1st January

Prove \((2n + 2)^2 - (2n + 1)\) is always odd.

Rationalise the denominator
\[
\frac{3 + \sqrt{2}}{\sqrt{3}}
\]

Shown is \(f(x)\)

Sketch the function \(f(x + 1)\)

\[
f(x) = 3x + 2 \\
g(x) = x^2
\]

Find \(fg(x)\)

Find \(gf(5)\)
<table>
<thead>
<tr>
<th>2nd January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve the simultaneous equations</td>
</tr>
</tbody>
</table>
| \[
| y = x^2 - 1 \\
| x = 5 - y
|\]                                           |
| Work out                                      |
| \[
| \sqrt{200} + \sqrt{50}
|\]                                           |
| Sketch \( y = \sin x \) for \( 0 < x < 360 \). |
| Solve \( x^2 - 2x - 15 > 0 \)                 |
| Find the nth term of                          |
| 10, 12, 16, 22, 30... ...                     |
### 3rd January

<table>
<thead>
<tr>
<th>-0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
</tr>
</tbody>
</table>

Prove

\[ (n + 1)^2 - (n - 1)^2 + 4 \]

is always even, if \( n \) is a positive integer.

Rationalise the denominator

\[ \frac{\sqrt{3}}{\sqrt{2}} \]

Find the equation of the line that is perpendicular to \( 3x + y = 8 \) and passes through the point \( (1, 5) \)

Simplify

\[ (81x^8)^{-\frac{3}{4}} \]
<table>
<thead>
<tr>
<th>4th January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve the simultaneous equations</td>
</tr>
<tr>
<td>[ x + y = 3 ]</td>
</tr>
<tr>
<td>[ x^2 + y^2 = 5 ]</td>
</tr>
<tr>
<td>Donald saves some of his pocket money each week.</td>
</tr>
<tr>
<td>He saves 10p in week 1, 16p in week 2, 22p in week 3 and so on for 40 weeks.</td>
</tr>
<tr>
<td>Find the amount he saves in week 40.</td>
</tr>
<tr>
<td>Calculate his total savings over the 40 weeks.</td>
</tr>
<tr>
<td>Rationalise the denominator of</td>
</tr>
<tr>
<td>[ \frac{\sqrt{5}}{\sqrt{3} + 2} ]</td>
</tr>
<tr>
<td>Prove that the angle in a semi-circle is always 90°</td>
</tr>
<tr>
<td>5th January</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Express ((8 + \sqrt{5})^2) in the form (a + b\sqrt{5})</td>
</tr>
<tr>
<td>Find the minimum value of (x^2 + 6x + 20) and the value of (x) for which it occurs.</td>
</tr>
<tr>
<td>Write the equation of a circle (C), with centre (O) and radius (4)cm.</td>
</tr>
<tr>
<td>Write (2.1\dot{6}) as a mixed number. Give your answer in its simplest form.</td>
</tr>
<tr>
<td>Find the (n)th term of (1, 3, 7, 13, 21, ..., ...)</td>
</tr>
</tbody>
</table>
### 6th January

**Solve the simultaneous equations**

\[ 2y - x + 3 = 0 \]
\[ x^2 + xy = 0 \]

**Shown is a sketch of the graph**
\[ y = f(x) \].

(a) Sketch \(-f(x)\)
(b) Sketch \(f(x + 1)\)

Label known coordinates

- \((2,0)\)
- \((-3,-8)\)
- \((-8,0)\)

**The line \(l_1\) has equation** \(y = 4x - 10\). **The line \(l_2\) has equation** \(x + y = 20\)

The lines \(l_1\) and \(l_2\) intersect at the point \(C\).
The lines \(l_1\) and \(l_2\) cross the line \(y = 2\) at the points \(A\) and \(B\).

Find the area of triangle \(ABC\).

**A circle has equation** \(x^2 + y^2 = 100\)

Find the equation of the tangent to the circle at the point \((6, 8)\)
### 7th January

**Expand and simplify**

\[(x + 2)(x + 5)(2x - 1)\]

**The line** \(l_1\) **has equation** \(y = 4x + 3\)

The line \(l_2\) **has equation** \(5x + 2y - 9 = 0\)

**Find the point of intersection of** \(l_1\) **and** \(l_2\)

**Find the gradient of line** \(l_2\)

**Find the value of** \(x\)

**Which number has no reciprocal?**

**ABCD is a square,** \(X\) **is a point in the diagonal** \(BD\) **and the perpendicular from** \(B\) **to** \(AX\) **meets** \(AC\) **in** \(Y\).

