<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>Method mark</td>
</tr>
<tr>
<td>A</td>
<td>Accuracy mark</td>
</tr>
<tr>
<td>B</td>
<td>Working mark</td>
</tr>
<tr>
<td>cao</td>
<td>Correct answer only</td>
</tr>
<tr>
<td>oe</td>
<td>Or equivalent</td>
</tr>
<tr>
<td>ft</td>
<td>Follow through</td>
</tr>
<tr>
<td>Question</td>
<td>Working</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td>1a</td>
<td>1 : 6 ≠ 1 because 1 : 6 = 6 : 36 (+6) Or 6:1 = 1 : \frac{1}{6} (+6)</td>
</tr>
<tr>
<td>b</td>
<td>19 : 95 = 1 × 19 : 5 × 19 = 1 : 5</td>
</tr>
<tr>
<td>c</td>
<td>No, because the units must be the same in order to compare</td>
</tr>
<tr>
<td>d</td>
<td>B : G 2 : 5 4 : 10 6 : 15 (21 students) 7 : 17.5 (not possible) 8 : 20 (28 students)</td>
</tr>
<tr>
<td>2a</td>
<td>Packs of 3: 90 ÷ 3 = 30 30 packs cost 30 × £1.50 = £45 Packs of 15: 90 ÷ 15 = 6 6 packs cost 6 × £5 = £30 Packs of 25: Not possible, because 90 is not divisible by 25.</td>
</tr>
<tr>
<td>b</td>
<td>Buy 2 get one free on packs of 15. Buy two packs of 15 for £10 Get a pack of 15 free. 45 will cost £20. So new cost = £20 Or (3 × 15) + (3 × 15) = 90 £10 + £10 = £20</td>
</tr>
</tbody>
</table>
### 3 a

Appropriate workings related to their question.

For example:

**Easy:** A shop increased its prices by 10%. If an item costs £100, how much more does it cost after the price increase? £10

Easy to find because original amount is £100.

**Difficult:** A worker’s hourly rate increased by 25%. If the hourly rate was £8 before the increase, how much does the worker get paid per hour after the increase? £10

Difficult to find because the percentage is not a multiple of 10 and context is more complex.

### 3 b

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<tbody>
<tr>
<td>B1</td>
<td>2</td>
<td>B1 for clarity of question</td>
<td>B</td>
</tr>
<tr>
<td>B1</td>
<td>3</td>
<td>B1 for explanation that links complexity of mathematics to context of question</td>
<td></td>
</tr>
</tbody>
</table>

### 4

The formula for density is:

\[ \text{density} = \frac{\text{mass}}{\text{volume}} \]

If the objects have the same volume but different masses, this formula indicates that the densities will be different and so suggests the objects are made from different metals.

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<tbody>
<tr>
<td>B1</td>
<td>3</td>
<td>B1 for insight into the effect of changing a variable in a formula</td>
<td>M</td>
</tr>
</tbody>
</table>

<p>| | | | |</p>
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<td>1</td>
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</tbody>
</table>
a 1 g/cm³ = 1000 kg/m³
So
2.3 g/cm³ = 2300 kg/m³
Use the formula:
density = \(\frac{\text{mass}}{\text{volume}}\)
Rearrange the formula:
volume = mass ÷ density
1 tonne = 1000 kg
so volume = \(\frac{30,000}{2300}\) kg
2.7 g/cm³ = 2700 kg/m³
They both have the same volume.
Again, use the formula:
mass = density × volume
13 × 2700 = 35,100
The granite has a mass of 35.1 tonnes and the sandstone has a mass of 30 tonnes
OR
\(\frac{35,100}{30,000}\) = 1.17
5.1 tonnes heavier or 17% heavier.

b 13 m³ to nearest m³

M1 2 3
M1 for conversion from g/cm³ to kg/m³
M1 for correct rearrangement of formula
A1 oe
M1 for calculating correct tonnage for granite
M1 for correct method for comparison of mass
A1 for stating correct comparison

