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National Qualifications SPECIMEN ONLY

Mark

S844/75/02

Applications of Mathematics Paper 2

Date — Not applicable

Duration — 1 hour 40 minutes

* S 8 4 4 7 5 0 2 *

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day | Month | Year

Scottish candidate number

Total marks — 55

Attempt ALL questions.

You may use a calculator.

To earn full marks you must show your working in your answers.

State the units for your answer where appropriate.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

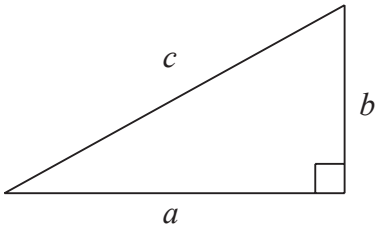
* S 8 4 4 7 5 0 2 0 1 *

FORMULAE LIST

Circumference of a circle $C = \pi d$

Area of a circle $A = \pi r^2$

Theorem of Pythagoras



$a^2 + b^2 = c^2$

Volume of a cylinder $V = \pi r^2 h$

Volume of a prism $V = Ah$

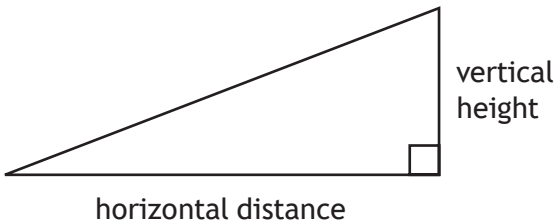
Volume of a cone $V = \frac{1}{3}\pi r^2 h$

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

Standard deviation $s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$

or $s = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n - 1}}$, where n is the sample size.

Gradient



$$\text{gradient} = \frac{\text{vertical height}}{\text{horizontal distance}}$$

Total marks — 55

Attempt ALL questions

1. Jack bought a car 3 years ago costing £1400.
The car has decreased in value by 13% each year.

(a) Calculate the current value of the car.
Give your answer to **2 significant figures**. **4**

Jack sells his car for £950.

(b) Calculate his loss as a percentage of the **original price**. **2**

2. The prices of lambs sold in September was recorded.

A sample of the prices, in pounds, is shown.

72 75 73 68 65 70

(a) For these prices, calculate:

(i) the mean **1**

(ii) the standard deviation. **3**

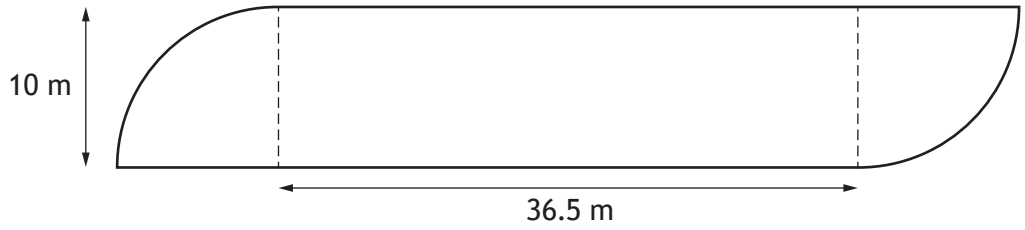
The price of lambs sold in August was also recorded.

The mean price was £70.20 and the standard deviation was £3.85.

(b) Make two valid comparisons about the prices of lambs in August and September. **2**

3. A hotel is having a swimming pool built.

It is in the shape of a rectangle and two quarter circles as shown below.



The swimming pool will have a safety rail fitted around its edge.

- There will be two 125 cm wide gaps to allow access to the pool.
- Safety rail is sold in 3 metre lengths.
- Each 3 metre length costs £11.49.

Calculate the minimum cost of the safety rail for the pool. **5**

4. Finlay travelled from his home to work, 23.1 miles away.

His average speed was 42 mph.

He left his home at 08:12.

(a) Calculate what time he arrived at work. **2**

At the weekend, Finlay plans to make a **return** journey from his home to the shopping centre.

He knows:

- the shopping centre is 26 miles away
- his car will cover an average of 67 km per gallon of fuel
- the car has 5 litres of fuel in its tank.

(b) Determine if Finlay will have enough fuel to complete this **return** journey.

