



National  
Qualifications  
2025

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## **2025 Mathematics**

### **National 5 - Paper 2**

#### **Question Paper Finalised Marking Instructions**

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## General marking principles for National 5 Mathematics

*Always apply these general principles. Use them in conjunction with the detailed marking instructions, which identify the key features required in candidates' responses.*

*For each question, the marking instructions are generally in two sections:*

*generic scheme – this indicates why each mark is awarded*

*illustrative scheme – this covers methods which are commonly seen throughout the marking*

*In general, you should use the illustrative scheme. Only use the generic scheme where a candidate has used a method not covered in the illustrative scheme.*

- (a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.
- (b) If you are uncertain how to assess a specific candidate response because it is not covered by the general marking principles or the detailed marking instructions, you must seek guidance from your team leader.
- (c) One mark is available for each ○. There are no half marks.
- (d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.
- (e) Only award full marks where the solution contains appropriate working. A correct answer with no working receives no mark, unless specifically mentioned in the marking instructions.
- (f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.
- (g) If an error is trivial, casual or insignificant, for example  $6 \times 6 = 12$ , candidates lose the opportunity to gain a mark, except for instances such as the second example in point (h) below.

- (h) If a candidate makes a transcription error (question paper to script or within script), they lose the opportunity to gain the next process mark, for example

This is a transcription error and so the mark is not awarded.

This is no longer a solution of a quadratic equation, so the mark is not awarded.

$$x^2 + 5x + 7 = 9x + 4$$

$$x - 4x + 3 = 0$$

$$x = 1$$

The following example is an exception to the above

This error is not treated as a transcription error, as the candidate deals with the intended quadratic equation. The candidate has been given the benefit of the doubt and all marks awarded.

$$x^2 + 5x + 7 = 9x + 4$$

$$x - 4x + 3 = 0$$

$$(x - 3)(x - 1) = 0$$

$$x = 1 \text{ or } 3$$

(i) **Horizontal/vertical marking**

If a question results in two pairs of solutions, apply the following technique, but only if indicated in the detailed marking instructions for the question.

Example:

	$\bigcirc^5$	$\bigcirc^6$
$\bigcirc^5$	$x = 2$	$x = -4$
$\bigcirc^6$	$y = 5$	$y = -7$

Horizontal: $\bigcirc^5 x = 2 \text{ and } x = -4$ $\bigcirc^6 y = 5 \text{ and } y = -7$	Vertical: $\bigcirc^5 x = 2 \text{ and } y = 5$ $\bigcirc^6 x = -4 \text{ and } y = -7$
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You must choose whichever method benefits the candidate, **not** a combination of both.

- (j) In final answers, candidates should simplify numerical values as far as possible unless specifically mentioned in the detailed marking instruction. For example

$\frac{15}{12}$ must be simplified to $\frac{5}{4}$ or $1\frac{1}{4}$  $\frac{15}{0.3}$ must be simplified to 50  $\sqrt{64}$ must be simplified to 8*	$\frac{43}{1}$ must be simplified to 43  $\frac{4}{3}$ must be simplified to $\frac{4}{15}$
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\*The square root of perfect squares up to and including 144 must be known.

- (k) Commonly Observed Responses (COR) are shown in the marking instructions to help mark common and/or non-routine solutions. CORs may also be used as a guide when marking similar non-routine candidate responses.
- (l) Do not penalise candidates for any of the following, unless specifically mentioned in the detailed marking instructions:
- working subsequent to a correct answer
  - correct working in the wrong part of a question
  - legitimate variations in numerical answers/algebraic expressions, for example angles in degrees rounded to nearest degree
  - omission of units
  - bad form (bad form only becomes bad form if subsequent working is correct), for example

$(x^3 + 2x^2 + 3x + 2)(2x + 1)$  written as

$(x^3 + 2x^2 + 3x + 2) \times 2x + 1$

$= 2x^4 + 5x^3 + 8x^2 + 7x + 2$

gains full credit

- repeated error within a question, but not between questions or papers
- (m) In any ‘Show that...’ question, where candidates have to arrive at a required result, the last mark is not awarded as a follow-through from a previous error, unless specified in the detailed marking instructions.
- (n) You must check all working carefully, even where a fundamental misunderstanding is apparent early in a candidate’s response. You may still be able to award marks later in the question so you must refer continually to the marking instructions. The appearance of the correct answer does not necessarily indicate that you can award all the available marks to a candidate.
- (o) You should mark legible scored-out working that has not been replaced. However, if the scored-out working has been replaced, you must only mark the replacement working.
- (p) If candidates make multiple attempts using the same strategy and do not identify their final answer, mark all attempts and award the lowest mark. If candidates try different valid strategies, apply the above rule to attempts within each strategy and then award the highest mark.

For example:

Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Note: Marking from Image (MFI) annotation change from 2025

A double cross-tick is used to indicate correct working which is irrelevant or insufficient to score any marks. In MFI marking instructions prior to 2025 this was shown as ü<sub>2</sub> or ü2.

From 2025, the double cross-tick will no longer be used in MFI. A cross or omission symbol will be used instead.