A1 for stating correct comparison
### 6

\[ p_0 = 630 \text{ kg/m}^3 \]
\[ p_m = 550 \text{ kg/m}^3 \]
\[ m_0 = 315 \text{ g} \]
\[ = 0.315 \text{ kg} \]

Start with the formula: \( p = \frac{m}{v} \)

Rearrange to: \( v = \frac{m}{p} \)

The carvings are identical so the volume is the same.

\[ \frac{0.315}{630} = \frac{m_0}{550} \]

Rearranging:

\[ m_0 = 550 \times \frac{0.315}{630} \]
\[ = 0.275 \text{ kg} \]

Mass = 275 g or 0.275 kg

### 7

**a**

The ratio men : women is 5 : 2. There are 24 women so the total membership is:

\[ 5 \times 12 : 2 \times 12 \]

The ratio becomes 60 : 24

Then the total membership = 60 + 24 = 84

84

**b**

The ratio R : S : J is 2 : 3 : 5. There are 10 shares.

\[ £85 \div 10 = £8.50 \]

Shaun pays \( 3 \times £8.50 = £25.50 \)

£25.50

**c**

Own question like the one in part a. For example: In a tennis club, 30 members are men. The ratio of women to men is 6 : 5. How many of the members are female? **36**
### 8 a

\[ b_2 = \frac{5}{4} \times b_1 \]

\[ b_2 = \frac{5}{4} \times 8 \]

\[ = \frac{40}{4} = 10 \text{ hours} \]

\[ b_2 \text{ costs } £198 \]

\[ b_1 \text{ costs } £118 \]

\[ \frac{198}{118} = 1.68 \text{ to 2dp} \]

\[ \frac{5}{4} = 1.25 \]

\[ \frac{b_2}{118} = \frac{5}{4} \]

\[ b_2 = \frac{5 \times 118}{4} \]

\[ = \frac{590}{4} = £147.50 \]

Reduction is:

\[ £198 - £147.50 = £50.50 \]

10 hours

B1

The increase in cost is proportionally more than the increase in battery life.

B1 for division of higher cost by lower cost

B1 for use of comparison to justify the answer

M for multiplying lower cost by 5 and dividing by 4

### 8 c

\[ \frac{b_2}{118} = \frac{5}{4} \]

\[ b_2 = \frac{5 \times 118}{4} \]

\[ = \frac{590}{4} = £147.50 \]

She would need a reduction of £50.50.

A1

A1 cao

### 9 a

For the first 5-pack:

\[ 5 \times 90 \text{ minutes} = 450 \text{ minutes} \]

\[ £6.60 = 660p \]

\[ 650p \div 450 = 1.44p \text{ per minute} \]

For the 10-pack:

\[ 10 \times 80 = 800 \text{ minutes for } £6.50 \div 800 = 0.8125p \text{ per minute cheapest} \]

For the second 5-pack:

\[ 5 \times 80 = 400 \text{ minutes} \]

\[ £4.00 = 400p \]

\[ 400p \div 400 = 1p \text{ per minute} \]

Or

\[ 450 \div 6.50 = 69 \text{ minutes per } £1 \]

\[ 800 \div 6.50 = 123 \text{ minutes per } £1 \text{ best value} \]

The best buy is the 10-pack of 80 minutes each @ £6.50.

M for process of multiplying up for total minutes and then division to identify either cost per minute or time per £

