

# SIMULTANEOUS EQUATIONS (LINEAR)

DATE OF SOLUTIONS: 15/05/2018  
MAXIMUM MARK: 77

# SOLUTIONS

GCSE (+ IGCSE) EXAM QUESTION PRACTICE

1. [Edexcel, 2013]

Simultaneous Equations (Linear) [3 Marks]

Solve the simultaneous equations

$$\begin{aligned}y - 2x &= 6 \\ y + 2x &= 0\end{aligned}$$

Show clear algebraic working.

$$\begin{array}{r}y - 2x = 6 \quad \text{--- (1)} \\ y + 2x = 0 \quad \text{--- (2)} \\ \hline \text{ADD} \quad 2y = 6 \quad \text{(M1)} \\ \quad \quad y = 3\end{array}$$

→ SUBSTITUTING  $y = 3$  INTO (1)

$$\begin{aligned}\Rightarrow 3 - 2x &= 6 \\ -2x &= 3 \\ x &= -\frac{3}{2} \quad (-1.5)\end{aligned}$$

$$x = -1.5 \quad \text{(A1)}$$

$$y = 3 \quad \text{(A1)}$$

Showing clear algebraic working, solve the simultaneous equations

$$3a + 2b = 1 \quad \text{---} \textcircled{1}$$

$$a + 2b = 5 \quad \text{---} \textcircled{2}$$

SUBTRACT  $\overline{\hspace{1.5cm}}$

$$2a = -4 \quad \textcircled{M1}$$

$$a = -\frac{4}{2}$$

$$= \underline{\underline{-2}}$$

SUBSTITUTE  $a = -2$  INTO  $\textcircled{1}$

$$3 \times (-2) + 2b = 1$$

$$-6 + 2b = 1$$

$$2b = 7$$

$$b = \underline{\underline{3.5}}$$

$$a = \underline{\underline{-2}} \quad \textcircled{A1}$$

$$b = \underline{\underline{3.5}} \quad \textcircled{A1}$$

Solve the simultaneous equations

$$\begin{array}{l} 3x + y = 4 \longrightarrow \textcircled{1} \\ 5x - y = 8 \longrightarrow \textcircled{2} \end{array}$$

You must show sufficient working.

ADD  $\textcircled{1}$  AND  $\textcircled{2}$

$$\begin{array}{l} 8x = 12 \quad \textcircled{M1} \\ x = \frac{12}{8} \\ = \underline{\underline{1.5}} \end{array}$$

SUBSTITUTE  $x = 1.5$  INTO  $\textcircled{1}$

$$\begin{array}{l} 3 \times 1.5 + y = 4 \\ y = 4 - 3 \times 1.5 \\ = \underline{\underline{-0.5}} \end{array}$$

$$\begin{array}{l} x = \underline{\underline{1.5}} \quad \textcircled{A1} \\ y = \underline{\underline{-0.5}} \quad \textcircled{A1} \end{array}$$

Solve the simultaneous equations

EXACTLY THE SAME

$$\begin{array}{r} 5x + y = 17 \quad \text{--- (1)} \\ x + y = 3 \quad \text{--- (2)} \end{array} \left. \vphantom{\begin{array}{r} 5x + y = 17 \\ x + y = 3 \end{array}} \right\} \text{SUBTRACT}$$

Show clear algebraic working.

$$\begin{array}{r} 4x = 14 \quad \text{(M1)} \\ x = \frac{14}{4} \\ = \underline{\underline{3.5}} \quad \text{(A1)} \end{array}$$

SUBSTITUTE INTO (1)

$$\begin{aligned} 5(3.5) + y &= 17 \\ y &= 17 - 5(3.5) \\ &= \underline{\underline{-0.5}} \quad \text{(A1)} \end{aligned}$$

$$x = \underline{\underline{3.5}}$$

$$y = \underline{\underline{-0.5}}$$

Solve the simultaneous equations

$$\begin{array}{r} c + 5d = -13 \quad \text{--- ①} \\ 4c - 5d = 48 \quad \text{--- ②} \end{array} \left. \vphantom{\begin{array}{r} c + 5d = -13 \\ 4c - 5d = 48 \end{array}} \right\} \text{ADD}$$

Show clear algebraic working.