## Marking Instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.			<ul style="list-style-type: none"> <li>•<sup>1</sup> know how to increase by 4%</li> <li>•<sup>2</sup> know how to calculate visitors after 2 years</li> <li>•<sup>3</sup> consistent calculation</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\times 1.04</math></li> <li>•<sup>2</sup> <math>118750 \times 1.04^2</math></li> <li>•<sup>3</sup> 128 440</li> </ul>	3
<b>Notes:</b> <ol style="list-style-type: none"> <li>Correct answer without working. award 3/3</li> <li>Where an incorrect percentage is used, the working must be followed through to give the possibility of awarding 2/3. eg <math>118750 \times 1.4^2 = 232750</math> award 2/3 <span style="color: red;">x✓1✓1</span></li> <li>Where an incorrect power ( &gt; 2 ) is used, the working must be followed through to give the possibility of awarding 2/3. eg <math>118750 \times 1.04^3 = 133577</math> or 133578 or 133577.6 award 2/3 <span style="color: red;">✓xx✓1</span></li> <li>Where division is used:               <ol style="list-style-type: none"> <li>along with 1.04 •<sup>1</sup> is not available. eg <math>118750 \div 1.04^2 = 109791</math> or 109792 or 109791.0503 award 2/3 <span style="color: red;">x✓1✓1</span></li> <li>along with an incorrect percentage, •<sup>1</sup> and •<sup>2</sup> are not available. eg <math>118750 \div 0.96^2 = 128851</math> or 128852 or 128851.9965 award 1/3 <span style="color: red;">xx✓1</span></li> </ol> </li> </ol>					
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li><math>118750 \times 0.96^2 = 109440</math> award 2/3 <span style="color: red;">x✓1✓1</span></li> <li><math>118750 \times 1.04 = 123500</math> award 1/3 <span style="color: red;">✓^^</span></li> <li><math>118750 \times 1.04 \times 2 = 247000</math> award 1/3 <span style="color: red;">✓xx</span></li> <li> <ol style="list-style-type: none"> <li><math>118750 \times 0.04 = 4750 \rightarrow 118750 + 4750 = 123500</math> award 1/3 <span style="color: red;">✓^^</span></li> <li><math>118750 \times 0.04 = 4750 \rightarrow 118750 + 4750 \times 2 = 128250</math> award 0/3</li> </ol> </li> <li> <ol style="list-style-type: none"> <li><math>118750 \times 1.08^2 = 138510</math> award 2/3 <span style="color: red;">x✓1✓1</span></li> <li><math>118750 \times 1.08 = 128250</math> award 0/3</li> </ol> </li> <li><math>118750 \times 0.04 \times 2 = 9500</math> award 0/3</li> </ol>					

Question			Generic scheme	Illustrative scheme	Max mark
2.			<ul style="list-style-type: none"> <li>•<sup>1</sup> substitute into formula</li> <li>•<sup>2</sup> calculate volume</li> <li>•<sup>3</sup> round to 3 significant figures AND state correct units</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{4}{3} \times \pi \times 10.5^3</math></li> <li>•<sup>2</sup> 4849(.0...)</li> <li>•<sup>3</sup> 4850 cm<sup>3</sup></li> </ul>	3
<b>Notes:</b> 1. Correct answer without working. award 0/3 2. Accept variations in $\pi$ . eg $\frac{4}{3} \times 3.14 \times 10.5^3 = 4846.59 = 4850 \text{ cm}^3$ award 3/3 3. For the award • <sup>2</sup> the calculation must involve a fraction, $\pi$ and a power. eg $\pi \times 10.5^2 = 346.36... = 346 \text{ cm}^3$ award 1/3 <span style="color: red;">xx✓1</span>					
<b>Commonly Observed Responses:</b> 1. (a) $\frac{4}{3} \times \pi \times 21^3 [= 38792(.3...)] = 38800 \text{ cm}^3$ award 2/3 <span style="color: red;">x✓1✓1</span> (b) $\frac{4}{3} \times \pi \times 21^2 [= 1847.25...] = 1850 \text{ cm}^3$ award 2/3 <span style="color: red;">x✓1✓1</span> 2. $\frac{4}{3} \times \pi \times 10.5^2 [= 461.8(1...)] = 462 \text{ cm}^3$ award 2/3 <span style="color: red;">x✓1✓1</span> 3. (a) $\frac{4}{3} \times \pi \times 10.5^2 = 461.8(1...) = 461 \text{ cm}^3$ award 1/3 <span style="color: red;">x✓1x</span> (b) $\frac{4}{3} \times \pi \times 10.5^2 = 461 \text{ cm}^3$ award 0/3 <span style="color: red;">xxx</span> 4. (a) $\frac{4}{3} \times \pi \times 10.5^3 = 461.8(1...) = 462 \text{ cm}^3$ award 2/3 <span style="color: red;">✓xx✓1</span> (b) $\frac{4}{3} \times \pi \times 10.5^3 = 462 \text{ cm}^3$ award 1/3 <span style="color: red;">✓xx</span> 5. $\frac{4}{3} \times \pi \times 10.5 [= 43.98(2...)] = 44.0 \text{ cm}^3$ award 1/3 <span style="color: red;">xx✓1</span>					

Question			Generic scheme	Illustrative scheme	Max mark
3.			<ul style="list-style-type: none"> <li>•<sup>1</sup> correct method</li> <li>•<sup>2</sup> answer</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{6.1}{100} \times (3.27 \times 10^{-22})</math> or equivalent</li> <li>•<sup>2</sup> <math>1.99(47) \times 10^{-23}</math> (grams)</li> </ul>	2
<b>Notes:</b> <ol style="list-style-type: none"> <li>Correct answer without working. award 2/2</li> <li>For <math>2.0 \times 10^{-23}</math> or <math>2 \times 10^{-23}</math> (no working necessary). award 2/2</li> <li>For the award of •<sup>1</sup> accept <math>100\% = 3.27 \times 10^{-22} \rightarrow 1\% = \dots \rightarrow 6.1\% = \dots</math></li> <li>(a) <math>\left( \frac{6.1}{100} \times 3.27 = 0.19947 \rightarrow \right) 0.199(47) \times 10^{-22}</math> (no working necessary). award 1/2 ✓x</li> <li>(b) <math>\left( \frac{6.1}{100} \times 3.27 \times 10^{-22} \rightarrow \right) 1.99(47) \times 10^{-23}</math> (no working necessary). award 1/2 ✓x</li> <li>For a subsequent answer not expressed in scientific notation •<sup>2</sup> is not available. eg <math>\frac{6.1}{100} \times (3.27 \times 10^{-22}) \rightarrow 1.99(47) \times 10^{-23} \rightarrow 19.9(47) \times 10^{-24}</math> award 1/2 ✓x</li> </ol>					
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li><math>\frac{6.1}{100} \times (3.27 \times 10^{-22}) = 1.9 \times 10^{-23}</math> award 1/2 ✓x</li> <li><math>\frac{6.1}{100} \times (3.27 \times 10^{22}) = 1.99(47) \times 10^{21}</math> award 1/2 x✓1</li> <li><math>(3.27 \times 10^{-22}) \div 6.1 = 5.36 \dots \times 10^{-23}</math> award 1/2 x✓1</li> <li>(a) <math>(3.27 \times 10^{-22}) \div 6.1\% = 5.36 \dots \times 10^{-21}</math> award 1/2 x✓1</li> <li>(b) <math>(3.27 \times 10^{-22}) \div 6.1\% = 5.36 \dots \times 10^{-23}</math> award 0/2</li> <li><math>6.1 \times (3.27 \times 10^{-22}) = 1.99 \times 10^{-21}</math> award 1/2 x✓1</li> <li><math>0.61 \times (3.27 \times 10^{-22}) = 1.99 \times 10^{-22}</math> award 1/2 x✓1</li> <li><math>6.1 \div (3.27 \times 10^{-22}) = 1.87 \times 10^{22}</math> award 1/2 x✓1</li> <li><math>6.1\% \div (3.27 \times 10^{-22}) = 1.87 \times 10^{20}</math> award 1/2 x✓1</li> </ol>					