B2 for correct workings in each of the three cases

M
<table>
<thead>
<tr>
<th></th>
<th>b</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>400 ÷ 4.00 = 100 minutes per £1</td>
<td>There are more CDs than are needed. A recording time of 80 minutes is not long enough. £6.50 is too expensive at time of purchase (prefer just to spend £4).</td>
<td>A1</td>
<td>A1 for explanation of possible reasons not to choose the best buy</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>£800 × 1.19 gives €952</td>
<td>They will get €24 more.</td>
<td>M1</td>
<td>M1 for multiplications</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>£800 × 1.22 gives €976</td>
<td></td>
<td>M1</td>
<td>M1 for subtraction ft</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>€976 – €952 = €24</td>
<td></td>
<td>A1</td>
<td>A1 cao</td>
<td>3</td>
</tr>
<tr>
<td>11 a i</td>
<td>By expressing this as: ’How many….. in ….’</td>
<td>B2</td>
<td>B1 for correct justification</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td></td>
<td>How many in Answer 2</td>
<td></td>
<td>B1 for showing diagram oe</td>
<td></td>
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<tr>
<td></td>
<td>How many in Answer 3</td>
<td>B1</td>
<td>B1 for correct justification showing diagram oe</td>
<td></td>
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<tr>
<td></td>
<td>How many in Answer one and a half</td>
<td>B1</td>
<td>1 for correct justification showing diagram oe</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Use chosen method from part a to explain correctly how to divide, using fractions.</td>
<td>B1</td>
<td>B1 for correct explanation</td>
<td></td>
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<tr>
<td></td>
<td>M1</td>
<td></td>
<td>M1 for process showing that dividing by ( \frac{1}{2} ) doubles the number of pieces, so is the same as multiplying by 2</td>
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<td>6</td>
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</tbody>
</table>
| 12a | 8 kg = 8000 g  
8000 ÷ 250 = 32  
3 kg = 3000 g  
3000 ÷ 85 = 35 (to nearest whole number)  
2 kg = 2000 g  
2000 ÷ 20 = 100  
7 kg = 7000 g  
7000 ÷ 250 = 28  
So the limiting value is the amount of icing sugar. Therefore she can make 24 × 28 = 672 biscuits.  
672 ÷ 15 = 44.8  
44 ÷ 3 = 33  
OR  
33 x £2.99 = £98.67  
44 – 33 = 11 discounted  
£2.99 x 0.85 = £2.54 to 2 dp  
11 x 2.54 = £27.94  
Total sales  
= £98.67 + £27.94  
= £126.61  
Total costs  
= £59 + £26 = £85  
To calculate percentage profit:  
profit = \( \frac{(\text{£126.61} - \text{£85})}{\text{£85}} \)  
= 0.489529412  
and percentage profit  
= 0.489529412 x 100% = 48.95%  
49% profit to the nearest integer.  
| A1 | M1 | 2 | 3 | M1 for process of division to see how many batches of 15 biscuits can be made with each ingredient  
B1 for 32, 35, 100 and 28 | M |

| 12b | She can make 44 complete packs of 15 biscuits.  
| A1 | M1 |  |  | M1 for correct identification of limiting value  
| A1 | M1 |  |  | A1 for correct cost of \( \frac{3}{4} \) of biscuits | M |

| 13 | Price including VAT = £595 x 1.20 = £714  
With a 20% discount: £714 x 0.8 = £571.20  
£571.20 – £595 = £23.80  
£595 x 0.8 = £476  
£476 x 1.2 = £571.20  
He is overpaying by £23.80  
Disagree. He would pay the shop more than he needs to.  
| A1 | M1 | 2 |  | M1 for process of multiplying by 1.2 to find cost with VAT  
M1 for multiplying by 0.8 to find 20% reduced price (ft) | M |
With a reduction of 15%, the sale price \((B)\) is \(A \times 0.85\).
\[
A = \frac{B}{0.85}
\]

Yes, the new value will always be the original value multiplied by a percentage, calculated from the percentage change. For a reduction, the multiplier is \((100 - \text{the percentage reduction})\)%; for an increase it is \((100 + \text{the percentage increase})\)%.

Percentage change problem, for example: The cost of a new car was £\(A\). In the new financial year, it increased by 5% to £\(B\). Write a formula to describe the proportional change.
\[
B = A \times 1.05 \quad \text{and} \quad A = \frac{B}{1.05}.
\]

<table>
<thead>
<tr>
<th>14a</th>
<th>15a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>b</strong></td>
<td><strong>b</strong></td>
</tr>
<tr>
<td><strong>c</strong></td>
<td><strong>c</strong></td>
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</tbody>
</table>
### 16 a
\[ A \times \frac{6}{7} = \£996 \]
\[ A = \£996 \times \frac{7}{6} = \£1162 \]
\[ A \times 1.04 = \£6.50 \]
\[ A = \frac{\£6.50}{1.04} = \£6.25 \]
\[ A \times 1.07 = \£957.65 \]
\[ A = \frac{\£957.65}{1.07} = \£895 \]