1 mile = 1.609 km

1 gallon = 4.545 litres **4**

5. David is writing his new book.

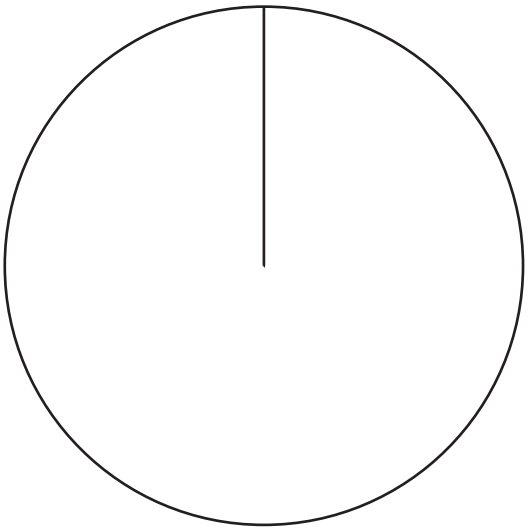
He spends:

- 210 hours on research
- 96 hours in meetings
- 234 hours writing the book.

(a) Construct a pie chart to illustrate this information. **3**

(An additional diagram, if required, can be found on *page 18*.)

Time spent on each task



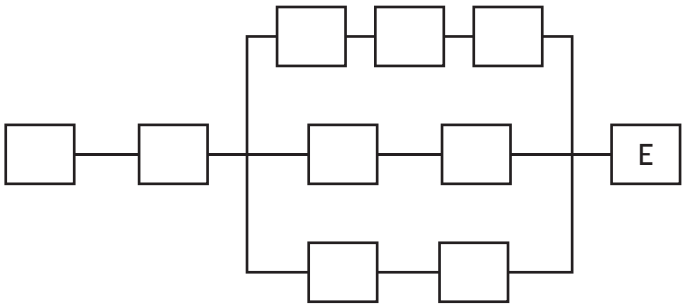
5. (continued)

The publishing company produced the following table to show all the tasks involved in publishing the book.

Activity	Description	Preceding task
A	illustrate cover	H
B	write 1st draft	C
C	research ideas	none
D	edit book	B
E	publish book	A,J,G
F	re-work	D
G	proof read	F
H	choose title	B
I	copyright	B
J	ISBN	I

(b) Complete the diagram below to show the tasks. **2**

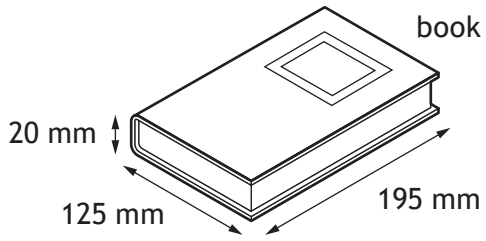
(An additional diagram, if required, can be found on *page 18*.)

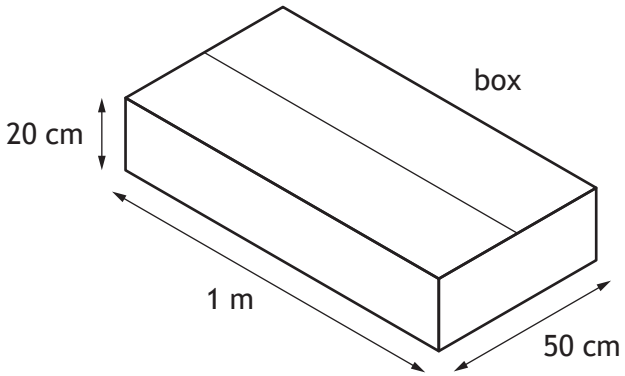


5. (continued)

The books are to be packed in boxes for transporting to the bookshops.

The dimensions of the book and the internal dimensions of the box are shown in the diagrams.





The books need to be laid with the front cover facing upwards in the boxes.

They must all be aligned in the same direction.

(c) Calculate the maximum number of books that can be packed into each box. **3**

5. (continued)

This is the fourth book that David has written in this series of books.

The cost of each book is shown in the table.

Book	Cost	Year published
1	£5.50	2013
2	£8.50	2015
3	£4.00	2016
4	£12.00	2019

The following special offers are available to buy all four books.

(d) Determine which shop offers the best deal for buying all four books.
Use your working to justify your answer. **3**

6. A local primary school is having a summer event.

They plan to make shortbread to sell at the event.

- They make 10 trays of shortbread.
- Each tray contains 24 slices of shortbread.
- The total cost to make 10 trays of shortbread is £38.20.

The school want to make a profit of at least £20 from the sale of this shortbread.