Question			Generic scheme	Illustrative scheme	Max mark
4.	(a)		<b>Method 1</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> calculate mean</li> <li>•<sup>2</sup> calculate <math>(x - \bar{x})^2</math></li> <li>•<sup>3</sup> substitute into formula</li> <li>•<sup>4</sup> calculate standard deviation</li> </ul> <b>Method 2</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> calculate mean</li> <li>•<sup>2</sup> calculate <math>\sum x</math> and <math>\sum x^2</math></li> <li>•<sup>3</sup> substitute into formula</li> <li>•<sup>4</sup> calculate standard deviation</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 98</li> <li>•<sup>2</sup> 25, 25, 1, 49, 100, 64, 36</li> <li>•<sup>3</sup> <math>\sqrt{\frac{300}{6}}</math></li> <li>•<sup>4</sup> 7.07(1...) or 7.1</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> 98</li> <li>•<sup>2</sup> 686, 67528</li> <li>•<sup>3</sup> <math>\sqrt{\frac{67528 - \frac{686^2}{7}}{6}}</math></li> <li>•<sup>4</sup> 7.07(1...) or 7.1</li> </ul>	4
<b>Notes:</b> <ol style="list-style-type: none"> <li>For 98 and 7.07(1...) without working. award 1/4 ✓✓✓x</li> <li>(a) For 98 and <math>\frac{\sqrt{300}}{6} = 7.1</math> award 4/4</li> <li>(b) For 98 and <math>\frac{\sqrt{300}}{6} = 2.89</math> award 3/4 ✓✓x✓1</li> <li>For the award of •<sup>4</sup> accept an answer in simplified surd form eg <math>5\sqrt{2}</math></li> <li>If one <math>x</math> value is missing from list, do not award •<sup>2</sup>; however, •<sup>3</sup> may be awarded for consistent substitution into standard deviation formula with: <ol style="list-style-type: none"> <li>5 in the denominator (from number of values on written list).</li> <li>6 in the denominator (from wording of the question).</li> </ol> </li> </ol>					
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li>98 and <math>\frac{300}{6} = 50</math> award 2/4 ✓✓xx</li> <li>98 and <math>\sqrt{\frac{300}{98-1}} = 1.75...</math> award 3/4 ✓✓x✓1</li> </ol>					

Question			Generic scheme	Illustrative scheme	Max mark
4.	(b)		<ul style="list-style-type: none"> <li>•<sup>5</sup> compare means</li> <li>•<sup>6</sup> compare standard deviations</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>5</sup> eg on average the weights of the rugby players in Scotland are lower.</li> <li>•<sup>6</sup> eg the weights of the rugby players in Scotland are more varied.</li> </ul>	2

#### Notes:

- Answers must be consistent with answer to part (a).
- If standard deviation answer to part (a) is left in surd form, •<sup>6</sup> can only be awarded if there is evidence that the comparison is based on two numbers in decimal format.
- Statements must involve reference to weights and Scotland or France:
  - Accept eg
    - on average the weights of Scottish players were lower.
    - on average the Scottish rugby team's **weights** are lighter.
  - Do not accept eg
    - on average the **players** in Scotland were lower.
    - on average the **results/scores/data** were lower.
    - the Scotland players' **results/scores/data** were less consistent.
    - on average the Scottish rugby **team** is lighter.
- For the award of •<sup>5</sup>
  - Accept eg
    - the weights of the players in Scotland averaged less.
    - the average weight was less for the Scottish players.
  - Do not accept eg
    - the players in Scotland weighed less.
    - on average the **mean** weights of the players in Scotland were less.
    - the **mean** weight was lower for the players in Scotland.
    - on average the weights of the players in France were better.
- For the award of •<sup>6</sup>
  - Accept eg
    - the weights of the players in Scotland were less consistent.
    - the weights of the players in Scotland were more spread out.
  - Do not accept eg
    - the Scotland players were more spread out.
    - the Scotland players were more varied.
    - the **standard deviation** of the weights of the players in Scotland were less consistent.
    - the **range** of the weights of the players in Scotland was more.
- Numbers are not required for •<sup>5</sup> and •<sup>6</sup> however, where they appear they must be consistent with the statement. For answers in parts (a) and (b) award as follows:
 

eg (i) (a) mean = 98 and sd = 7.07	award 4/4
(b) On average the weights of the rugby players in Scotland are lower as $5.9 < 7.07$	
The weights of the rugby players in Scotland are more varied as $98 < 105$	award 0/2
(ii) (a) mean = 98 and sd = 7.07	award 4/4
(b) On average the weights of the rugby players in Scotland are lower as $98 > 105$	
The weights of the rugby players in Scotland are more varied as $5.9 > 7.07$	award 0/2