**Prove that triangles** \(AXD\) **and** \(AYB\) **are congruent.**
<table>
<thead>
<tr>
<th>8th January</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve the simultaneous equations</td>
<td></td>
</tr>
<tr>
<td>(x^2 + y^2 = 9)</td>
<td></td>
</tr>
<tr>
<td>(y = x + 3)</td>
<td></td>
</tr>
<tr>
<td>Find the coordinates where (y = 2x^2 - 7x + 3) crosses each axis.</td>
<td></td>
</tr>
<tr>
<td>Sketch (y = \tan x) for (0 \leq x \leq 360)</td>
<td></td>
</tr>
<tr>
<td>Prove that the angle at the centre is twice the angle at the circumference.</td>
<td></td>
</tr>
<tr>
<td>Given that (125^x = 25^{x+5})</td>
<td></td>
</tr>
<tr>
<td>Find (x)</td>
<td></td>
</tr>
</tbody>
</table>
9th January

Simplify \( \frac{18x^4}{6x} \)

Find the equation of the straight line passing through B(−2, 8) and C(1, 0).
Give your answer in the form \( ax + by + c = 0 \)
where \( a, b \) and \( c \) are integers.

Express \( 3x^2 + 12x + 13 \) in the form \( a(x + b)^2 + c \)

Find the vector \( \overrightarrow{OB} \) in terms of \( a \) and \( b \)

Q is the midpoint of OB.
B is the midpoint of AC.
Show PQC is a straight line.

AOB is a triangle.
P is a point on AO.

\[ \overrightarrow{AB} = 2a \quad \overrightarrow{AO} = 6b \quad \frac{AP}{PO} = 2:1 \]
Given
\[ 2y = \frac{1}{8} \]

Find \( y \)

Show the equation \( x^2 - 4x + 1 = 0 \) can be written in the form
\[ x = 4 - \frac{1}{x} \]

Starting with \( x_0 = 3 \), use the iteration formula
\[ x_{n+1} = 4 - \frac{1}{x_n} \]
twice to find an estimate of the solution of \( x^2 - 4x + 1 = 0 \)

Express these vectors in terms of \( x \) and \( y \)

\[ \overrightarrow{BC} \]

\[ \overrightarrow{BM} \]

\[ \overrightarrow{AM} \]

ABC is a triangle.
M lies on BC such that \( BM = \frac{4}{5} BC \)

Express these vectors in terms of \( x \) and \( y \)
11th January

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Simplify</strong></td>
<td>( (6x^{\frac{1}{2}})^3 ) ( \frac{2x}{2x} )</td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td>( 1 \frac{11}{25} )^{-\frac{1}{2}}</td>
</tr>
<tr>
<td><strong>Solve</strong></td>
<td>( 2x^2 - 5x + 3 &lt; 0 )</td>
</tr>
</tbody>
</table>

The histogram shows the speeds in miles per hour of 82 cars on a road.

- 14 cars were travelling over 50 mph.

Calculate an estimate of the number of cars that were travelling between 42 and 49 mph.

14 cars were travelling over 50 mph.
<table>
<thead>
<tr>
<th>12th January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve the simultaneous equations</td>
</tr>
<tr>
<td>[ x = 3y + 6 ]</td>
</tr>
<tr>
<td>[ 3xy = 24 - x ]</td>
</tr>
<tr>
<td>Write ( x^2 + 8x + 17 ) in the form ( (x + a)^2 + b )</td>
</tr>
<tr>
<td>Find the coordinates of the turning point of ( y = x^2 + 8x + 17 )</td>
</tr>
<tr>
<td>Calculate the length BC.</td>
</tr>
<tr>
<td>Find ( x ), the number of apples in the crate.</td>
</tr>
</tbody>
</table>

There are \( x \) apples in a crate. 4 of the apples are bad.

Fiona chooses two apples from the crate, without replacement. The probability she selects two bad apples is \( \frac{1}{11} \)

Prove \( x^2 - x - 132 = 0 \)
### 13th January

<table>
<thead>
<tr>
<th>Speed (m/s)</th>
<th>Find t</th>
<th>Find the rate of deceleration from 12 to t seconds.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Graph" /></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The average speed from 0 to t seconds was 5.96m/s

<table>
<thead>
<tr>
<th>Solve</th>
<th>Find x</th>
<th>Prove the opposite angles in a cyclic quadrilateral add to 180°</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x^2 - 5x + 4 &gt; 0$</td>
<td><img src="image" alt="Diagram" /></td>
<td></td>
</tr>
</tbody>
</table>

Prove the opposite angles in a cyclic quadrilateral add to 180°
14th January

Find the value of
\[ \frac{2}{5} \]

32

Find the vector \[ \overrightarrow{AB} \]

Find the vector
\[ \overrightarrow{EC} = \frac{1}{5} \overrightarrow{CB} \]
\[ \overrightarrow{DE} = \frac{1}{5} \overrightarrow{a} \]

Prove DC is parallel to AB

Prove the angles in the same segment are equal.

