Six questions to be attempted.
All questions are of equal value.
Mathematics tables may be obtained from the Superintendent.

1. (a) Calculate the compound interest on £1,200 for 2 years at 9% per annum.
(b) A bought goods and sold them to B making a profit of 10%. B then sold the goods for £5.94 and his profit was 20%. What did A pay for the goods and what was B’s profit in cash?

2. (a) Find the solution set of
(i) \(2x - 1 < x - 2\)
(ii) \(2x - 1 < x - 2 \leq 3x + 10\)
and graph the solution set on the number line in each case.
(b) Factorise \(2x^2 + 5x - 3\) and hence, or otherwise, find the solution set of \(2x^2 + 5x \leq 3\) and graph the solution set on the number line.

3. (a) Use Venn diagrams to illustrate that
\[A \cap (B \cup C) = (A \cap B) \cup (A \cap C)\]
(b) A music group consists of 30 members each of whom can sing and also play an instrument. The group gives a number of performances and occasionally some members are absent. During each performance, however, 18 must play and 24 must sing, some playing and singing at the same time.
(i) When 2 members are absent, how many sing only?
(ii) how many both play and sing at the same time?
(iii) how many play only?

What is the greatest number:
(iv) that can play and sing at the same time?
(v) that can be absent at the same time?

4. Let \(P = \{a, b, c, d, e, f\}\). Draw a Venn diagram of \(P\) and put their names on the elements.
Graph the relations:
(i) \(\mathcal{R} = \{(d, a), (d, f)\}\)
(ii) \(\mathcal{S} = \{(f, a), (f, b), (f, c), (f, d)\}\).
Write down the elements of:
(a) \(\mathcal{R}^{-1}\)
(b) \(\mathcal{S}^{-1}\)
(c) \(\mathcal{S} \circ \mathcal{R}^{-1}\)
(d) \((\mathcal{S} \circ \mathcal{R})^{-1}\)
(e) \((\mathcal{S} \circ \mathcal{R}^{-1})^{-1}\).
Is \((\mathcal{S} \circ \mathcal{R})^{-1} = \mathcal{S}^{-1} \circ \mathcal{R}^{-1}\)? Give a reason for your answer.

5. (a) The \(n\)th term of an arithmetic sequence is \(2n + 5\). Write down the first four terms of the sequence and find which term of the sequence is 135.
(b) The first three terms of an arithmetic sequence are 5, \(x\), 10\(\frac{1}{2}\). Find \(x\) and the common difference of the sequence.
(c) Write down the first four terms of the sequence \(3(2)^{n-2}\) and say, giving a reason, whether the sequence is geometric or not.
6. Sketch the graph of the function $f$ for $0 \leq x \leq 6$ given that:

$$f(x) = -x^2 + 6x - 5.$$  

Find from your graph the values of $x$ for which

(i) $f(x) > 0$,
(ii) $f(x)$ is positive and increasing.

Show from your graph that $f(x)$ will never be equal to 5 and find those values of $x$ for which $f(x) = x$.

7. An open tin box has a volume of 54 cm$^3$. The box was made from a large square sheet of tin, $A$, by cutting away a small square of side 3 cm from each corner of $A$ and then turning the four outer edges vertically upwards. (See the diagram in which the outer edges are indicated by shading). Find:

(i) the length of the side of the square $A$,
(ii) the area of the square $A$.

(Note: you may leave your answer in surd form in each case).

8. (a) (i) Write the denary numbers 13 and 4$\frac{1}{2}$ in binary form.
(ii) Write the binary numbers 1111 and 1.111 in denary form.

(b) (i) Find the value of each of the following:

$$\log_2 9; \log_3 8; \log_5 3.$$  

(ii) Find the solution set of:

$$\{ x \mid \log_{13} (x^2 + x + 8) = 1 \}. $$

9. The following table shows the frequency distribution of the marks in an examination:

<table>
<thead>
<tr>
<th>Mark</th>
<th>0-20</th>
<th>20-30</th>
<th>30-40</th>
<th>40-50</th>
<th>50-60</th>
<th>60-70</th>
<th>70-100</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of</td>
<td>4</td>
<td>8</td>
<td>14</td>
<td>20</td>
<td>30</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>candidates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Note: 0-20 means 0 but less than 20, 20-30 means 20 but less than 30 etc.)

Draw a histogram to illustrate the distribution. Find:

(i) the total number of candidates,
(ii) the modal class,
(iii) the median mark of the distribution.

10. Using the same axes and the same scales draw:

(i) the line $2x + y = 0$,
(ii) the triangle $ABC$ whose vertices are $A(3,5), B(2,2), C(6,4)$.

If $S$ is the set of points $(x,y)$ of the triangle together with its interior, find the points of $S$ for which:

(iii) $2x+y$ is a minimum,
(iv) $2x+y$ is a maximum,
and find the minimum and maximum values.

Indicate the points of $S$ for which:

(v) $2x+y = 8$,
(vi) $8 \leq 2x+y \leq 12$.  