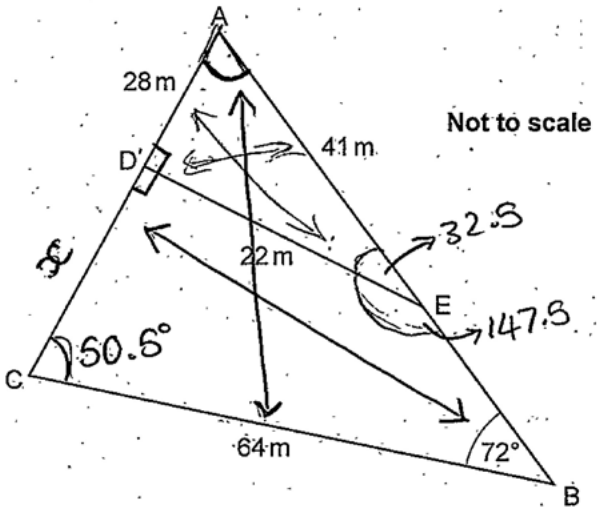
AD = 28 m, AE = 41 m, DE = 22 m and BC = 64 m.

Calculate the length CD.

..... m **[6]**

Mark(s): 2

14 The diagram shows triangle ABC with D on AC and E on AB.
DE is a straight line.



AD = 28 m, AE = 41 m, DE = 22 m and BC = 64 m.

Calculate the length CD.

$\frac{\sin A}{22} = \frac{\sin 90}{41}$

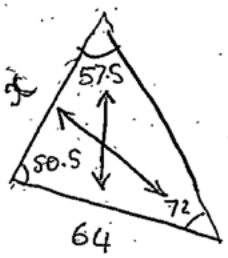
$\sin A = \frac{22 \times \sin 90}{41}$

$\sin A = 32.5$

Angle C = 180 − 72 − 147.5 − 90
= 50.5

180 −
A = 72 + 50.5

A = 57.5



$\frac{AC}{\sin 72} = \frac{64}{\sin 57.5}$

$AC = \frac{\sin 72 \times 64}{\sin 57.5}$ M2

AC = 72.17

so

CD = 72.17 − 28

CD = 44.17

44.17

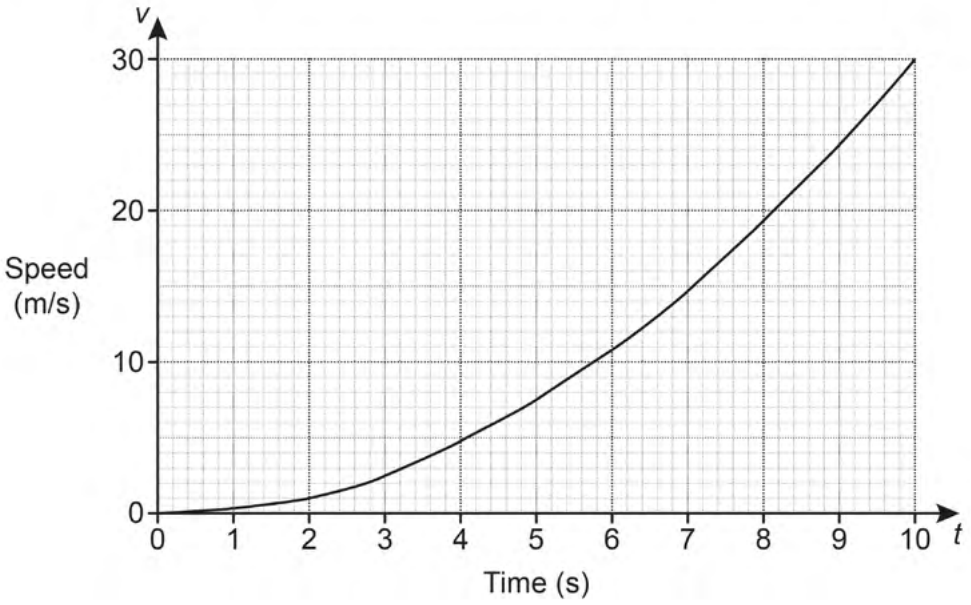
..... m [6]

Examiner commentary

This candidate has assumed that angle ADE is 90°, but if that was the case, they would have been told this in the stem of the question. Hence they get an incorrect angle DAE of 57.5°. However they have a good sketch of the triangle ABC with angles and sides marked. They have the correct working for side AC using the sine rule from their diagram so the mark scheme awards M2, using follow through. They would have gained more marks had they realised that triangle ADE was not right-angled and then used the cosine rule to find angle DAE correctly.