### b
If the original amount is \( A \), the multiplier is \( b \) for a percentage increase or decrease, and the new value is \( C \):
\[ A \times b = C \]

### c
\[ A = \£895 \]
\[ B = \£6.25 \]
\[ C = \£6.50 \]
\[ D = \£1162 \]

### d
If the original amount is \( A \), the multiplier is \( b \) for a percentage increase or decrease, and the new value is \( C \):
\[ A \times \frac{1}{b} = C \]

### e
If the multiplier is \( x \):
\[ x > 1 \text{ means an increase} \]
\[ 0 < x < 1 \text{ means a decrease.} \]

### 17 a
Comparing salary in May and April:
\[ \£1568 - \£1544 = \£24 \]
Comparing sales in May and April:
\[ \£24 \text{ is earned on } \£4000 \text{ sales.} \]
\[ 24000 \div 4000 = 6 \]
\[ 6 \times \£24 = \£144 \]
\[ \£1544 - \£144 = \£1400 \]
So the basic salary is \£1400.
\[ \£1553 - \£1400 = \£153 \]
\[ \frac{153}{24} = \frac{51}{8} = 6.375 \]
\[ 6.375 \times 4000 = \£25500 \]

### b
Own question

---

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18 Number on Saturday = 2 \times \text{number on Friday} \\
S \times 1.5 = (2F) \times 1.5 \\
S = \frac{3F}{1.5} = 2F

There are still twice as many visitors on Saturday as on Friday. There are 100% more visitors on Saturday compared to Friday.

19 a Number of workers = W \\
Number of days = t \\
K = \text{constant} \\
W = \frac{K}{t} \\
2 = \frac{K}{20} \text{ so } K = 40 \\
W = \frac{40}{t} \\
With 3 workers: \\
3 = \frac{40}{t} \\
\frac{40}{3} = 13 \frac{1}{3} \text{ days} \\
This is Thursday of week 3.

They would finish after 13 \frac{1}{3} \text{ days.}

b They would probably get in each other's way and would not be able to complete the job in a very short time. Some jobs have to wait until others are finished, for example, they can't paint until the walls have been plastered.

They would probably get in each other's way and would not be able to complete the job in a very short time. Some jobs have to wait until others are finished, for example, they can't paint until the walls have been plastered.

20 Current costs are £1.50 per mile and 20p per minute. 
Competitive pricing structure: answers will vary.

<table>
<thead>
<tr>
<th>Time taken</th>
<th>2 min</th>
<th>5 min</th>
<th>10 min</th>
<th>12 min</th>
<th>15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>1 mile</td>
<td>2 miles</td>
<td>3 miles</td>
<td>5 miles</td>
<td>6 miles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total charge (A)</td>
<td>£2.50</td>
<td>£4.00</td>
<td>£6.50</td>
<td>£9.50</td>
<td>£12.00</td>
</tr>
<tr>
<td>Total charge (B)</td>
<td>£1.90</td>
<td>£4.00</td>
<td>£6.50</td>
<td>£9.90</td>
<td>£12.01</td>
</tr>
</tbody>
</table>