Write
\[ \frac{4}{\sqrt{5}} - \sqrt{\frac{2}{9}} \]

in the form \( k\sqrt{5} \)
Factorise completely
\[ x^3 - 25x \]

The square of \( w \) is 5
Write down the value of \( w^5 \)

Find the probability of \( B \) given \( A \).

Find the values of \( a, b \) and \( c \).

A curve has equation \( y = ax^2 + bx + c \)
The curve crosses the \( x \)-axis at \((3, 0)\) and \((4, 0)\)
The curve crosses the \( y \)-axis at \((0, 12)\)

\[ \begin{array}{|c|c|} 
\hline
\text{Weight (x kg)} & \text{Frequency} \\
\hline
60 < x \leq 64 & 10 \\
64 < x \leq 68 & 20 \\
68 < x \leq 72 & 30 \\
72 < x \leq 76 & 15 \\
76 < x \leq 80 & 18 \\
80 < x \leq 84 & 7 \\
\hline
\end{array} \]

Calculate an estimate of the median
### 16th January

<table>
<thead>
<tr>
<th><strong>Evaluate</strong></th>
<th><strong>A bag contains 14 sweets. 8 sweets are red. 4 sweets are yellow. 2 sweets are green. Two sweets are taken from the bag without replacement.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>( (125 \times 6)^{\frac{2}{3}} )</td>
<td>Work out the probability that the two sweets are different colours.</td>
</tr>
<tr>
<td><strong>A bag contains 14 sweets. 8 sweets are red. 4 sweets are yellow. 2 sweets are green. Two sweets are taken from the bag without replacement.</strong></td>
<td><strong>Work out the probability that the two sweets are different colours.</strong></td>
</tr>
<tr>
<td><strong>Calculate the bearing of A from B.</strong></td>
<td><strong>Calculate the bearing of A from B.</strong></td>
</tr>
<tr>
<td>Ship A is 50km from X on a bearing of 258°. Ship B is 44km from X on a bearing of 312°.</td>
<td><strong>Ship A is 50km from X on a bearing of 258°. Ship B is 44km from X on a bearing of 312°.</strong></td>
</tr>
<tr>
<td><strong>Shown is a right angle triangle.</strong> Find the possible value(s) of x</td>
<td><strong>Shown is a right angle triangle.</strong> Find the possible value(s) of x</td>
</tr>
<tr>
<td><strong>Shown below is a rectangular based pyramid. The apex E is directly over the centre of the base. Calculate angle between the face ABE and the base ABCD.</strong></td>
<td><strong>Shown below is a rectangular based pyramid. The apex E is directly over the centre of the base. Calculate angle between the face ABE and the base ABCD.</strong></td>
</tr>
</tbody>
</table>
### 17th January

**Simplify fully**

\[
\frac{4x^2 - 25}{6x^2 - 11x - 10}
\]

**Shown is the graph of the function**

\[y = f(x)\]

**Sketch**

(a) \(f(x + 1)\)

(b) \(f(-x)\)

**A formula for the area of a regular hexagon with side length \(x\) is given. Prove this formula.**

**Area**

\[
Area = \frac{3}{2} \sqrt{3} \ x^2
\]

**The straight line \(l_1\) has equation**

\[3x + y - 1 = 0\]

**The straight line \(l_2\) is perpendicular to line \(l_1\) and passes through the point \((8, 2)\)**

Find the equation of \(l_2\) in the form

\[y = mx + c\]
### 18th January

1. **Rearrange** \( y + 3 = x(y + 2) \) to make \( y \) the subject of the formula.

2. **Vector Question**: \( \overrightarrow{AB} = \left( \begin{array}{c} 2 \\ 4 \end{array} \right) \)
   
   Write down a vector that is perpendicular to \( \overrightarrow{AB} \) and the twice the length.

3. **Price Reduction**: After a reduction of 3% in the original price, a motorbike is sold for £700.
   
   Both of these values are correct to one significant figure.

4. **Calculate Original Price**: Calculate the greatest possible original price before the reduction was applied.