Question 15(b)

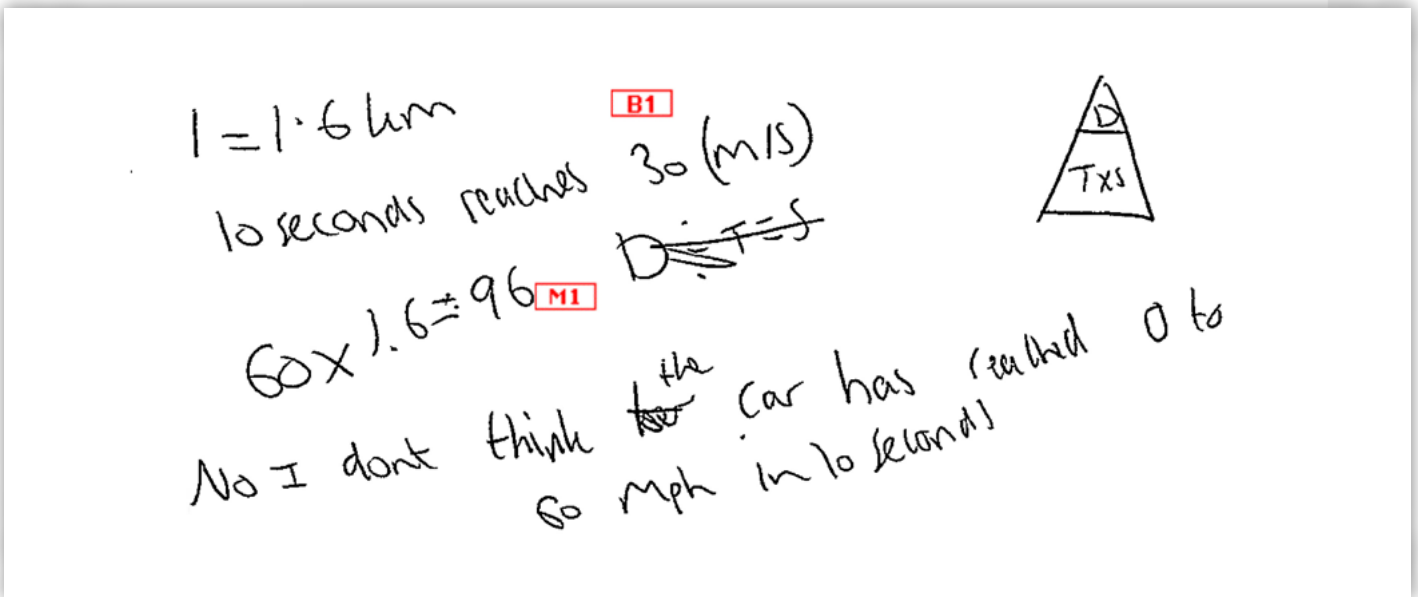
The graph shows the speed, v metres per second (m/s), of a car at time t seconds.



It is claimed that the car has accelerated from 0 to 60 miles per hour in the first 10 seconds.

Does the graph support this claim? Show your reasoning.
Use 1 mile = 1.6 kilometres. **[5]**