#### Commonly Observed Responses:

Question			Generic scheme	Illustrative scheme	Max mark
5.			<ul style="list-style-type: none"> <li>•<sup>1</sup> correct bracket with square</li> <li>•<sup>2</sup> complete process consistently</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>(x+5)^2 \dots</math></li> <li>•<sup>2</sup> <math>(x+5)^2 - 6</math></li> </ul>	2
<b>Notes:</b> 1. Correct answer without working. award 2/2 2. Answer for • <sup>2</sup> must be consistent with • <sup>1</sup> . eg (a) $(x-5)^2 - 6$ award 1/2 <del>x</del> ✓1 (b) $(x \pm 10)^2 - 81$ award 1/2 <del>x</del> ✓1 (c) $(x \pm 10)^2 - 6$ award 0/2 <del>x</del> <del>x</del> 3. Do not penalise subsequent working [see general marking principle (l)].					
<b>Commonly Observed Responses:</b> No working necessary 1. (a) $(x+5)^2 + -6$ or $(x+5)^2 + (-6)$ award 2/2 (b) $(x+5)(x+5) - 6$ award 2/2 2. (a) $(x \pm 5) - 6$ award 1/2 <del>x</del> ✓1 (b) $(x^2 \pm 5) - 6$ award 1/2 <del>x</del> ✓1 (c) $(x^2 \pm 5)^2 - 6$ award 1/2 <del>x</del> ✓1 (d) $(x \pm 5x)^2 - 6$ award 1/2 <del>x</del> ✓1 (e) $(x^2 \pm 5x)^2 - 6$ award 1/2 <del>x</del> ✓1 3. $(x+5)^2 + 44$ award 1/2 ✓ <del>x</del>					

Question			Generic scheme	Illustrative scheme	Max mark
6.			<b>Method 1</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> appropriate fraction</li> <li>•<sup>2</sup> consistent substitution into area formula</li> <li>•<sup>3</sup> calculate sector area</li> </ul>	<b>Method 1</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{170}{360}</math></li> <li>•<sup>2</sup> <math>\frac{170}{360} \times \pi \times 15^2</math></li> <li>•<sup>3</sup> 333.79... (cm<sup>2</sup>)</li> </ul>	3
			<b>Method 2</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> appropriate fraction</li> <li>•<sup>2</sup> consistent substitution into area formula</li> <li>•<sup>3</sup> calculate sector area</li> </ul>	<b>Method 2</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{170}{360}</math></li> <li>•<sup>2</sup> <math>\frac{170}{360} = \frac{\text{area of sector}}{\pi \times 15^2}</math></li> <li>•<sup>3</sup> 333.79... (cm<sup>2</sup>)</li> </ul>	

**Notes:**

1. Correct answer without working.

award 0/3

2. For the award of •<sup>3</sup> accept 334.

3. Do not penalise variations in  $\pi$ .

eg  $\frac{170}{360} \times 3.14 \times 15^2 = 333.6(25)$

award 3/3

4. Premature rounding: rounded working must be to at least 2 significant figures.

eg (a)  $\frac{170}{360} \times \pi \times 15^2 = 0.47 \times \pi \times 15^2 = 332.22...$

award 3/3

(b)  $\frac{170}{360} \times \pi \times 15^2 = 0.5 \times \pi \times 15^2 = 353.42...$

award 2/3 ✓✓x

5. Accept  $\pi \times 15^2 - \frac{190}{360} \times \pi \times 15^2 = 333.79...$

award 3/3

6. For subsequent incorrect working, •<sup>3</sup> is not available.

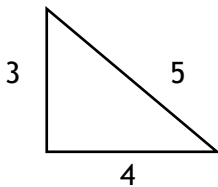
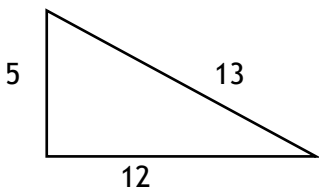
eg  $\pi \times 15^2 - \frac{170}{360} \times \pi \times 15^2 = 373(.06...)$

award 2/3 ✓✓x

Question			Generic scheme	Illustrative scheme	Max mark
6.			Continued.		
Commonly Observed Responses:					
1.	$\frac{170}{360}$	$\times \pi \times 30^2 = 1335.17 \dots$		award 2/3 ✓x✓1	
2.	$\frac{170}{360}$	$\times \pi \times 30 = 44.50 \dots$		award 2/3 ✓x✓1	
3.	$\frac{170}{360}$	$\times \pi \times 15 = 22.25 \dots$		award 2/3 ✓x✓1	
4.	$\frac{190}{360}$	$\times \pi \times 15^2 = 373.06 \dots$		award 2/3 x✓1✓1	
5.	$\frac{190}{360}$	$\times \pi \times 30 = 49.74 \dots$		award 1/3 xx✓1	
6.		$\pi \times 15^2 = 706.85 \dots$		award 0/3	