(a) Calculate the minimum price that the school should charge for one slice of shortbread. **2**

6. (continued)

The local orienteering club set up a course at the event.

- Participants leave the start point and run on a bearing of 055° for 140 m to flag A.
- They then run on a bearing of 170° for 252 m to flag B.

(b) (i) Construct a scale drawing to illustrate the route. **3**

Use a scale of 1 cm : 40 m

(An additional diagram, if required, can be found on *page 19*.)

(ii) The pupils then return to the start point.

Use the scale drawing to determine the bearing and distance of the start point from flag B. **2**

6. (continued)

Two of the games at the event are a lucky dip and a dice game.

The lucky dip has tickets numbered 1 to 150.
To win a prize the ticket needs to end in a zero or a five.

The dice game involves rolling two dice at the same time.
To win a prize a total of **9 or more** is needed.

(c) Determine which game has the higher probability of a prize being won. **4**

7. Jamel keeps fish.

To make tap water safe for fish, a conditioner is added.

The volume of conditioner required is directly proportional to the volume of tap water.

5 ml of conditioner must be used for every 20 000 ml of tap water.

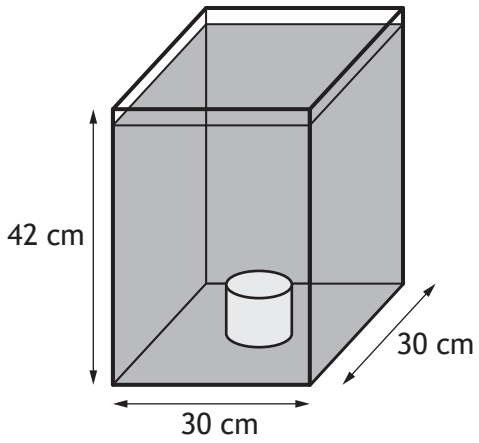
(a) Calculate the volume of conditioner required for 14 litres of tap water. **2**

7. (continued)

Jamel has a fish tank.

The fish tank is a cuboid with dimensions 30 cm by 30 cm by 42 cm.

The tank has a cylindrical light box at the bottom as shown.



The cylindrical light box has a diameter of 10 cm and a height of 8 cm.

There is a **2 cm gap** between the top of the tank and the water level.

The light box **does not** hold any water.

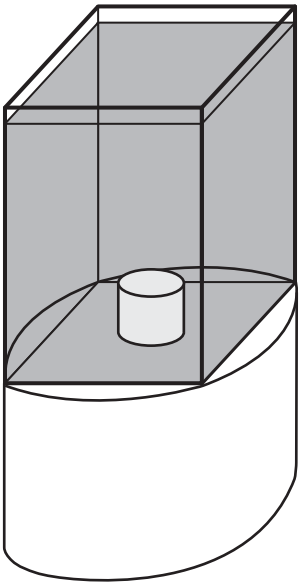
(b) Calculate the volume of water in the tank. **4**

7. (continued)

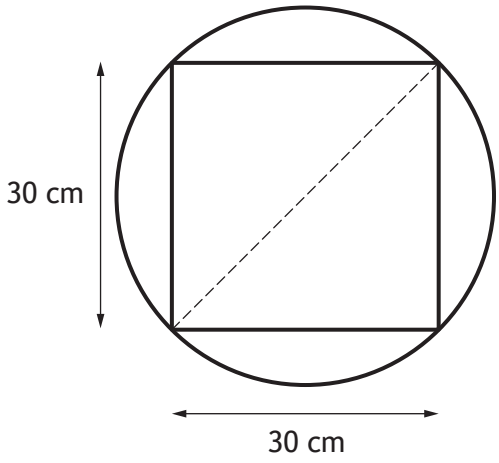
Jamel bought a stand for this fish tank.

The top of the stand is circular.

The corners of the square base of the tank touch the edge of the circle as shown.