Mark(s): 2

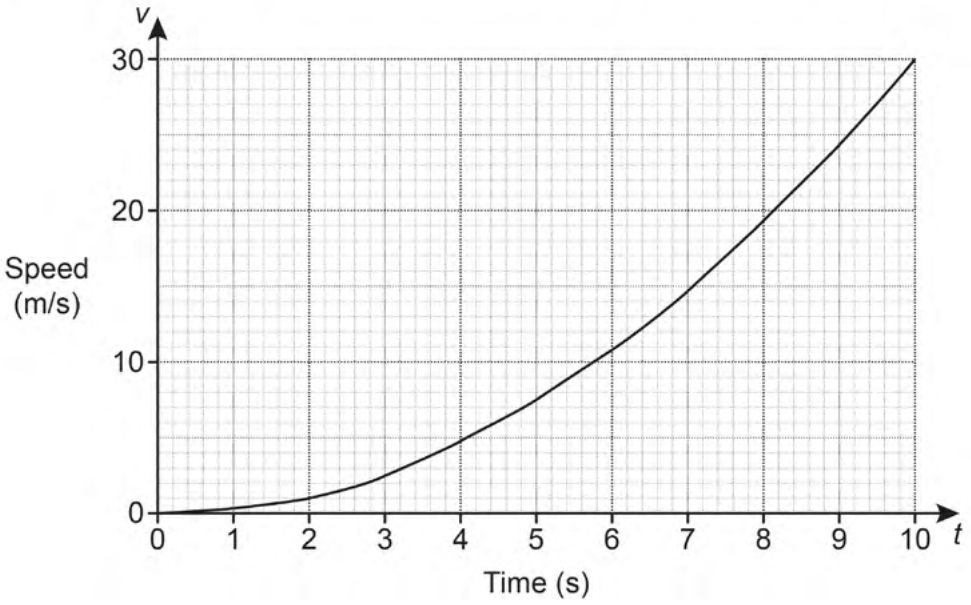


Examiner commentary

This candidate has read the 30(m/s) correctly from the graph for B1, then correctly converted 60 miles to kilometres, $60 \times 1.6 = 96$, for M1. They then need to convert the time to seconds, $96 \div 60^2 = 0.02666\ldots$, and then convert that to metres, $0.02666... \times 1000 = 26.66\ldots$. They would have been awarded M1 for each of these two steps. The final A1 would have been awarded for saying 'Yes' and comparing 30 to 26.66… .

Question 15(c)

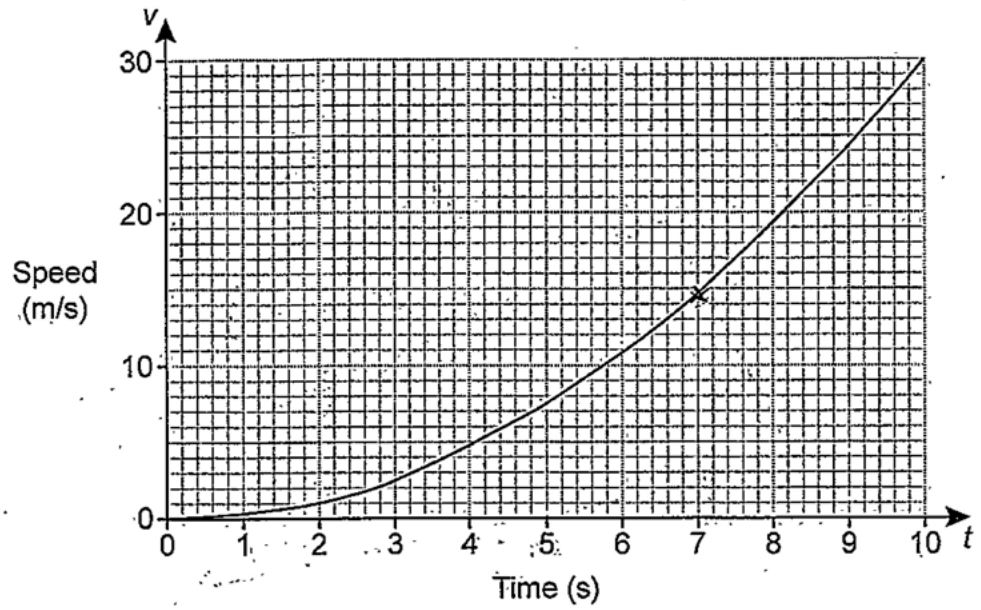
The graph shows the speed, v metres per second (m/s), of a car at time t seconds.



Use the graph to estimate the acceleration at $t = 7$.

(c) ..... m/s^2 **[3]**

Mark(s): 1



(c) Use the graph to estimate the acceleration at $t = 7$.