Question			Generic scheme	Illustrative scheme	Max mark
7.			<ul style="list-style-type: none"> <li>•<sup>1</sup> calculate the size of an interior angle of the pentagon or angle FAE</li> <li>•<sup>2</sup> calculate the size of angle FEA</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> 108 or FAE = 72</li> <li>•<sup>2</sup> 43</li> </ul>	2
<b>Notes:</b> <ol style="list-style-type: none"> <li>Correct answer without working. award 0/2</li> <li>Degree signs are not required.</li> <li>Full marks may be awarded for information marked on the diagram.</li> <li>Where FEA has been calculated incorrectly •<sup>2</sup> is only available where there is clear evidence that FEA has been calculated by using the interior angle or angle at centre of the pentagon and FEA is acute.</li> <li>Accept <b>clear</b> working outwith the diagram. The final answer must be <b>clearly</b> indicated.               <ol style="list-style-type: none"> <li><math>360 \div 5 = 72 \rightarrow 72 + 65 = 137 \rightarrow 180 - 137 = 43</math> award 2/2</li> <li>An answer of <math>360 \div 5 = 72</math> alone is not enough for the award of •<sup>1</sup>.</li> </ol> </li> <li>Where a candidate marks an answer on the diagram but then writes a different answer outwith the diagram, award marks for the angles indicated on the diagram.</li> <li>Disregard incorrect angles which are not on the valid pathway followed by the candidate.</li> <li>Accept 54 and 54 marked on one interior angle, or an isosceles triangle containing angle 72 at the centre and remaining two angles of 54 and 54, as evidence of •<sup>1</sup>.</li> <li> <ol style="list-style-type: none"> <li>Angle at centre = 60 <math>\rightarrow</math> FAE = 60 <math>\rightarrow</math> FEA = 55 award 1/2 x✓1</li> <li>Evidence of <math>720 \div 6 = 120</math> (incorrect assumption of hexagon) <math>\rightarrow</math> FAE = 60 <math>\rightarrow</math> FEA = 55 award 1/2 x✓1</li> <li><b>No</b> angle indicated at centre or <b>no</b> evidence of <math>720 \div 6 = 120</math> <math>\rightarrow</math> Interior angle = 60 + 60 <math>\rightarrow</math> FAE = 60 <math>\rightarrow</math> FEA = 55 award 0/2 xx</li> </ol> </li> </ol>					
<b>Commonly Observed Responses:</b> <ol style="list-style-type: none"> <li>FAE = 90 <math>\rightarrow</math> FEA = 25 award 0/2 xx</li> <li> <ol style="list-style-type: none"> <li>FAE = 65 <math>\rightarrow</math> FEA = 50 award 0/2 xx</li> <li>FAE = FEA = 57.5 award 0/2 xx</li> </ol> </li> </ol>					

Question			Generic scheme	Illustrative scheme	Max mark
8.	(a)		• <sup>1</sup> state coordinates	• <sup>1</sup> (4,3,12)	1
<b>Notes:</b> 1. Brackets must be shown. 2. If <b>coordinates</b> appear in (b) they must be clearly indicated as M, or used in the calculation of OM. 3. For $\begin{pmatrix} 4 \\ 3 \\ 12 \end{pmatrix}$ award 0/1					
<b>Commonly Observed Responses:</b>					
	(b)		• <sup>2</sup> start valid strategy  • <sup>3</sup> continue strategy  • <sup>4</sup> calculate length of space diagonal	• <sup>2</sup> $3^2 + 4^2$ or $3^2 + 12^2$ or $4^2 + 12^2$ (stated or implied by • <sup>3</sup> )  • <sup>3</sup> $3^2 + 4^2 + 12^2$  • <sup>4</sup> 13	3

Question			Generic scheme	Illustrative scheme	Max mark
8.	(b)		Continued.		
<b>Notes:</b> 1. Correct answer without working. award 0/3 2. Accept $\bullet^2 \begin{pmatrix} 4 \\ 3 \\ 12 \end{pmatrix} \rightarrow \bullet^3 3^2 + 4^2 + 12^2 \rightarrow \bullet^4 13$ award 3/3 3. Calculation must use the coordinate stated in (a) or 3, 4 and 12. 4. Where a candidate uses coordinates containing a zero stated in (a) then only $\bullet^2$ is available. eg $\sqrt{4^2 + 0^2 + 12^2} = 12.6$ award 1/3 ✓1xx 5. Premature rounding: rounded working must be to at least one decimal place. (a) $\sqrt{4^2 + 12^2} = 12.6... \rightarrow \sqrt{12.6^2 + 3^2} = 12.95...$ award 3/3 (b) $\sqrt{4^2 + 12^2} = 12.6... \rightarrow \sqrt{13^2 + 3^2} = 13.34...$ award 2/3 ✓✓x 6. Accept correct use of cosine rule. 7. Where a candidate demonstrates recognition of 3,4,5 triple, accept: (a)  Evidence may appear on the given diagram. (b) 5, since 3,4 5 is a Pythagorean triple. (c) $3^2 + 4^2 = 5^2$ . 8. Where a candidate demonstrates recognition of 5, 12, 13 triple, accept: (a)  Evidence may appear on the given diagram. (b) 13, since 5, 12, 13 is a Pythagorean triple. (c) $5^2 + 12^2 = 13^2$ . 9. For an invalid strategy involving the addition or subtraction of the lengths of two edges followed by a Pythagoras calculation. eg $4 + 3 = 7 \rightarrow \sqrt{7^2 + 12^2} = 13.89...$ award 0/3 10. Where a candidate uses four lengths, only $\bullet^2$ is available. eg (a) $\sqrt{3^2 + 4^2 + 12^2 + 5^2} (= 13.9)$ award 1/3 ✓xx (b) $\sqrt{3^2 + 4^2} + \sqrt{4^2 + 12^2} (= 17.6)$ award 1/3 ✓xx					
<b>Commonly Observed Responses:</b> 1. $\sqrt{4^2 + 3^2} = 5$ award 1/3 ✓xx 2. $\sqrt{4^2 + 12^2} = 12.6$ award 1/3 ✓xx 3. $\sqrt{3^2 + 12^2} = 12.36...$ award 1/3 ✓xx					



Question			Generic scheme	Illustrative scheme	Max mark
9.			<b>Method 1</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> add <math>3c</math></li> <li>•<sup>2</sup> multiply by 4</li> <li>•<sup>3</sup> divide by <math>c^2</math></li> </ul> <b>Method 2</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> multiply by 4</li> <li>•<sup>2</sup> add <math>12c</math></li> <li>•<sup>3</sup> divide by <math>c^2</math></li> </ul>	<b>Method 1</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>B + 3c = \frac{1}{4}kc^2</math></li> <li>•<sup>2</sup> <math>4(B + 3c) = kc^2</math></li> <li>•<sup>3</sup> <math>k = \frac{4(B + 3c)}{c^2}</math> or equivalent</li> </ul> <b>Method 2</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>4B = kc^2 - 12c</math></li> <li>•<sup>2</sup> <math>4(B + 3c) = kc^2</math></li> <li>•<sup>3</sup> <math>k = \frac{4B + 12c}{c^2}</math> or equivalent</li> </ul>	3