The diameter of the circle is shown by the dotted line in the aerial view.



aerial view

7. (continued)

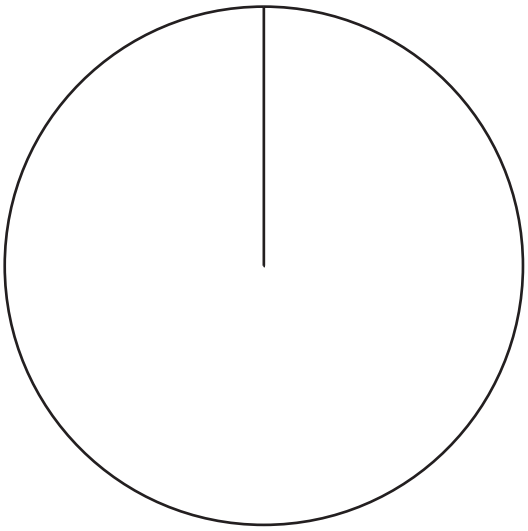
(c) Calculate the area of the top of the stand.
Give your answer in **square metres**. **4**

[END OF SPECIMEN QUESTION PAPER]

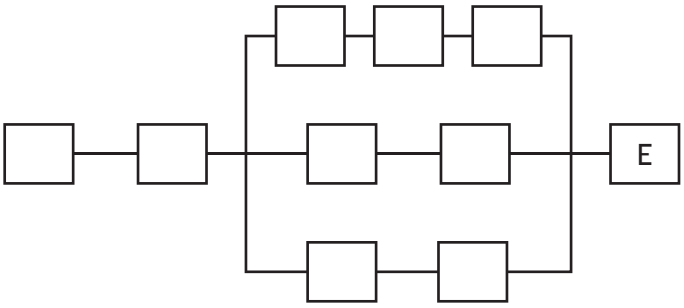
ADDITIONAL SPACE FOR ANSWERS

Additional diagram for use with question 5 (a)

Time spent on each task



Additional diagram for use with question 5 (b)



ADDITIONAL SPACE FOR ANSWERS

Additional diagram for use with question 6 (b) (i)

National
Qualifications
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S844/75/02

Applications of Mathematics
Paper 2

Marking Instructions

These marking instructions have been provided to show how SQA would mark this specimen question paper.

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General marking principles for National 5 Applications of 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.

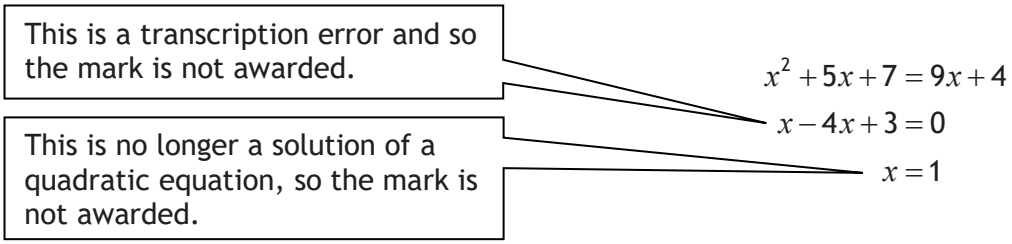
(d) If a candidate's response contains an error, all working subsequent to this error must still be marked. Only award marks if the level of difficulty in their working is similar to the level of difficulty in the illustrative scheme.

(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.

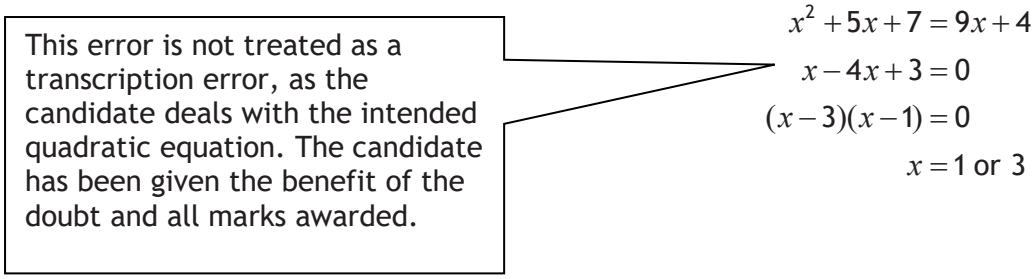
(f) Candidates may use any mathematically correct method to answer questions, except in cases where a particular method is specified or excluded.

(g) If an error is trivial, casual or insignificant, for example 6 x 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



The following example is an exception to the above



(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:

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

Horizontal: $\bullet^5$ $x=2$ and $x=-4$ Vertical: $\bullet^5$ $x=2$ and $y=5$
$\bullet^6$ $y=5$ and $y=-7$ $\bullet^6$ $x=-4$ and $y=-7$

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 $1\frac{1}{4}$ $\frac{43}{1}$ must be simplified to 43

$\frac{15}{0.3}$ must be simplified to 50 $\frac{4/5}{3}$ must be simplified to $\frac{4}{15}$

$\sqrt{64}$ must be simplified to 8*

*The square root of perfect squares up to and including 144 must be known.