Acceleration = gradient

$\frac{\text{rise}}{\text{run}} = \frac{y}{x}$

$\frac{14}{7} = 2$

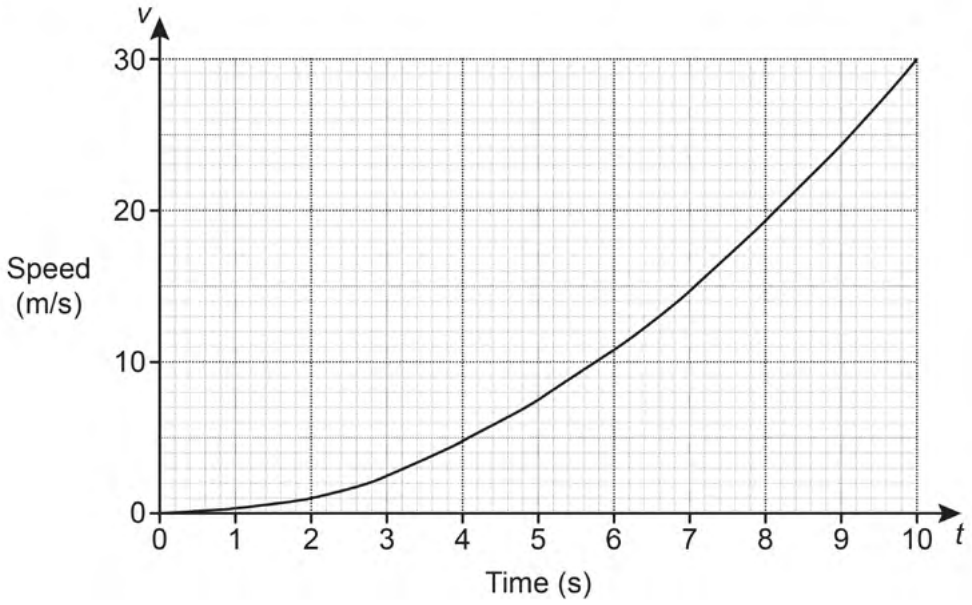
(c) 2 ..... m/s^2 [3]

Examiner commentary

This candidate has scored M1 for speed divided by time, 14 ÷ 7, even though they are calculating the average acceleration and not the acceleration at $t = 7$. The response would have been improved by drawing a tangent at $t = 7$ and then obtaining an answer within the range 4 to 4.5 for the gradient of this tangent.

Question 15(d)

The graph shows the speed, v metres per second (m/s), of a car at time t seconds.

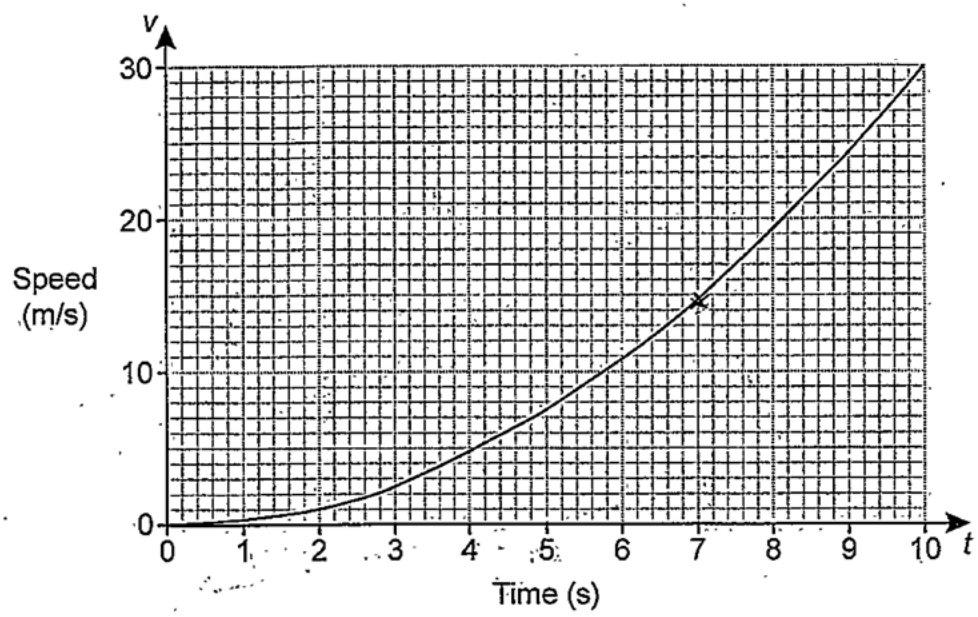


The speed of this car is directly proportional to the square of the time.

Find a formula linking v and t.

(d) ..... **[3]**

Mark(s): 1



(d) The speed of this car is directly proportional to the square of the time.

Find a formula linking v and t.