$$\underline{5c = 35} \quad \text{(m)}$$

$$c = \frac{35}{5}$$

$$c = \underline{\underline{7}}$$

SUBSTITUTE INTO ①

$$7 + 5d = -13$$

$$5d = -20$$

$$d = \underline{\underline{-4}}$$

$$c = \underline{\underline{7}} \quad \text{(A5)}$$

$$d = \underline{\underline{-4}} \quad \text{(A1)}$$

Solve  $x + 2y = 3$

$x - y = 6$

Show clear algebraic working.

$$\begin{array}{r}
 x + 2y = 3 \quad \text{--- ①} \\
 x - y = 6 \quad \text{--- ②} \\
 \hline
 3y = -3 \quad \text{③} \\
 y = \frac{-3}{3} \\
 = \underline{\underline{-1}} \quad \text{④}
 \end{array}
 \left. \vphantom{\begin{array}{r} x + 2y = 3 \\ x - y = 6 \end{array}} \right\} \text{SUBTRACT}$$

SUBSTITUTE INTO ①

$$\begin{array}{l}
 x + 2x(-1) = 3 \\
 x - 2 = 3 \\
 x = \underline{\underline{5}} \quad \text{⑤}
 \end{array}$$

Solve the simultaneous equations

$$y = x + 3 \quad \text{--- (1)}$$

$$y = 7x \quad \text{--- (2)}$$

COMBINE!

$$7x = x + 3 \quad \text{(M1)}$$

$$6x = 3$$

$$x = \underline{\underline{0.5}}$$

SUBSTITUTE  $x = 0.5$  INTO (1)

$$y = 0.5 + 3$$

$$= \underline{\underline{3.5}}$$

$$x = \dots 0.5 \quad \text{(A1)}$$

$$y = \dots 3.5 \quad \text{(A1)}$$

Solve the simultaneous equations

$$\begin{array}{l} 5y - 4x = 8 \quad \text{---} \textcircled{1} \\ y + x = 7 \quad \text{---} \textcircled{2} \times 4 \end{array}$$

Show clear algebraic working.

$$\begin{array}{r} \textcircled{m1} \quad 5y - 4x = 8 \quad \text{---} \textcircled{3} \\ \quad 4y + 4x = 28 \quad \text{---} \textcircled{4} \\ \hline 9y \quad = 36 \\ y \quad = \frac{36}{9} \\ \quad = \underline{\underline{4}} \quad \textcircled{AV} \end{array}$$

USING  $\textcircled{2}$  IS EASIER THAN  $\textcircled{1}$ !  
 $\downarrow$   
 SUBSTITUTE INTO  $\textcircled{2}$   

$$\begin{array}{l} 4 + x = 7 \\ x = \underline{\underline{3}} \quad \textcircled{AV} \end{array}$$

ADD



Solve the simultaneous equations

$$\begin{array}{r} 5x + 4y = 3 \quad \text{---} \textcircled{1} \\ x - 2y = 2 \quad \text{---} \textcircled{2} \times 2 \end{array}$$

You must show sufficient working.

$$\begin{array}{r} 5x + 4y = 3 \quad \text{---} \textcircled{3} \\ 2x - 4y = 4 \quad \text{---} \textcircled{4} \end{array} \quad \left. \vphantom{\begin{array}{r} 5x + 4y = 3 \\ 2x - 4y = 4 \end{array}} \right\} \text{ADD } \textcircled{MI}$$


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$$\begin{array}{r} 7x \qquad \qquad = 7 \\ x = \underline{\underline{1}} \quad \textcircled{AI} \end{array}$$

→ SUBSTITUTED INTO  $\textcircled{1}$

$$\begin{array}{r} 5x + 4y = 3 \\ 4y = 3 - 5 \\ 4y = -2 \\ y = \underline{\underline{-\frac{1}{2}}} \quad \textcircled{AI} \end{array}$$

$$\begin{array}{l} x = \dots\dots\dots 1 \dots\dots\dots \\ y = \dots\dots\dots -\frac{1}{2} \dots\dots\dots \end{array}$$