(k) 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

(l) 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.

(m) 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.

(n) 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.

(o) 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:

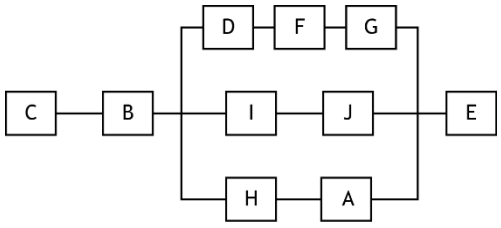
Strategy 1 attempt 1 is worth 3 marks.	Strategy 2 attempt 1 is worth 1 mark.
Strategy 1 attempt 2 is worth 4 marks.	Strategy 2 attempt 2 is worth 5 marks.
From the attempts using strategy 1, the resultant mark would be 3.	From the attempts using strategy 2, the resultant mark would be 1.

In this case, award 3 marks.

Marking Instructions for each question

Question			Generic scheme	Illustrative scheme	Max mark
1.	(a)		•[1] Strategy: identify multiplier •[2] Strategy: identify power •[3] Process: calculate value •[4] Communication: round to 2 significant figures	•[1] 0.87 •[2] …[3] •[3] 921.90(42) •[4] 920	**4**
	(b)		•[5] Strategy: know how to calculate percentage loss •[6] Process: calculate percentage	•[5] $\frac{450}{1400}\times 100$ •[6] 32(.1…)	**2**
			Alternative Strategy •[5] Strategy: know to use trial and improvement •[6] Process: calculate percentage	 •[5] evidence •[6] 32	**2**
2.	(a)	(i)	•[1] Process: calculate mean	•[1] 70.5	**1**
		(ii)	•[2] Process: calculate $(x-\bar{x})^2$ •[3] Strategy/process: calculate $\sum(x-\bar{x})^2$ and substitute into formula •[4] Process: calculate standard deviation	•[2] 2.25, 20.25, 6.25, 6.25, 30.25, 0.25 •[3] $\sqrt{\frac{65.5}{6-1}}$ •[4] 3.62	**3**
			Alternative Strategy •[2] Process: calculate $\sum x$ and $\sum x^2$ •[3] Strategy/process: substitute into formula •[4] Process: calculate standard deviation	 •[2] 423, 29887 •[3] $\sqrt{\frac{29887-\frac{423^2}{6}}{6-1}}$ •[4] 3.62	**3**
	(b)		•[5] Communication: comment regarding mean •[6] Communication: comment regarding standard deviation	•[5] eg on average prices in August were cheaper. •[6] eg prices in August were less consistent	**2**

Question			Generic scheme	Illustrative scheme	Max mark
3.			•[1] Strategy: know how to find arc length of quarter or semi-circle •[2] Process: calculate curved edge of one quarter circle or semi-circle •[3] Process: calculate perimeter of swimming pool •[4] Strategy: know how to calculate number of lengths •[5] Process: calculate number of lengths, appropriate rounding and calculate cost	•[1] $\frac{20\pi}{4}$ or $\frac{20\pi}{2}$ •[2] 15.7... or 31.4... •[3] $2\times15.7...+2\times10+2\times36.5=124.4...$ •[4] $(...-2\times1.25)\div3$ •[5] 40.6 leading to $41\times11.49=471.09$	**5**
4.	(a)		•[1] Process: calculate time in hours •[2] Process/communication: calculate the time of arrival	•[1] 0.55 •[2] 08:12 + 33 mins = 08:45	**2**
	(b)		•[3] Strategy/process: convert litres to gallons •[4] Strategy/process: •[5] Strategy/process: convert km to miles •[6] Communication: state conclusion consistent with working	•[3] $5\div4.545=1.1...$ •[4] $1.1...\times67=73.7...$ •[5] $73.7\div1.609=45.8...$ •[6] No, since $45.8<52$	**4**