$v = kt^2$

$v = kt^2$

(d) $v = kt^2$ **[3]**

Examiner commentary

This candidate scores B1 for writing $v = kt^2$. They now need to find the value of k and they can use any point on the graph though (10, 30) is an obvious one to use. Finally they can then write out the formula for this graph when they find the value of k to be 0.3.

Question 16

Write $x^2 - 10x + 16$ in the form $(x + a)^2 + b$.

..... [3]

Mark(s): 1

Write $x^2 - 10x + 16$ in the form $(x + a)^2 + b$.

$(x - 5)^2 + 16$

$(x - 5)(x - 5)$

$+41$

$x^2 - 5x - 5x - 25$

$x^2 - 10x - 25$

$(x - 5)^2 + 41$

$(x - 5)^2 + 41$ [3]

Examiner commentary

The square part $(x - 5)^2$ is correct and scores B1. Unfortunately the candidate has written $(-5)^2$ as -25 and not $+25$ so cannot score the final 2 marks. Those final 2 marks are obtained by working out $-25 + 16 = -9$.

Candidates are allowed a calculator on this question paper and should be encouraged to check their answers.

Question 17

Describe fully the graph which has the equation $x^2 + y^2 = 9$.

..... [2]

Mark(s): 1

It is a circle with a radius of 3 ..... [2]

Examiner commentary

This candidate has identified the equation as a circle so they score B1. In order to score the second mark they must describe the circle accurately so we need the centre (0, 0) as well as the radius 3.

Question 18(a)

Solve by factorisation.

$2x^2 + 5x - 12 = 0$

(a) $x =$ ..... or $x =$ ..... [3]

Mark(s): 2

(a) Solve by factorisation.

$2x^2 + 5x - 12 = 0$

a b c

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

$(2x - 3)(x + 4) = 0$

(a) $x =$ 3 or $x =$ −4 [3]

Examiner commentary

The quadratic equation has been factorised correctly so scores B2. The candidate believes that the negative of the two numbers at the end of each bracket are the answers, but they need to solve $2x - 3 = 0$ to find the answer of 1.5 that goes with −4.

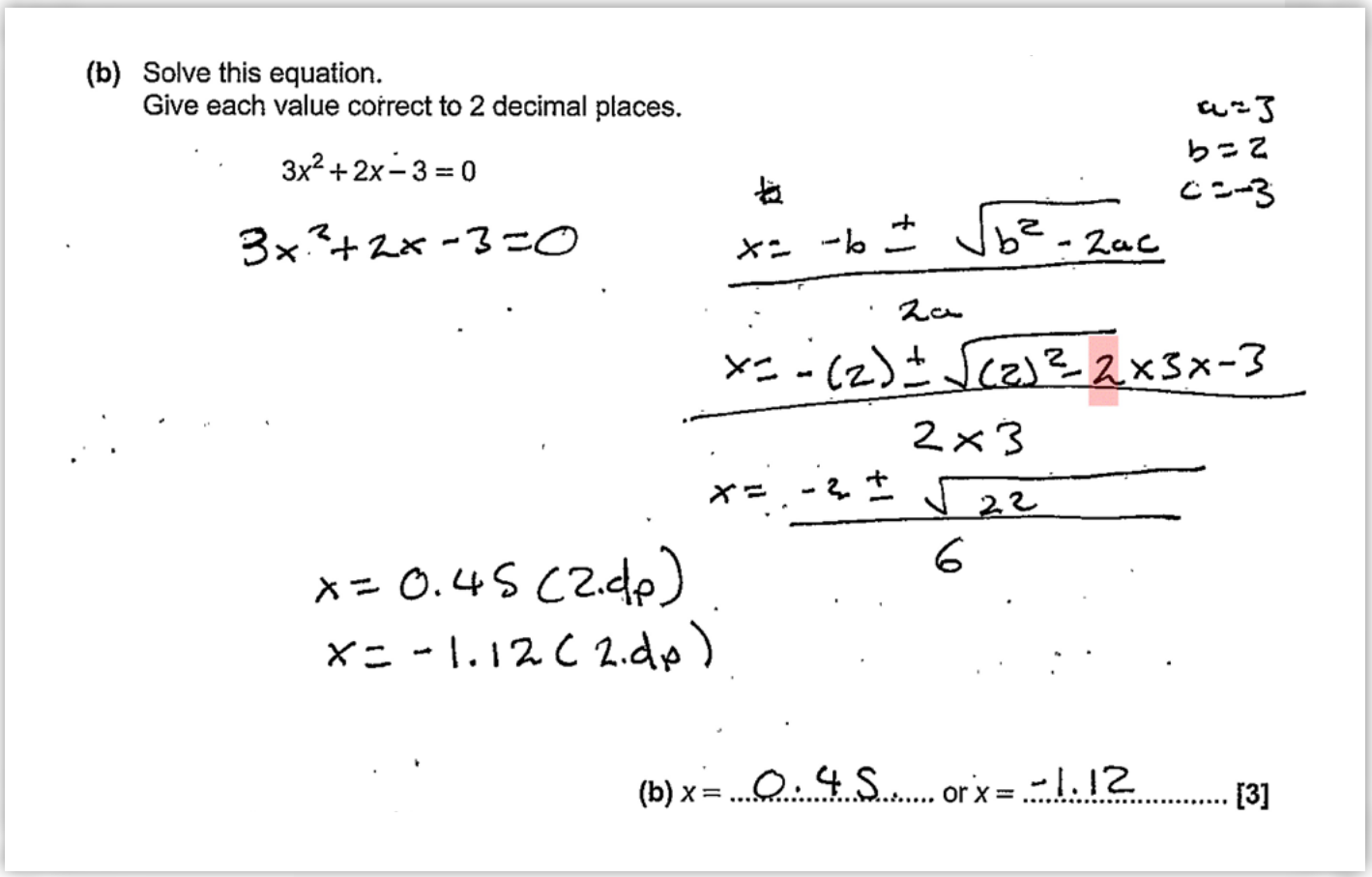
Question 18(b)