**Notes:**

1. For correct answer without working.
2. For subsequent incorrect working, •<sup>3</sup> is not available.
3. For the award of •<sup>3</sup>:

award 0/3

(a) accept  $k = \frac{4B}{c^2} + \frac{12}{c}$

(b) do not accept  $k = \frac{4B}{c^2} + \frac{12c}{c^2}$

**Commonly Observed Responses:**

1.  $B + 3c = \frac{1}{4}kc^2 \rightarrow 4 \times (B + 3c) = kc^2 \rightarrow \frac{4 \times (B + 3c)}{c^2} = k$

award 3/3 ✓✓✓

2.  $B + 3c = \frac{1}{4}kc^2 \rightarrow 4(B + 3c) = kc^2 \rightarrow \sqrt{4(B + 3c)} = kc \rightarrow \frac{\sqrt{4(B + 3c)}}{c} = k$

award 2/3 ✓✓×

3.  $4B = kc^2 - 3c \rightarrow 4B + 3c = kc^2 \rightarrow \frac{4B + 3c}{c^2} = k$

award 2/3 ×✓1✓1

4.  $B + 3c = \frac{1}{4}kc^2 \rightarrow 4B + 3c = kc^2 \rightarrow \frac{4B + 3c}{c^2} = k$

award 2/3 ✓×✓1

5.  $B + 3c = \frac{1}{4}kc^2 \rightarrow \frac{B + 3c}{\frac{1}{4}c^2} = k$

award 2/3 ✓×✓

6.  $4B = kc^2 - 12c \rightarrow 4B + 12c = kc^2 \rightarrow \frac{4B + 12c}{c^2} = k \rightarrow \frac{4B + 12}{c} = k$

award 2/3 ✓✓×

7. (a)  $B + 3c = \frac{1}{4}kc^2 \rightarrow \frac{B + 3c}{c^2} = \frac{1}{4}k \rightarrow 4 \frac{B + 3c}{c^2} = k$

award 3/3 ✓✓✓

(b)  $B + 3c = \frac{1}{4}kc^2 \rightarrow \frac{B + 3c}{c^2} = \frac{1}{4}k \rightarrow \frac{4B + 3c}{c^2} = k$

award 2/3 ✓✓×

8.  $B = \frac{1}{4}kc^2 \rightarrow 4B = kc^2 \rightarrow \frac{4B}{c^2} = k$

award 0/3 ×××

Question			Generic Scheme	Illustrative Scheme	Max mark
10.	(a)		• <sup>1</sup> construct equation	• <sup>1</sup> $7p + 3e = 2400$	1
<b>Notes:</b> 1. • <sup>1</sup> is not available where a candidate uses alternative variables. 2. Accept $7p + 3e = 2400$ kg. 3. Answer may appear in (c).					
<b>Commonly Observed Responses:</b>					
	(b)		• <sup>2</sup> construct equation	• <sup>2</sup> $3p + 4e = 1300$	1
<b>Notes:</b> 1. Accept use of consistent alternative variables from (a). 2. Accept $3p + 4e = 1300$ kg. 3. Answer may appear in (c).					
<b>Commonly Observed Responses:</b>					
	(c)		• <sup>3</sup> correct scaling      • <sup>4</sup> value for $p$ or $e$ • <sup>5</sup> value for $e$ or $p$ • <sup>6</sup> consistent calculation	• <sup>3</sup> eg $28p + 12e = 9600$ $9p + 12e = 3900$  <b>OR</b>  $21p + 9e = 7200$ $21p + 28e = 9100$  • <sup>4</sup> $p = 300$ or $e = 100$ • <sup>5</sup> $e = 100$ or $p = 300$  • <sup>6</sup> 2300 (kg)	4
<b>Notes:</b> 1. Correct answer without working. award 0/4 2. For a solution obtained by repeated substitution. award 0/4 3. • <sup>6</sup> is not available where either $p$ or $e$ is negative. 4. Alternative method for • <sup>5</sup> : $e = 100 \rightarrow 3p + 4e = 1300 \rightarrow 3p = 900$ .					
<b>Commonly Observed Responses:</b>					

Question			Generic scheme	Illustrative scheme	Max mark
11.			<p><b>Method 1</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> find linear scale factor</li> <li>•<sup>2</sup> multiply area by square of linear scale factor</li> <li>•<sup>3</sup> find area of large wing (calculation must include a power of a linear scale factor)</li> </ul> <p><b>Method 2</b></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> find linear scale factor</li> <li>•<sup>2</sup> divide area by square of linear scale factor</li> <li>•<sup>3</sup> find area of large wing (calculation must include a power of a linear scale factor)</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{31.5}{14} (= 2.25)</math></li> <li>•<sup>2</sup> <math>\left(\frac{31.5}{14}\right)^2 \times 24</math></li> <li>•<sup>3</sup> 121.5 (cm<sup>2</sup>)</li> </ul> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{14}{31.5} (= 0.444...)</math></li> <li>•<sup>2</sup> <math>24 \div \left(\frac{14}{31.5}\right)^2</math></li> <li>•<sup>3</sup> 121.5 (cm<sup>2</sup>)</li> </ul>	3
<p><b>Notes:</b></p> <p>1. Correct answer without working award 0/3</p> <p>2. •<sup>3</sup> is not available where there is invalid subsequent working eg <math>338 - 32 = 306</math> (cm<sup>2</sup>) award 2/3 ✓✓x</p> <p>3. •<sup>3</sup> is not available if a linear or area scale factor has been rounded eg <math>\left(\frac{31.5}{14}\right)^2 \times 24 \rightarrow 5.1 \times 24 = 122.4</math> award 2/3 ✓✓x</p>					
<p><b>Commonly Observed Responses:</b></p> <p>1. <math>\left(\frac{31.5}{14}\right) \times 24 = 54</math> award 1/3 ✓xx</p> <p>2. <math>\left(\frac{31.5}{14}\right)^3 \times 24 = 273.375</math> award 2/3 ✓x✓1</p> <p>3. <math>\left(\frac{31.5}{14}\right) \times 24^2 = 1296</math> award 1/3 ✓xx</p> <p>4. <math>\left(\frac{14}{31.5}\right)^2 \times 24 = 4.74(0...)</math> award 2/3 ✓x✓1</p> <p>5. (a) <math>\left(\frac{31.5}{14}\right)^2 \times 24 = 121.5 = 122</math> award 3/3</p> <p>(b) <math>\left(\frac{31.5}{14}\right)^2 \times 24 = 122</math> award 2/3 ✓✓x</p>					