M1 for process of finding charges
A1 for working out current price structure
B1 for correct calculation of a pricing structure that has an element of competition
The suggestion (B) competes for short distances, matches for mid distances and is not competitive for longer journeys.
<p>| | | | | | | |</p>
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<tbody>
<tr>
<td><strong>21 a</strong></td>
<td>Travel 30 miles in 45 minutes.</td>
<td><strong>B1</strong></td>
<td>2</td>
<td><strong>B1</strong> for correct explanation with calculation that indicates 10 miles every 15 minutes implies 40 miles every 60 minutes oe</td>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>45 minutes = ( \frac{3}{4} ) hour</td>
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<tr>
<td></td>
<td>( \frac{30}{\frac{3}{4}} = \frac{3 \times 4}{3} = \frac{120}{3} = 40 ) mph as required</td>
<td><strong>B1</strong></td>
<td></td>
<td><strong>B1</strong> for clear explanation</td>
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<tr>
<td></td>
<td>Not changing minutes into hours.</td>
<td><strong>B1</strong></td>
<td></td>
<td><strong>B1</strong> for stating a common misconception</td>
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<tr>
<td></td>
<td>Units of speed = ( \frac{\text{units of distance}}{\text{units of time}} )</td>
<td><strong>B1</strong></td>
<td></td>
<td><strong>B1</strong> for correctly stating the relationship between speed, distance and time</td>
<td></td>
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<tr>
<td></td>
<td>Own easy and difficult examples</td>
<td><strong>B2</strong></td>
<td></td>
<td><strong>B1</strong> for one easy and one difficult example with justification</td>
<td></td>
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<td></td>
<td><strong>B1</strong> for multiple different examples</td>
<td></td>
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<tr>
<td><strong>22</strong></td>
<td>A rectangle 1 m × 2 m</td>
<td></td>
<td><strong>M1</strong></td>
<td><strong>M1</strong> for process of trial and improvement</td>
<td><strong>M</strong></td>
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<td></td>
<td>Area = 2 m²</td>
<td></td>
<td>2</td>
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<td>A rectangle 4 m × 8 m</td>
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<td></td>
<td>Area = 32 m²</td>
<td></td>
<td>3</td>
<td></td>
<td><strong>M</strong></td>
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<td>Length scale factor = 4</td>
<td></td>
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<tr>
<td></td>
<td>Area scale factor = 16 (4²)</td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>32 m²</td>
<td><strong>A1</strong></td>
<td></td>
<td>A1 cao</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>23</strong></td>
<td>75 ÷ 30 = 2.5</td>
<td><strong>M1</strong></td>
<td>2</td>
<td><strong>M1</strong> for calculation of length scale factor</td>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Length scale factor is 2.5</td>
<td><strong>M1</strong></td>
<td>3</td>
<td><strong>M1</strong> for calculation of volume scale factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume scale factor is (2.5)³ = 15.625</td>
<td><strong>M1</strong></td>
<td></td>
<td>A1 cao</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5000 × 15.625 = 78,125 cm³ = 78.125 litres</td>
<td><strong>A1</strong></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>24</strong></td>
<td>Length scale factor = 450 ÷ 15 = 30</td>
<td><strong>M1</strong></td>
<td>2</td>
<td><strong>M1</strong> for calculation of length scale factor</td>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume scale factor = 30³ = 27 000</td>
<td><strong>M1</strong></td>
<td>3</td>
<td><strong>M1</strong> for calculation of volume scale factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>450 × 27 000 = 12 150 000 cm³</td>
<td><strong>M1</strong></td>
<td></td>
<td>A1 cao</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>(( \div 100^3 ) for m³)</td>
<td><strong>M1</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>= 12.15 m³</td>
<td><strong>A1</strong></td>
<td></td>
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</tr>
<tr>
<td><strong>25</strong></td>
<td>Length scale factor = 18 ÷ 12 = 1.5</td>
<td><strong>M1</strong></td>
<td>2</td>
<td><strong>M1</strong> for calculation of length scale factor</td>
<td><strong>M</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume scale factor = (1.5)³</td>
<td><strong>M1</strong></td>
<td></td>
<td><strong>M1</strong> for calculation of volume scale factor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume of paint in big tin = 800 ml × (1.5)³ = 2700 ml</td>
<td><strong>M1</strong></td>
<td></td>
<td>A1 cao</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2700 ÷ 800 = 3.375</td>
<td><strong>A1</strong></td>
<td></td>
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<tr>
<td></td>
<td>So he can fill 3 tins.</td>
<td></td>
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<tr>
<td></td>
<td>3 small tins can be filled from one large tin.</td>
<td><strong>M1</strong></td>
<td></td>
<td>A1 cao</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
26 a  New area is $(a \times 1.15)^2$
   $= a^2 \times 1.15^2$
   $= 1.3225a^2$

Percentage increase = $(1.3225 - 1) \times 100$

Area increases by 32.25%.

b  

\[
\begin{array}{c}
\times 1.15 \\
\times 0.95 \\
\end{array}
\]

Area = $a \times 1.15 \times b \times 0.95$
   $= ab \times 1.15 \times 0.95 = 1.0925ab$

Percentage increase $(1.0925 - 1) \times 100$

Area increases by 9.25%.