Solve this equation.
Give each value correct to 2 decimal places.

$3x^2 + 2x - 3 = 0$

(b) $x =$ ..... or $x =$ ..... **[3]**

Mark(s): 1



Examiner commentary

This candidate has written the quadratic formula incorrectly, it should be 4*ac* not 2*ac*, so they score M1 for the formula with just one error. If they had the correct formula but the incorrect answer(s) they would have scored M2.

Question 19(a)

Here are the first four terms of a sequence.

$\frac{1}{2}$ $\frac{4}{3}$ $\frac{9}{4}$ $\frac{16}{5}$

Find the *n*th term of this sequence.

(a) ..... [2]

Mark(s): 0

(a) Here are the first four terms of a sequence.

0.5 $\frac{1}{2}$ 1.3 $\frac{4}{3}$ 2.25 $\frac{9}{4}$ 3.2 $\frac{16}{5}$

Find the *n*th term of this sequence.

$\frac{1}{2}$, $\frac{4}{3}$, $\frac{9}{4}$, $\frac{16}{5}$ ... $\frac{11}{12} = \frac{5}{6}$

$\frac{5}{6}$ $\frac{11}{12}$ $\frac{19}{20}$

0.83 0.916 0.95

0.083 0.03

(a) ..... [2]

Examiner commentary

This response begins with the differences being calculated but this only works for linear and quadratic sequences at this level. The candidate therefore scores no marks.

This is a special sequence. To earn B1, candidates need to either see the pattern in the numerators which is that they are square numbers so n^2 or spot the denominator is one more than n each time hence $n + 1$.

Question 19(b)

Here are the first four terms of a quadratic sequence, the nth term of this quadratic sequence is $an^2 + bn + c$.

2 12 28 50

Find the values of a, b and c.