Question			Generic scheme	Illustrative scheme	Max mark
12.			<ul style="list-style-type: none"> <li>•<sup>1</sup> correct substitution into the sine rule</li> <li>•<sup>2</sup> rearrange equation</li> <li>•<sup>3</sup> calculate angle ACB</li> <li>•<sup>4</sup> calculate bearing</li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\frac{\sin C}{250} = \frac{\sin 41}{200}</math></li> <li>OR</li> <li><math>\frac{250}{\sin C} = \frac{200}{\sin 41}</math></li> <li>•<sup>2</sup> <math>\sin C = \frac{250 \times \sin 41}{200} (= 0.820\dots)</math></li> <li>•<sup>3</sup> <math>55(.09\dots)</math></li> <li>•<sup>4</sup> 186</li> </ul>	4

#### Notes:

1. For a correct answer without working. award 0/4
2. For answer obtained by guess and check. award 0/4
3. Degree signs are not required.
4. •<sup>4</sup> is only available where trigonometry has been used to find angle ACB.
5. •<sup>4</sup> is not available where a candidate uses 131 in the calculation.

eg (a)  $\frac{250}{\sin C} = \frac{200}{\sin 131} \rightarrow \sin C = \frac{250 \times \sin 131}{200} \rightarrow C = 71 (\rightarrow B = 68) \rightarrow \text{bearing} = 202$  award 2/4 x✓1✓1x

(b)  $\frac{250}{\sin 131} = \frac{200}{\sin C} \rightarrow \sin C = \frac{200 \times \sin 131}{250} \rightarrow C = 37 (\rightarrow B = 12) \rightarrow \text{bearing} = 258$  award 2/4 x✓1✓1x

6. Disregard premature rounding provided that angle ACB can be rounded to 55.

eg (a)  $\sin C = \frac{250 \times 0.656}{200} = 0.82 \rightarrow C = 55.08\dots \rightarrow \text{bearing} = 186$  award 4/4

(b)  $\sin C = \frac{250 \times 0.66}{200} = 0.825 \rightarrow C = 55.58\dots \rightarrow \text{bearing} = 187$  award 3/4 ✓✓x✓1

7. Inappropriate use of GRAD or RAD should only be penalised once in either Q12 or Q14.

(a)  $\sin C = 0.7505\dots \rightarrow C = 54.0398\dots (\rightarrow B = 85) \rightarrow \text{bearing} = 185$  (GRAD).

(b)  $\sin C = -0.1982\dots \rightarrow C = -0.1996\dots (\rightarrow B = 139) \rightarrow \text{bearing} = 131$  (RAD).

(but in this case •<sup>4</sup> is unavailable since angle ACB < 0).

8. Where a candidate has started with:

(a) the cosine rule.

(b) Pythagoras' theorem.

(c) invalid right angled trigonometry.

award 0/4

(Take  $\sin 90$  in a sine rule calculation as evidence of invalid use of right angled trigonometry)

9. Accept bearings with decimal places.

#### Commonly Observed Responses:

1.  $\frac{250}{\sin C} = \frac{200}{\sin 41} \rightarrow \sin C = \frac{200 \times \sin 41}{250} \rightarrow C = 32 (\rightarrow B = 107) \rightarrow \text{bearing} = 163$  award 3/4 ✓x✓1✓1

Question			Generic scheme	Illustrative scheme	Max mark
13.			<ul style="list-style-type: none"> <li>•<sup>1</sup> eliminate denominators</li> <li>•<sup>2</sup> rearrange into the form <math>ax = b</math></li> <li>•<sup>3</sup> solve for <math>x</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>3(5x+1) = 8x+6</math> or equivalent</li> <li>•<sup>2</sup> <math>7x = 3</math></li> <li>•<sup>3</sup> <math>x = \frac{3}{7}</math></li> </ul>	3

**Notes:**

- Correct answer without working. award 0/3
- For repeated substitution. award 0/3
- For the award of •<sup>1</sup>.
  - accept  $\frac{15x+3}{6} = \frac{8x}{6} + 1 \rightarrow 15x+3 = 8x+6$
  - do not accept  $\frac{15x+3}{6} = \frac{8x}{6} + 1$  alone.
- <sup>3</sup> is not available for division by a single digit leading to an integer answer.
- Do not award •<sup>3</sup> for a decimal approximation of  $\frac{3}{7}$ , but do not penalise incorrect conversion to a mixed number or decimal approximation following an answer of  $\frac{3}{7}$ .
  - $3(5x+1) = 8x+6 \rightarrow 7x = 3 \rightarrow x = \frac{3}{7} \rightarrow 0.428\dots$  award 3/3
  - $3(5x+1) = 8x+6 \rightarrow 7x = 3 \rightarrow 0.428\dots$  award 2/3 ✓✓✗
- For subsequent incorrect working •<sup>3</sup> is not available.