5. **Probability Problem**: Rebecca has 9 cards, each with a number on it.
   
   She picks three cards at random, without replacement.
   Rebecca multiplies the three numbers to get a score.

   Calculate the probability that the score is an even number.
### 19th January

The events A and B are mutually exclusive.

P(A) = 0.5  
P(B) = 0.4

Find P(A ∪ B)

---

Write in the form $a\sqrt{b}$, where $a$ and $b$ are integers to be found.

\[
\frac{24}{\sqrt{6}}
\]

Prove algebraically that the sum of the squares of any two odd numbers is always even.

---

Work out the rate at which the pulse is increasing at four minutes.  
Include units.

Work out the rate at which the pulse is decreasing at seven minutes.  
Include units.
<table>
<thead>
<tr>
<th>20th January</th>
<th></th>
</tr>
</thead>
</table>
| ![Graph](image.png) | Shown is the curve \( y = \frac{1}{4}\sin x \)  
Write down the coordinates of A and B |
| The point (12, 5) lies on a circle with centre (0, 0)  
Write down the coordinates of another three points on the circle. |  |
| Expand and simplify  
\((x - 3)^3\) |  |
| There are 20 sweets in a box. There are \( y \) chocolate sweets and the rest of the sweets are mints.  
Florence takes out two sweets, at random, from the box. | Find an expression, in terms of \( y \), for the probability that Florence takes two chocolate sweets. |
| ![Frustum](image.png) | Calculate the surface area of the frustum  
Shown is a frustum of a cone that had a perpendicular height of 40cm |  |

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21st January

Express as a single fraction.
\[
\frac{1}{x + 1} + \frac{4}{x - 2}
\]

<table>
<thead>
<tr>
<th>Salary (£1000s)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 ≤ s ≤ 10</td>
<td>8</td>
</tr>
<tr>
<td>10 ≤ s ≤ 20</td>
<td>48</td>
</tr>
<tr>
<td>20 ≤ s ≤ 30</td>
<td>50</td>
</tr>
<tr>
<td>30 ≤ s ≤ 50</td>
<td>11</td>
</tr>
<tr>
<td>50 ≤ s ≤ 200</td>
<td>3</td>
</tr>
</tbody>
</table>

Calculate an estimate of the median salary

Show the equation
\[x^3 + 3x = 1\]
has a solution between x=0 and x=1

Show the equation
\[x^3 + 3x = 1\]
can be rearranged to give
\[x = \frac{1}{3} - \frac{x^3}{3}\]

Starting with \(x_1 = 0\)
use the iteration formula
\[x_{n+1} = \frac{1}{3} - \frac{(x_n)^3}{3}\]
three times to find a solution to
\[x^3 + 3x = 1\]
**22nd January**

A cuboid has length \((x + 9)\) cm, width \((x + 2)\) cm and height 5 cm. The surface area of the cuboid is 400 cm².

Find the value of \(x\) to 2 decimal places.

Which transformation will have a minimum point of \((-5, 2)\)?

Which transformation will have a minimum point of \((8, 2)\)?

Shown is the curve with equation \(y = f(x)\)
The coordinates of the minimum point of the curve are \((5, 2)\).

Find \(x\)

By considering bounds, work out the value of \(w\) to a suitable degree of accuracy.

\[ w = \frac{\sqrt{c}}{p} \]

\(c = 4.24\) correct to 2 decimal places
\(p = 7.88\) correct to 3 decimal places
### 23rd January

Find the minimum point of the graph $y = x^2 - 6x + 7$

The set of values for $x$ that satisfies a quadratic inequality is $x < -0.5$ or $x > 1.5$

Write down a possible quadratic inequality.

---

### Diagram

- **A**
- **B**
- **C**
- **D**
- **E**
- **F**

- **BCDE** is a square
- **DFE** and **ABE** are equilateral triangles

Find the length of **AF**

---

Below is a regular hexagon

Find $x$
### 24th January

Given

\[ f(x) = \frac{ax + 3}{4} \]

\[ f(7) = 6 \]

Find \(a\)

A PE test has two sections, theory and practical.
Everyone in a class who took the PE test passed at least one section.
65% passes the theory section and 80% passed the practical section.

Represent this information on a Venn diagram

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

ABCD is a quadrilateral.

\[ AB = 8\text{cm}, \ AD = 15\text{cm} \text{ and } CD = 12\text{cm}. \]

\[ \text{Angle } ADC = 78^\circ \text{ and angle } BAC = 20^\circ \]

Calculate the length of AC.

Calculate the area of triangle ABC.