27 a  

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>3.2</td>
<td>13.6</td>
</tr>
<tr>
<td>2</td>
<td>1.6</td>
<td>6.8</td>
</tr>
<tr>
<td>8</td>
<td>6.4</td>
<td>27.2</td>
</tr>
<tr>
<td>12</td>
<td>9.6</td>
<td>40.8</td>
</tr>
<tr>
<td>6.8</td>
<td>5.44</td>
<td>23.12</td>
</tr>
<tr>
<td>2.8</td>
<td>2.24</td>
<td>9.52</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
B &= \frac{1.6}{2} = 0.8 \\
A &= \frac{17}{5} = 3.4 \\
C &= \frac{17}{4} = 4.25
\end{align*}
\]

This also means that

\[
\begin{align*}
C &= \frac{17}{4} = 4.25 \\
B &= \frac{17}{4} = 4.25
\end{align*}
\]

So yes there is enough information.

b  

13 items
e.g.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
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<td>●</td>
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</tbody>
</table>
c) One variable is isolated from the other two. 9 items e.g.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
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<td>●</td>
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<td>●</td>
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<td>●</td>
</tr>
</tbody>
</table>

There should be at least one value in each row and two rows should have at least two pairs linking a different pair. Always start in a row where at least 2 quantities are given, to work out the third quantity, so that relationships between all three are known. Then use these to work out other quantities. In this example there are 2 possible starting points.

<table>
<thead>
<tr>
<th></th>
<th>B1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

B1 for clear explanation that there should be at least one value in each row and two rows should have at least two values linking a different pair of A, B, C.

B1 for clear explanation

B1 for explanation of the best starting point and stating how many different starting points there are

28 In year 1:
£8000 × 0.027 = £216
Interest = £216
Less 20% tax:
£216 × 0.8 = £172.80
So the total at end of year 1
= £8000 + £172.80
= £8172.80
In year 2:
£8172.80 × 0.027 = £220.67
Interest = £220.67
Less 20% tax:
£220.67 × 0.8 = £176.54
At end of year 2:
Amount = £8172.80 + £176.54
= £8349.34

No, Sam is incorrect.
She will have £8349.34
See workings as explanation.

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

M1 for use of correct multipliers
M1 for multistep calculation for year 1
M1 for multistep calculation for Year 2 (ft)
A1 for clarity of explanation through setting out of calculations

A1 for clarity of explanation through setting out of calculations

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29

\[ B \times 0.8^n < \frac{B}{2} \]

Divide both sides by \( B \).

\[
0.8^n < \frac{1}{2}
\]

\[
0.8^3 = 0.512 \\
0.8^4 = 0.4096
\]

OR

\[
£100 \times 0.8 = £80 \\
£80 \times 0.8 = £64 \\
£64 \times 0.8 = £51.20 \\
£51.20 \times 0.8 = £40.96
\]

4 weeks

A1

M1

M1

M1

2

B1 for choosing a starting position, either a variable such as \( B \) or a specific amount such as £100

M1 for working through the weeks in some way

M1 for the process of finding amounts for weeks 3 and 4 to show the point at which the bank account first dips below 50% of the original balance

cao

B1 for clear explanation of inverse proportion

H

30

i graph d

ii graph e

iii graph b

iv graph c

v graph f

vi graph a

B6

2

B1 for each correctly identified graph with reference to why, for example:

\[ f(x) = x^2 \] is graph d as points are (–2, 4), (–1, 1), (0, 0), (1, 1), (2, 4) and it is a parabola

\[ f(x) = 2x, x > 0 \] \( f(x) = −2x, x < 0 \) is graph e as it is linear and has no negative \( f(x) \) values; the gradient is 2 and –2