Solve the simultaneous equations

$$6x + 5y = 5 \longrightarrow \textcircled{1} \quad \times 2$$

$$3x - 10y = 15 \longrightarrow \textcircled{2}$$

$$12x + 10y = 10 \longrightarrow \textcircled{3} \quad \text{m}$$

$$3x - 10y = 15 \longrightarrow \textcircled{2}$$

ADD

$$15x = 25$$

$$x = \frac{25}{15}$$

$$= 1.\dot{6}$$

SUBSTITUTE  $x = 1.\dot{6}$  INTO  $\textcircled{1}$ 

$$6 \times 1.\dot{6} + 5y = 5$$

$$\Rightarrow 5y = 5 - 6 \times 1.\dot{6}$$

$$x = 1.\dot{6} \quad \text{AD}$$

$$y = -1 \quad \text{AD}$$

$$5y = -5$$

$$y = \underline{\underline{-1}}$$

Solve the simultaneous equations

$$\begin{array}{r} 2x + 5y = 16 \quad \text{--- (1) } \times 2 \\ 4x + 3y = 11 \quad \text{--- (2)} \end{array}$$

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$$\begin{array}{r} 4x + 10y = 32 \quad \text{--- (3)} \\ 4x + 3y = 11 \quad \text{--- (4)} \end{array}$$

(m) (OR SIMILAR METHOD)

SUBTRACT

$$\begin{array}{r} 7y = 21 \\ y = \frac{21}{7} \\ y = 3 \end{array}$$

(A1)

→ SUBSTITUTE  $y = 3$   
INTO EQ. (1)

$$2x + 5 \times 3 = 16$$

$$2x + 15 = 16$$

$$2x = 1$$

$$x = \underline{\underline{0.5}}$$

(A1)

Solve the simultaneous equations

$$\begin{array}{r} 8x - 4y = 7 \longrightarrow \textcircled{1} \times 2 \\ 12x - 8y = 6 \longrightarrow \textcircled{2} \end{array}$$

Show clear algebraic working.

$$\begin{array}{r} 16x - 8y = 14 \longrightarrow \textcircled{3} \\ 12x - 8y = 6 \longrightarrow \textcircled{4} \end{array} \left. \vphantom{\begin{array}{r} 16x - 8y = 14 \\ 12x - 8y = 6 \end{array}} \right\} \text{SUBTRACT}$$

$$\hline 4x = 8$$

$$x = \frac{8}{4}$$

$$= \underline{\underline{2}} \quad \textcircled{\text{A1}}$$

SUBSTITUTE  $x = 2$  INTO EQU  $\textcircled{1}$ 

$$8 \times 2 - 4y = 7$$

$$\Rightarrow 16 - 4y = 7$$

$$\Rightarrow -4y = 7 - 16$$

$$-4y = -9$$

$$y = \frac{-9}{-4}$$

$$= \underline{\underline{2.25}} \quad \textcircled{\text{A1}}$$

$$x = \underline{\underline{2}}$$

$$y = \underline{\underline{2.25}}$$

Solve the simultaneous equations

$$\begin{array}{r} 2x - 5y = 13 \quad \text{---} \textcircled{1} \quad \text{---} \times 3 \\ 6x + 3y = 3 \quad \text{---} \textcircled{2} \quad \text{---} \times 5 \end{array}$$

$$6x - 15y = 39 \quad \text{---} \textcircled{3} \quad \text{mi}$$

$$30x + 15y = 15 \quad \text{---} \textcircled{4}$$

$$\underline{\underline{\text{ADD}}} \quad 36x \quad = 54$$

$$x = \frac{54}{36}$$

$$= \underline{\underline{1.5}}$$

SUBSTITUTE INTO  $\textcircled{1}$

$$2x(1.5) - 5y = 13$$

$$3 - 5y = 13$$

$$-5y = 10$$

$$y = \underline{\underline{-2}}$$

$$x = \underline{\underline{1.5}} \quad \text{AV}$$

$$y = \underline{\underline{-2}} \quad \text{AV}$$

Solve the simultaneous equations

$$\begin{array}{r} 2x - 3y = 3 \quad \text{---} \quad \textcircled{1} \times 2 \\ 3x + 6y = 1 \quad \text{---} \quad \textcircled{2} \end{array}$$

$$\begin{array}{r} \textcircled{m} \rightarrow \quad \hline 4x - 6y = 6 \quad \text{---} \quad \textcircled{3} \\ 3x + 6y = 1 \quad \text{---} \quad \textcircled{4} \\ \hline 7x \qquad \qquad = 7 \\ x = \underline{\underline{1}} \quad \textcircled{AV} \end{array} \quad \left. \vphantom{\begin{array}{r} 4x - 6y = 6 \\ 3x + 6y = 1 \end{array}} \right\} \text{ADD}$$