Find the set of values of \(x\) for which

\[ \text{both } 9x - 2 < 18 - x \]
\[ \text{and } x^2 - x \geq 20 \]
## 25th January

### Prove the angles in a triangle add up to $180^\circ$.

**Hint:** consider parallel lines.

### A boat sails 4 miles North from A to B. Then the boat sails 5 miles North-East from B to C. The boat then sails directly back to C.

**How far does the boat sail in total?**

### Rationalise the denominator of $\frac{2 + \sqrt{3}}{\sqrt{5} - 1}$

### $x$ is an obtuse angle.

**Given**

\[
\sin(x) = \frac{5}{13}
\]

**Find** $\cos(x)$

### Expand and simplify

\[(1 + \sqrt{2})(1 + \sqrt{3})(2 - \sqrt{3})\]
### 26th January

**Express in the form** \(2^n\)

(a) \(\frac{1}{16}\)

(b) \(2\sqrt{2}\)

---

The histogram shows the speeds of cars travelling down a road. 24 cars travelled faster than 40mph.

How many cars travelled less than 20mph?

---

The bearing of A to B is \(x\). \(x\) is less than 180°.

Prove the bearing of B to A is \((180 + x)^\circ\)

---

Find the area of the triangle

---

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27th January

Write \(1.24\) as a mixed number. Give your answer in its simplest form.

Write in the form \(a\sqrt{2}\)

\[\sqrt{72} + \sqrt{3 \times \sqrt{6}}\]

<table>
<thead>
<tr>
<th>Mass (m kg)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 &lt; m ≤ 45</td>
<td>64</td>
</tr>
<tr>
<td>45 &lt; m ≤ 50</td>
<td>74</td>
</tr>
<tr>
<td>50 &lt; m ≤ 55</td>
<td>155</td>
</tr>
<tr>
<td>55 &lt; m ≤ 60</td>
<td>80</td>
</tr>
<tr>
<td>60 &lt; m ≤ 65</td>
<td>26</td>
</tr>
<tr>
<td>65 &lt; m ≤ 70</td>
<td>1</td>
</tr>
</tbody>
</table>

Calculate an estimate of the interquartile range.

Shown is the graph of the function \(y = f(x)\)

Sketch
(a) \(-f(x)\)
(b) \(f(x + p)\) where \(0 < p < 1\)
### 28th January

**Solve the inequality**

\[ 5x^2 < 45 \]

**Jack picks three apples at random, one at a time, replacing each before picking the next. Find the probability that he chooses two over 90g and one under 75g.**

**The box plot shows information about the masses of apples in a box**

**The minimum point of a quadratic graph in the form \( y = x^2 + ax + b \) is \((-2, -10)\).**

Find \( a \) and \( b \).

**\( f(x) = 3x - 5 \)**

Find \( f^{-1}(x) \)

**ABCD and LMNO are squares. Angle CBL = x**

Prove that triangles ABO and CBL are congruent.
29th January

Shown is the graph of the function $y = f(x)$

Sketch
(a) $f(-x)$
(b) $f(x) + 3$

Find the coordinates where the line $2x - y + 3 = 0$ and the curve $y = x^2 - x - 7$ intersect

Find $P(A|B')$

Prove the opposite angles in a cyclic quadrilateral add to $180^\circ$
30th January

Make y the subject of the formula

\[ c = w - 4ay^3 \]

Calculate \( \theta \)

Perimeter = 22.81 cm

\[ \theta \]

\[ \begin{array}{c}
\bigcirc \\
C \\
4x \\
7 \\
D \\
\bigcirc
\end{array} \]

\( \xi = 40 \) students
C = students who own a cat
D = students who own a dog

A student is chosen at random. They own a dog. Work out the probability that they own a cat

\( \xi = 40 \) students

State the coordinates of the vertex of the curve \( y = x^2 + 10x + 21 \)
<table>
<thead>
<tr>
<th>31st January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expand and simplify</td>
</tr>
<tr>
<td>((2x + 3)^3)</td>
</tr>
<tr>
<td>Make (m) the subject of the formula</td>
</tr>
<tr>
<td>(E = mgh + \frac{1}{4}mv^2)</td>
</tr>
<tr>
<td>Calculate the sum of the first 50 odd numbers</td>
</tr>
<tr>
<td>Solve the inequality</td>
</tr>
<tr>
<td>(12x^2 + 7x + 1 \leq 0)</td>
</tr>
<tr>
<td>How many regular polygons have integer interior angles?</td>
</tr>
</tbody>
</table>