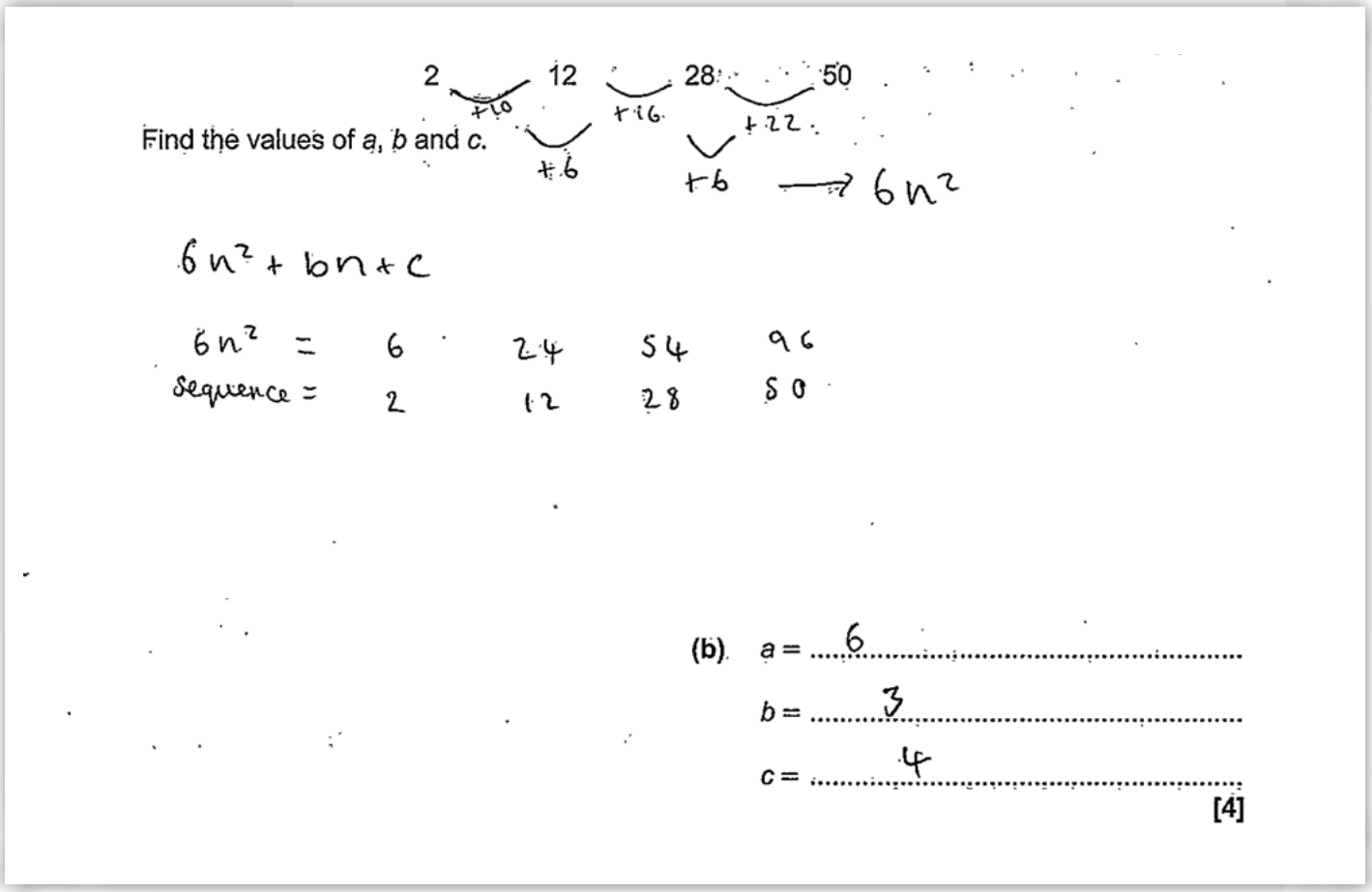
(b) $a =$ .....

$b =$ .....

$c =$ .....

[4]