SUBSTITUTE  $x = 1$  INTO EQUATION  $\textcircled{1}$ 

$$2 \times 1 - 3y = 3$$

$$-3y = 3 - 2$$

$$-3y = 1$$

$$y = \underline{\underline{-\frac{1}{3}}} \quad \textcircled{AV}$$

(a) Solve the simultaneous equations

$$\begin{array}{r}
 2x + 3y = 4 \quad \text{--- (1) } \times 3 \\
 6x + 5y = 8 \quad \text{--- (2)} \\
 \\
 \text{(m)} \\
 \begin{array}{r}
 6x + 9y = 12 \quad \text{--- (3)} \\
 6x + 5y = 8 \quad \text{--- (4)} \\
 \hline
 4y = 4 \\
 y = 1 \quad \text{(A)}
 \end{array}
 \end{array}$$

SUBTRACT

SUBSTITUTE INTO (1)

$$\begin{array}{r}
 2x + 3 \times 1 = 4 \\
 \Rightarrow x = \frac{4 - 3 \times 1}{2} \\
 = \frac{1}{2} \quad \text{(A)}
 \end{array}$$

(b) Write down the coordinates of the point of intersection of the two lines whose equations are

$$2x + 3y = 4 \text{ and}$$

$$6x + 5y = 8$$

$$\left( \frac{1}{2}, 1 \right) \quad \text{(A)}$$

(1)

Solve  $4x + 3y = 6$   $\longrightarrow$  ①  $\times 5$

$3x + 5y = -1$   $\longrightarrow$  ②  $\times 3$

Show clear algebraic working.

$$\begin{array}{r} 20x + 15y = 30 \quad \text{--- ③} \\ 9x + 15y = -3 \quad \text{--- ④} \end{array} \left. \vphantom{\begin{array}{r} 20x + 15y = 30 \\ 9x + 15y = -3 \end{array}} \right\} \text{SUBTRACT}$$

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$$11x = 33$$

$$x = \underline{\underline{3}} \quad \text{①}$$

SUBSTITUTE  $x = 3$  INTO ①:

$$4(3) + 3y = 6 \quad \text{②}$$

$$y = \frac{6 - 4(3)}{3}$$

$$= \underline{\underline{-2}} \quad \text{③}$$

$$x = \underline{\quad 3 \quad}$$

$$y = \underline{\quad -2 \quad}$$



Solve the simultaneous equations

$$6x - 5y = 13 \quad \text{--- (1) } \times 3$$

$$4x - 3y = 8 \quad \text{--- (2) } \times 5$$

$$\begin{array}{r} \text{(mi)} \quad 18x - 15y = 39 \quad \text{--- (3)} \\ \quad \quad 20x - 15y = 40 \quad \text{--- (4)} \\ \hline \end{array} \quad \left. \vphantom{\begin{array}{r} 18x - 15y = 39 \\ 20x - 15y = 40 \end{array}} \right\} \text{SUBTRACT (mi)}$$

$$\begin{array}{r} -2x \quad \quad \quad = -1 \\ x = \frac{-1}{-2} \\ \quad \quad \quad = \underline{\underline{0.5}} \end{array}$$

SUBSTITUTE  $x = 0.5$  INTO (1)

$$\begin{array}{r} 6 \times 0.5 - 5y = 13 \\ 3 - 5y = 13 \\ -5y = 10 \\ y = \underline{\underline{-2}} \end{array}$$

$$x = \dots 0.5 \quad \text{(A)}$$

$$y = \dots -2 \quad \text{(A)}$$

(a) Solve the simultaneous equations

$$\begin{array}{r} 2x - 3y = 9 \quad \text{---} \textcircled{1} \times 4 \\ 5x + 4y = 11 \quad \text{---} \textcircled{2} \times 3 \end{array}$$

$$\begin{array}{r} 8x - 12y = 36 \quad \text{---} \textcircled{3} \\ 15x + 12y = 33 \quad \text{---} \textcircled{4} \end{array} \quad \left. \vphantom{\begin{array}{r} 8x - 12y = 36 \\ 15x + 12y = 33 \end{array}} \right\} \textcircled{\text{mi}}$$

