1. Find, to the nearest penny, the compound interest on £2,400 for 2 years at 4\% per annum. Use the compound interest formula to find approximately the sum of money which would amount to £1,000 in 12 years at 5\% per annum.

2. (a) Two brothers David and William begin work in 1970 on commencing salaries of £800 and £1,000 per year respectively. David’s salary rises by £70 per year and William’s by £50 per year. When will both brothers have the same yearly salary? How much more than David will William have earned in the meantime?

(b) In the geometric series
\[
\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \ldots
\]
find an expression for the 20th term and show that the sum of 20 terms is
\[
\frac{1}{2} - \frac{1}{2^{20}}.
\]
What is the limit of the sum of n terms as n increases indefinitely?

3. (a) Define a complex number.
Explain why the set of real numbers is a subset of the set of complex numbers. What is the identity element for the addition of complex numbers? What is the additive inverse of \(3 - 4i\)? Express the multiplicative inverse of \(3 - 4i\) in the form \(a + bi\).

(b) \(z_1 = 2 - 4\) and \(z_2 = 2 + 4i\). Express \(z_1, z_2\) in the form \(a + bi, a, b \in \mathbb{R}\). What is \(|z_1|^2\)? Show that \(|z_1|, |z_2| = |z_1|, |z_2|\).
4A. (a) A = \{1, 2\}, B = \{1\}, C = \{2\}, D = \emptyset.
Draw up a Cayley table for the binary operation of intersection on \{A, B, C, D\}.
Is there an identity element? If so, what is it? Which element has an inverse?
Why is the set \{A, B, C, D\} not a group under intersection?
(b) For an equilateral triangle show that the set of rotations about the centroid mapping the triangle onto itself forms a commutative group under composition.

4B. (a) The table shows the number of graded potatoes per stalk in 100 stalks.

<table>
<thead>
<tr>
<th>no. of potatoes per stalk</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of stalks</td>
<td>4</td>
<td>9</td>
<td>14</td>
<td>25</td>
<td>26</td>
<td>12</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Draw a histogram to represent the distribution. What is the median number of graded potatoes per stalk? Explain your answer.
(b) Show that the mean of the distribution given by the following table is 3, and find the standard deviation:

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>frequency</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

5. (a) R is the relation \{(a, a), (a, b), (a, c), (b, b), (b, c), (c, c)\} on the set \{a, b, c\}.
Give reasons, say whether the relation is
(i) reflexive, (ii) symmetric, (iii) transitive, (iv) an equivalence relation,
(v) an order relation?
(b) \((x, y) \in R\) if \((x, y) \in R\) and \((y, x) \in R\). List the elements of \((R) \circ (R)\), \((R) \circ (R)\).
For what value of \(x\) is \(g \circ f(x) = 1\). For what \(y\) is \(f \circ g(y) = y\)?

6. (a) \(f\) is the map \(x + f(0) = \frac{12 - x - x^2}{2}\).
For what values of \(x\) is \((i) f(x) = 0, (ii) f(x) = -3\)?
What is the maximum value of \(12 - x - x^2\) and what value of \(x\) gives this maximum?
(b) If \(x \in \{-3, -2, -1, 0, 1, 2, 3\}\), write down the set of values of \(x\) for which:-(i) \(3 - 2x > 5\), (ii) \(x - 3 > 1\), (iii) \(x > 2x - 5\), (iv) \(x > 14\).

7. \(f\) is the map \(x + f(x) = x^3 - 2x^2 + 5x + 6\). What is \(f(3), f(0), f(-1)\)?
Find the solution set of \(\{x | x^3 - 2x^2 + 5x + 6 = 0\}\).
Graph the function \(\{(x, y) | x^3 - 2x^2 + 5x + 6 = y\}, x \in \mathbb{R}\), and trace the changes in value and sign of \(y\) for the domain \(-2 \leq x \leq 3\).

8. (a) \(\log_2 2 = x, \log_3 3 = y\). Express in terms of \(x\) and \(y\):
\((i) \log_2 6, (ii) \log_4 24, (iii) \log_2 3, (iv) \log_5 \sqrt{5}\)
(b) Show that
\(2^x, 3^x + 2^x, 3^x = \frac{2 \log_2 x}{6}\).

9. (a) Find the differential coefficient of \(x^3 + 1\) from first principles.
What is the value of the differential coefficient when \(x = 1\)? Interpret your result geometrically.
(b) \(f : \mathbb{R} \to \mathbb{R}; \ x \to x^3 + 1\). Show that \(f(x)\) increases as \(x\) increases.
(c) Evaluate \(\int (3x - 1)^2 \, dx\).

10. (a) Differentiate \(\frac{2x - 3}{x^2 - 2x + 3}\)
(b) The distance \(s\) ft. travelled in time \(t\) sec. by a stone thrown vertically upwards is given by
\(s = 16(2t - t^2)\)
Show that the stone stops after 1 second having travelled 16 feet. Show that the rate of change of the velocity is constant at all times.