Mark(s): 1



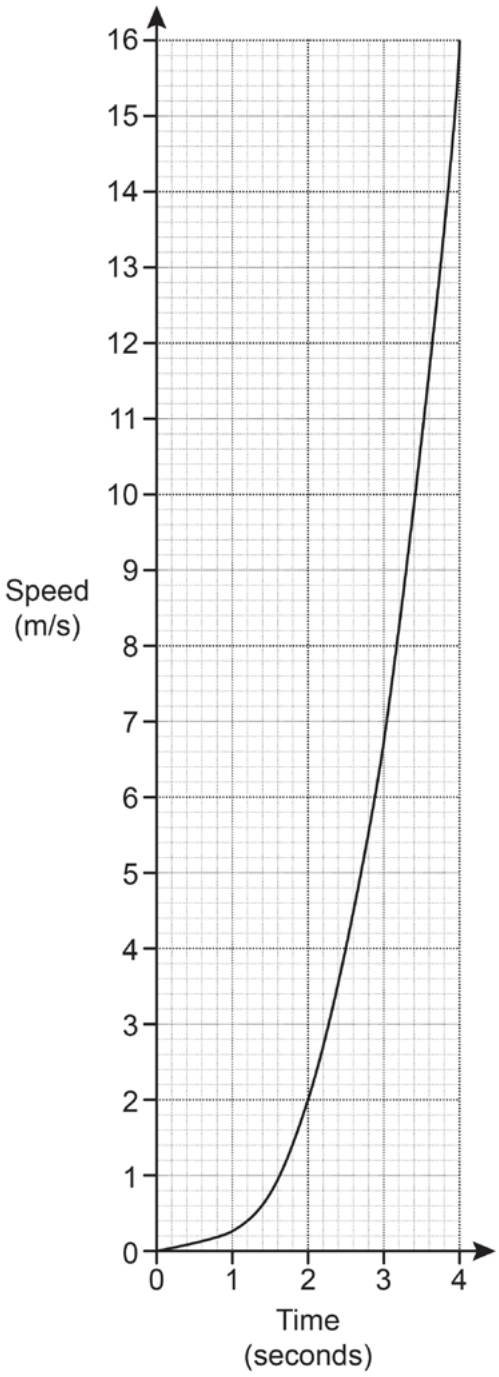
Examiner commentary

This response scores M1 for working out the second difference is 6. The candidate incorrectly believes this is $6n^2$ and no further marks are scored.

To work out the value of a, the candidate should have divided the second difference of 6 by 2 to get a value of 3. They then should have written down the values of $3n^2$ such as 3 12 27 48, and subtracted these from the sequence given to obtain -1 0 1 2. Once written as a linear sequence you get $n - 2$, so the values required are 3, 1 and -2.

Question 20

The graph shows the speed, in metres per second, of a particle over the first four seconds of motion.

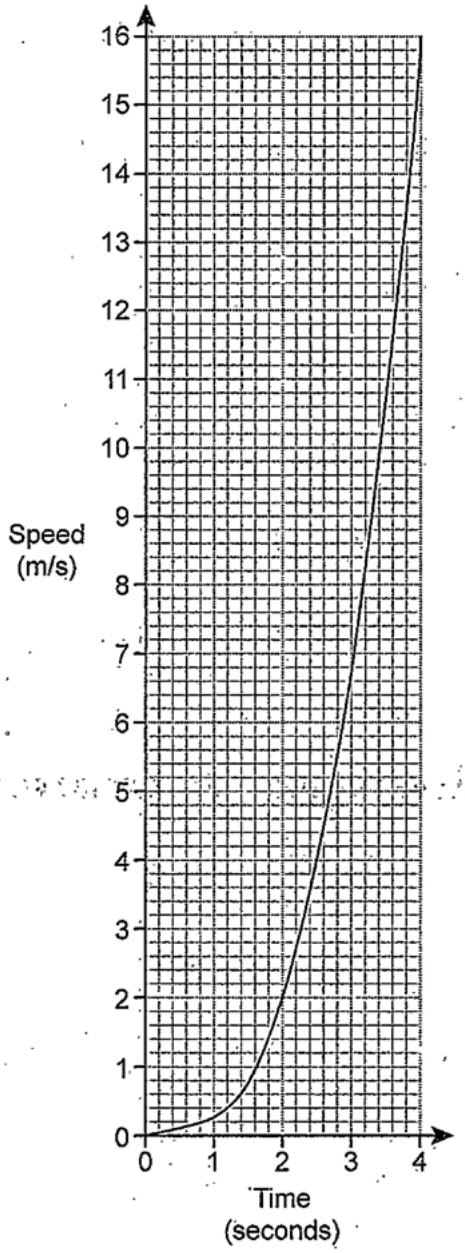


Use the graph to estimate the distance travelled by the particle in the four seconds.

..... metres **[2]**

Mark(s): 0

20 The graph shows the speed, in metres per second, of a particle over the first four seconds of motion.



Use the graph to estimate the distance travelled by the particle in the four seconds.

$d = s \times t$

$d = 16 \times 4$

$d = 64$

64 metres **[2]**

Examiner commentary

This candidate uses distance equal to speed multiplied by time. This works for constant speed problems but not here where the speed varies, so no marks were awarded.

Candidates need to find a way to estimate the area under the graph and any attempt at this will score M1, especially if they show working such as dividing the area up. The second mark is for getting a reasonably accurate answer in the range 15 to 22 which allows for any reasonable method they may have been taught.

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