ADD

$$\begin{array}{r} 23x \quad \quad = 69 \quad \textcircled{\text{mi}} \\ x = \frac{69}{23} \\ \quad \quad \quad = \underline{\underline{3}} \quad \textcircled{\text{AI}} \end{array}$$

SUBSTITUTE  $x=3$  INTO EQ.  $\textcircled{1}$ 

$$2 \times 3 - 3y = 9$$

$$-3y = 3 \Rightarrow y = \underline{\underline{-1}} \quad \textcircled{\text{AI}}$$

$$x = \underline{\underline{3}}$$

$$y = \underline{\underline{-1}} \quad (4)$$

(b) Write down the coordinates of the point of intersection of the two lines whose equations are  $2x - 3y = 9$  and  $5x + 4y = 11$ 

$$\left( \underline{\underline{3}}, \underline{\underline{-1}} \right) \quad \textcircled{\text{AI}} \quad (1)$$

Solve the simultaneous equations

$$4x + 5y = 13$$

$$3x - 2y = 27$$

Show clear algebraic working.

$$4x + 5y = 13 \quad \text{--- (1) } \times 2 \quad \text{m} \text{ [MULTIPLYING]}$$

$$3x - 2y = 27 \quad \text{--- (2) } \times 5$$

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$$8x + 10y = 26 \quad \text{--- (3)}$$

$$15x - 10y = 135 \quad \text{--- (4)}$$

} ADD

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$$23x = 161$$

$$x = \frac{161}{23}$$

$$= \underline{\underline{7}} \quad \text{(A1)}$$

SUBSTITUTE INTO (1)

$$4(7) + 5y = 13 \quad \text{m} \text{ [SUBSTITUTING]}$$

$$5y = 13 - 4(7)$$

$$y = \frac{13 - 4(7)}{5}$$

$$= \underline{\underline{-3}} \quad \text{(A1)}$$

$$x = \underline{\underline{7}}$$

$$y = \underline{\underline{-3}}$$

Solve the simultaneous equations

$$3x + 4y = 6 \quad \text{---} \textcircled{1} \times 3$$

$$5x + 6y = 11 \quad \text{---} \textcircled{2} \times 2$$

Show clear algebraic working.

$$\textcircled{m1} \left\{ \begin{array}{l} 9x + 12y = 18 \quad \text{---} \textcircled{3} \\ 10x + 12y = 22 \quad \text{---} \textcircled{4} \end{array} \right\} \text{SUBTRACT}$$

$$\hline -x \quad \quad = -4$$

$$\Rightarrow x = \underline{4} \quad \textcircled{A1}$$

SUBSTITUTE  $x=4$  INTO EQ  $\textcircled{1}$

$$3 \times 4 + 4y = 6 \quad \textcircled{m1}$$

$$4y = 6 - 12$$

$$4y = -6$$

$$y = -\frac{6}{4}$$

$$= -1.5 \quad \textcircled{A1}$$

$$x = \underline{4}$$

$$y = \underline{-1.5}$$

(a) Solve the simultaneous equations

$$\begin{array}{r} 5x + 3y = 9 \quad \text{---} \quad \textcircled{1} \times 2 \\ 7x - 2y = 25 \quad \text{---} \quad \textcircled{2} \times 3 \end{array}$$

Show clear algebraic working.

$$\textcircled{m1} \left\{ \begin{array}{r} 10x + 6y = 18 \quad \text{---} \quad \textcircled{3} \\ 21x - 6y = 75 \quad \text{---} \quad \textcircled{4} \end{array} \right\} \text{ ADD}$$

$$\hline 31x = 93$$

$$x = \underline{\underline{3}} \quad \textcircled{A1}$$

SUBSTITUTE  $x=3$  INTO EQ (1)

$$5 \times 3 + 3y = 9 \quad \textcircled{m1}$$

$$3y = 9 - 15 \Rightarrow y = \underline{\underline{-2}} \quad \textcircled{A1}$$

$$\begin{array}{l} x = \underline{\underline{3}} \\ y = \underline{\underline{-2}} \\ \quad \quad \quad (4) \end{array}$$

(b)  $P$  is the point of intersection of the lines with equations  $5x + 3y = 9$  and  $7x - 2y = 25$

Write down the coordinates of  $P$ .

$$\begin{array}{l} \textcircled{A1} \\ (\underline{\underline{3}}, \underline{\underline{-2}}) \\ \quad \quad \quad (1) \end{array}$$

POINTS OF INTERSECTION  
ARE THE SOLUTIONS TO SIMULTANEOUS  
EQUATIONS!