H

31 a

Inverse proportion describes the relationship between two variables such that as one increases the other decreases.

\[ xy = k \]

or \( y = \frac{k}{x} \)

B1

2

M1

M1 for correct equation

H

b

\[ y = \frac{k}{x} \]

\[ xy = k \] where \( k \) is the constant of proportionality

M1

A1

A1 for clear question

H

c

Own problem, for example: It takes 5 men 10 days to dig a hole. The number of men, \( y \), is inversely proportional to the number of days, \( x \). How long would it take for ten men to dig the same hole? (5 days)
### Question 32 a

**b**

\[ r = 6 \times 10^3 \text{m} \]

\[ F_1 \propto \frac{1}{(6 \times 10^3)^2} = \frac{1}{3.6 \times 10^6} \]

\[ F_2 \propto \frac{1}{(6 \times 10^3 + 12)^2} = \frac{1}{3.6144 \times 10^7} \]

\[ \frac{F_1}{F_2} = 0.996 \]

0.996 to 3 dp

The difference is too small (reference part b).

**c**

\[ \frac{M_{1A}}{M_{1B}} = 0.996 \] to 3 dp

The difference is too small (reference part b).

### Question 33

The speed of the faster car is 40 mph.

\[ T = \frac{20}{40} = \frac{1}{2} \]

So they meet after 30 minutes.

Speeds are in the ratio

\[ 1 : 2 = 20 : 40 = 10 : 20 \]

So the cars meet when the slower car has travelled 10 miles and the faster car has travelled 20 miles. It will take half an hour for a car travelling at 20 mph to go a distance of 10 miles.
### 34

$$4y = 2x^2$$

$$y = \frac{x^2}{2}$$

Gradient:

$$\frac{f(x_2) - f(x_1)}{2}$$

$$\frac{4^2 - 2^2}{2}$$

$$= \frac{8 - 2}{2}$$

$$= \frac{6}{2}$$

$$= 3$$

M1 for rearranging and substituting given values of $x$

H

### 35

$$f(x + h) - f(x) = \frac{(2 + 2)^2 - 2^2}{2}$$

$$\frac{4^2 - 2^2}{2}$$

$$= \frac{2}{2}$$

$$= 1$$

M1 for appropriate substitution to enable comparison with Q35

H

### 36 a

$$f(x) = mx + c$$

The gradient:

$$\frac{m(x + h) + c - (mx + c)}{h}$$

$$= \frac{m + mh + c - mx - c}{h}$$

$$= m$$

M1 for clarity of proof

A1 for accuracy with manipulation of function

H

### 36 b

$$f(x) = \frac{x^2}{2}$$

at $x = 2$

The gradient:

$$\frac{(x^2 + h^2 - x^2)}{2h}$$

$$= \frac{1}{2} (2x + h) \quad h \to 0$$

M1 for clear reasoning

A1 for accuracy with manipulation of function to show a gradient of 2
At $x = 2$, gradient = 2.
From the graph, points on the tangent are (1, 0) and (2, 2).
The gradient $\frac{2 - 0}{2 - 1} = 2$

<table>
<thead>
<tr>
<th>Question</th>
<th>Marks</th>
<th>Solution</th>
</tr>
</thead>
</table>
| 37 a | 5 | £28 000 × 1.05³ = £32 413.50
£14 500 × 1.05ⁿ > £20 000
$n = 7$ years.
£14 500 × 1.05² = £20 402.96 |
| b | 2 | £32 413.50
7 years |
| 38 | 3 | Sycamore:
$4 \times 1.08^{11} = 9.327$
$4 \times 1.08^{12} = 10.073$
Conifer:
$2 \times 1.15^{11} = 9.305$
$2 \times 1.15^{12} = 10.7$
|  | 2 | 12 years
After 11 years, the sycamore is 9.326 m tall and the conifer is 9.305 m tall. After 12 years, the sycamore is 10.073 m tall and the conifer is 10.7 m tall. |
39a

\[ A \times 1.04^n = 2A \]