Question			Generic scheme	Illustrative scheme	Max mark
5.	(a)		•[1] Process: calculate total number of hours •[2] Process: calculate angles •[3] Communication: draw and label pie chart consistent with previous working	•[1] 210 + 96 + 234 = 540 •[2] 210 hours research: $\frac{210}{540} \times 360 = 140$ 96 hours meetings: $\frac{96}{540} \times 360 = 64$ 234 hours writing: $\frac{234}{540} \times 360 = 156$ •[3] diagram consistent with working	**3**
Notes: 1. •[1] and •[2] can be implied in subsequent working 2. •[3] is available if any 2 angles are within tolerance $\pm 1°$ leading to third angle being outwith tolerance 3. •[3] is not available if the three calculated angles do not add to $360°$					
	(b)		•[4] Communication: any 5 in correct sequence •[5] Communication: remaining 4 in correct sequence		**2**
	(c)		•[6] Strategy: know to and starts to calculate the correct two ways of packing •[7] Process: calculate number of boxes for one arrangement •[8] Process/communication: calculate the second arrangement and state maximum number of books	•[6] evidence of the two **correct** ways of packing with the front cover facing upwards $100 \div 12.5 = 8$ •[7,8] $50 \div 19.5 = 2.56...$ $20 \div 2 = 10$ $2 \times 8 \times 10 = 160$ and $100 \div 19.5 = 5.12...$ $50 \div 12.5 = 4$ $20 \div 2 = 10$ $5 \times 4 \times 10 = 200$ Maximum - 200 books	**3**

Question			Generic scheme	Illustrative scheme	Max mark
5.	(d)		•[9] Process: calculate cost of shop A •[10] Process: calculate cost of shop C •[11] Communication: conclusion consistent with working	•[9] 24 •[10] 22 •[11] Shop C	**3**
			Alternative Strategy •[9] Process: calculate discount for 1 shop •[10] Process: calculate discount for other two shops •[11] Communication: conclusion consistent with working	•[9] 6 or 7.01 or 8 •[10] remaining two •[11] Shop C	
6.	(a)		•[1] Strategy: know how to calculate minimum price •[2] Process: calculations completed with appropriate rounding	•[1] Evidence •[2] $(38.20+20)\div(24\times10)=0.2425$ leading to 0.25	**2**
	(b)	(i)	•[3] Process: calculate scale distances •[4] Process/communication: correct bearing measured and correct length drawn •[5] Process/communication: correct bearing measured and correct length drawn	•[3] $140\div40=3.5\text{cm}$ $252\div40=6.3\text{cm}$ •[4] Bearing of $055^\circ(\pm1^\circ)$ measured correctly and 3.5 cm(±0.1 cm) correctly drawn •[5] Bearing of $170^\circ(\pm1)$ measured correctly and 6.3 cm(±0.1 cm) correctly drawn	**3**
		(ii)	•[6] Process: bearing consistent with diagram •[7] Process: distance consistent with diagram	•[6] evidence •[7] evidence	**2**

<table>
<tr><th colspan="3">Question</th><th>Generic scheme</th><th>Illustrative scheme</th><th>Max mark</th></tr>
<tr><td>6.</td><td>(c)</td><td></td><td>•8 Process/communication: calculate lucky dip probability

•9 Strategy/process: find all combinations for two dice

•10 Process: find the number of combinations 9 or more

•11 Process/communication: calculate probability and compare</td><td>•8 $\frac{30}{150}$ (or 0.2)

•9 Evidence of 36 combinations
<table><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr><tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr><tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr></table>•10 10

•11 $\frac{10}{36}$ (or 0.278)
since $0.2 < 0.278$ dice game has a better chance</td><td>4</td></tr>
<tr><td>7.</td><td>(a)</td><td></td><td>•1 Strategy/Process: change to consistent units

•2 Process: calculate volume of conditioner</td><td>•1 20 (l) or 14 000(ml)

•2 0.0035 (l) or 3.5 (ml)</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td></td><td>•3 Strategy: substitute correctly into cylinder formula

•4 Process: calculate volume of cylinder

•5 Strategy/Process: calculate volume of cuboid with height 40cm

•6 Strategy/Process: calculate volume of water</td><td>•3 $\pi \times 5^2 \times 8$

•4 628.318…

•5 36 000

•6 35 371.6…</td><td>4</td></tr>
</table>

Question			Generic scheme	Illustrative scheme	Max mark
7.	(c)		•[7] Strategy/communication: correct substitution into Pythagoras' theorem	•[7] $30^2 + 30^2$	**4**
			•[8] Process: calculate length of diameter	•[8] 42.426…	
			•[9] Process: calculate area of table top	•[9] 1413.7…	
			•[10] Process/communication: convert to square metres	•[10] 0.14137…	

[END OF SPECIMEN MARKING INSTRUCTIONS]