- (a) Solve the simultaneous equations  $3x + 5y = 14$  — (1)  $\times 3$   
 $4x + 3y = 4$  — (2)  $\times 5$

Show clear algebraic working.

$$\begin{array}{r}
 9x + 15y = 42 \quad \text{--- (3) (m1)} \\
 20x + 15y = 20 \quad \text{--- (4) (m1)} \\
 \hline
 \text{SUBTRACT: } -11x \quad = 22 \quad \text{(m1)} \\
 \quad \quad \quad \quad \quad = 22 \\
 \quad \quad \quad \quad \quad \quad -11 \\
 \quad \quad \quad \quad \quad = \underline{\underline{-2}}
 \end{array}$$

SUBSTITUTE INTO (1)

$$\begin{array}{r}
 3x(-2) + 5y = 14 \\
 5y = 20 \\
 y = \underline{\underline{4}}
 \end{array}$$

$$\begin{array}{r}
 x = \underline{\underline{-2}} \quad \text{(A1)} \\
 y = \underline{\underline{4}} \quad \text{(A1)} \\
 \quad \quad \quad (4)
 \end{array}$$

- (b) Write down the coordinates of the point of intersection of the two lines whose equations are  $3x + 5y = 14$  and  $4x + 3y = 4$

$$(\underline{\underline{-2}}, \underline{\underline{4}}) \quad \text{(A1)} \\
 \quad \quad \quad (1)$$

## Disclaimer

While reasonable endeavours have been used to verify the accuracy of these solutions, these solutions are provided on an “as is” basis and no warranties are made of any kind, whether express or implied, in relation to these solutions.

There is no warranty that these solutions will meet Your requirements or provide the results which You want, or that they are complete, or that they are error-free. If You find anything confusing within these solutions then it is Your responsibility to seek clarification from Your teacher, tutor or mentor.

Please report any errors or omissions that You find\*. These solutions will be updated to correct errors that are discovered. It is recommended that You always check that You have the most up-to-date version of these solutions.

The methods used in these solutions, where relevant, are methods which have been successfully used with students. The method shown for a particular question is not always the only method and there is no claim that the method that is used is necessarily the most efficient or ‘best’ method. From time to time, a solution to a question might be updated to show a different method if it is judged that it is a good idea to do so.

Sometimes a method used in these solutions might be unfamiliar to You. If You are able to use a different method to obtain the correct answer then You should consider to keep using your existing method and not change to the method that is used here. However, the choice of method is always up to You and it is often useful if You know more than one method to solve a particular type of problem.

Within these solutions there is an indication of where marks **might** be awarded for each question. B marks, M marks and A marks have been used in a similar, but **not identical**, way that an exam board uses these marks within their mark schemes. This slight difference in the use of these marking symbols has been done for simplicity and convenience. Sometimes B marks, M marks and A marks have been interchanged, when compared to an examiners’ mark scheme and sometimes the marks have been awarded for different aspects of a solution when compared to an examiners’ mark scheme.

B1 - This is an unconditional accuracy mark (the specific number, word or phrase must be seen. This type of mark cannot be given as a result of ‘follow through’).

M1 - This is a method mark. Method marks have been shown in places where they might be awarded for the method that is shown. If You use a different method to get a correct answer, then the same number of method marks would be awarded but it is not practical to show all possible methods, and the way in which marks might be awarded for their use, within these particular solutions. When appropriate, You should seek clarity and download the relevant examiner mark scheme from the exam board’s web site.

A1 - These are accuracy marks. Accuracy marks are typically awarded after method marks. If the correct answer is obtained, then You should normally (but not always) expect to be awarded all of the method marks (provided that You have shown a method) and all of the accuracy marks.

Note that some questions contain the words ‘show that’, ‘show your working out’, or similar. These questions require working out to be shown. Failure to show sufficient working out is likely to result in no marks being awarded, even if the final answer is correct.

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