Divide both sides by \( A \).

\[ 1.04^n \geq 2 \]

1.0410 = 1.48 (2 dp)
1.0415 = 1.80 (2 dp)
1.0420 = 2.19 (2 dp)
1.0417 = 1.95 (2 dp)
1.0418 = 2.03 (2 dp)

\[ 10 \times \left( \frac{3}{5} \right)^n = 1 \]

\[ \left( \frac{3}{5} \right)^n = 0.1 \]

0.6^4 = 0.1
0.6^2 = 0.36
0.6^0 = 0.07776
0.6^4 = 0.1296

18 years

4 bounces

40a

\( f(x) = a(b)^x \)

The population doubles each day.

Day | Number of bacteria
---|---
0   | 1
1   | 2
2   | 4
3   | 8
4   | 16
5   | 32
6   | 64 = 2^6

\( 2^6 = 64 \)

\( a \) and \( b \) are constants.
\( a \) is the starting size of the population and so doesn’t change.
\( b \) is the multiplier (by how much the population grows each day) and the value of this doesn’t change.
\( x \) is a variable as it represents the changing number of days.
<p>| | | | | | | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>41</td>
<td>I</td>
<td>ii</td>
<td>iii</td>
<td>F(x) = a(b)^x</td>
<td></td>
<td>B3</td>
</tr>
<tr>
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<td>2</td>
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<td>B1 for each correct explanation of the impact on the population as b varies</td>
</tr>
<tr>
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<td>b &lt; 1 the population decreases.</td>
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<td>b = 1 the population stays the same.</td>
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<td>b &gt; 1 the population increases.</td>
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<tr>
<td>42 a</td>
<td></td>
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<tr>
<td>b</td>
<td>Epidemic started by a single carrier so x0 = 1. Considering infection after 10 days so r = 10.</td>
<td></td>
<td></td>
<td>x_n+1 = R x_0</td>
<td>M1</td>
<td>2</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>x_10 = R^10</td>
<td>A1</td>
<td></td>
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<td></td>
<td>A1 for cao</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Newspaper headline to engage readers with the story of this epidemic e.g. how long before x people are infected.</td>
<td>B1</td>
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<td>B1 for relevant, informative headline</td>
</tr>
<tr>
<td>43</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>p = e ^ \frac{1}{7}</td>
<td>0.43 bar</td>
<td>M1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= (2.72)^{0.8396}</td>
<td></td>
<td>A1</td>
<td></td>
<td>M1 for correct use of formula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>= 2.72^{-0.842}...</td>
<td></td>
<td></td>
<td>A1 cao</td>
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<tr>
<td>= 0.430 555 245...</td>
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<tr>
<td>44 a</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td>x = 1 + \frac{11}{x - 3}</td>
<td>Show that... as workings.</td>
<td>M1</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>x(x - 3) = x - 3 + 11</td>
<td></td>
<td>A1</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>x^2 - 3x = x + 8</td>
<td></td>
<td>B1 for clarity of justification</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>x^2 - 4x - 8 = 0</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>if x_1 = 5</td>
<td></td>
<td>M1 for correct use of iteration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>x_2 = 1 + \frac{11}{(5 - 3)} = 1 + \frac{11}{2} = 6.5</td>
<td></td>
<td>M1 for substitutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>x_3 = 1 + \left( \frac{11}{6.5 - 3} \right) = 4.14286</td>
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<tr>
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<td></td>
<td></td>
<td>x = -1.46 to 2 dp</td>
<td></td>
<td>A1</td>
</tr>
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<td></td>
<td>Using x = 5 as the first iteration, after 19 iterations you arrive at x = -1.46 to 2 dp</td>
</tr>
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<td></td>
<td>Likewise, if the first trial is -1, 11 iterations lead to the solution x = -1.46 to 2 dp.</td>
</tr>
</tbody>
</table>