**Commonly Observed Responses:**

- $15x+3 = 8x+1 \rightarrow 7x = -2 \rightarrow x = -\frac{2}{7}$  award 2/3 ✗✓1✓1
- $15x+3 = 8x+2 \rightarrow 7x = -1 \rightarrow x = -\frac{1}{7}$  award 2/3 ✗✓1✓1
- $\frac{15x+3}{6} = \frac{8x}{6} + 2 \rightarrow 15x+3 = 8x+12 \rightarrow 7x = 9 \rightarrow x = \frac{9}{7}$  award 2/3 ✗✓1✓1
- $\frac{5x+1}{2} = \frac{4x}{3} \rightarrow 15x+3 = 8x \rightarrow 7x = -3 \rightarrow x = -\frac{3}{7}$  award 2/3 ✗✓1✓1

Question			Generic scheme	Illustrative scheme	Max mark
14.			<ul style="list-style-type: none"> <li>•<sup>1</sup> substitute <math>h = 13</math> into formula</li> <li>•<sup>2</sup> rearrange equation</li> <li>•<sup>3</sup> calculate one value of <math>x</math></li> <li>•<sup>4</sup> calculate 2<sup>nd</sup> value of <math>x</math></li> </ul>	<ul style="list-style-type: none"> <li>•<sup>1</sup> <math>13 = 10 - 8 \cos x</math></li> <li>•<sup>2</sup> <math>\cos x = -\frac{3}{8}</math></li> <li>•<sup>3</sup> <math>112(.024...)</math></li> <li>•<sup>4</sup> <math>247.97... \text{ or } 248</math></li> </ul>	4

**Notes:**

1. Correct answers (a) without working. award 1/4 <sup>^^^</sup>✓  
(b) by repeated substitution. award 1/4 <sup>^^^</sup>✓
2. Do not penalise omission of degrees sign.
3. •<sup>3</sup> and •<sup>4</sup> are only available where angles are obtained using a valid trigonometric calculation with  $-1 < \cos x < 1$ .
4. If  $\cos x < 0$  then •<sup>3</sup> and •<sup>4</sup> are only available for consistent 2<sup>nd</sup> and 3<sup>rd</sup> quadrant angles.  
eg  $13 = 10 - 8 \cos x \rightarrow \cos x = -\frac{3}{8} \rightarrow$  (a) 68, 112 award 3/4 ✓✓✓x  
(b) 68, 248 award 3/4 ✓✓✓x  
(c) 68, 292 award 2/4 ✓✓xx
5. If  $\cos x > 0$  then •<sup>3</sup> is not available (working eased) but •<sup>4</sup> is available for consistent 4th quadrant Angle.  
eg  $13 = 10 - 8 \cos x \rightarrow \cos x = \frac{3}{8} \rightarrow$  (a) 68, 112 award 1/4 ✓xxx  
(b) 68, 248 award 1/4 ✓xxx  
(c) 68, 292 award 2/4 ✓xx✓1
6. If 68 is **clearly** included as one of the final answers, then award marks as follows:  
eg  $\cos x = -\frac{3}{8} \rightarrow$  (a) 68, 112, 248 award 3/4 ✓✓✓x  
(b) 68, 112, 292 award 2/4 ✓✓xx  
(c) 68, 112, 248, 292 award 2/4 ✓✓xx
7. Inappropriate use of RAD or GRAD should only be penalised once in Q12 or Q14.  
(a)  $1.186... \rightarrow 178.813..., 181.186... \text{ (RAD)}.$   
(b)  $75.528... \rightarrow 104.471..., 255.528... \text{ (GRAD)}.$

**Commonly Observed Responses:**

1. (a)  $13 = 10 - 8 \cos x \rightarrow \cos x = \frac{3}{8} \rightarrow 112, 292$  award 2/4 ✓xxx✓1  
(b)  $13 = 10 - 8 \cos x \rightarrow \cos x = \frac{3}{8} \rightarrow 248, 292$  award 2/4 ✓xxx✓1

Question			Generic scheme	Illustrative scheme	Max mark
15.			<p>•<sup>1</sup> express <math>\overrightarrow{GF}</math> as a vector journey</p> <p>•<sup>2</sup> express <math>\overrightarrow{GF}</math> in simplest form</p>	<p>•<sup>1</sup> eg <math>\overrightarrow{GE} + \frac{1}{3}\overrightarrow{DE}</math> or <math>\overrightarrow{GD} + \overrightarrow{DE} + \frac{1}{3}\overrightarrow{DE}</math></p> <p>OR</p> <p><math>\mathbf{s} + \frac{1}{3}(\mathbf{r} + \mathbf{s})</math></p> <p>OR</p> <p><math>-\mathbf{r} + (\mathbf{r} + \mathbf{s}) + \frac{1}{3}(\mathbf{r} + \mathbf{s})</math></p> <p>•<sup>2</sup> <math>\frac{4}{3}\mathbf{s} + \frac{1}{3}\mathbf{r}</math></p>	2
<p><b>Notes:</b></p> <p>1. Correct answer without working. award 0/2</p> <p>2. <math>\overrightarrow{GE} + \overrightarrow{EF}</math> or <math>\overrightarrow{GD} + \overrightarrow{DF}</math> or <math>\overrightarrow{GD} + \overrightarrow{DE} + \overrightarrow{EF}</math> or <math>\overrightarrow{GD} + 3\overrightarrow{EF} + \overrightarrow{EF}</math> is not enough for the award of •<sup>1</sup>.</p> <p>3. For the award of •<sup>2</sup>, the resultant vector must include fractional vectors in both <math>\mathbf{r}</math> and <math>\mathbf{s}</math>.</p> <p>(a) <math>\mathbf{r} + \frac{1}{3}\mathbf{r} + \frac{1}{3}\mathbf{s} = \frac{4}{3}\mathbf{r} + \frac{1}{3}\mathbf{s}</math> award 1/2 x✓1</p> <p>(b) <math>\mathbf{s} + \frac{1}{3}\mathbf{r} + \mathbf{s} = 2\mathbf{s} + \frac{1}{3}\mathbf{r}</math> award 0/2</p> <p><b>Commonly Observed Responses:</b></p> <p>1. <math>1\frac{1}{3}\mathbf{s} + \frac{1}{3}\mathbf{r}</math> award 2/2</p> <p>2. <math>\mathbf{s} + \frac{1}{3}\overrightarrow{DE}</math> award 1/2 ✓x</p> <p>3. <math>\mathbf{s} + \overrightarrow{EF}</math> award 0/2</p>					

[END OF MARKING INSTRUCTIONS]