6. \( a(-2, -3), b(7, 3), c(3, 5) \) are the coordinates of the vertices of a triangle.
Verify that \( m \), the midpoint of \([ab]\), is on the x-axis.
Find the slope of \( cm \) and hence find the equation of the line through \( b \) which is parallel to \( cm \).
Investigate if \( c \) is inside the circle drawn on \([ab]\) as diameter.

7. (a) Using the usual notation prove that
area of \( \Delta = \frac{1}{2} \) ab \( \sin C \)
and hence, or otherwise, deduce that
\[
\frac{a}{\sin A} = \frac{c}{\sin C}
\]

(b) \( pqr \) is a triangular field in which
\[
\begin{align*}
|qr| &= 100 \text{ m} \\
\angle pqr &= 47^\circ 44' \\
\angle pqr &= 53^\circ 45'.
\end{align*}
\]
A farmer wishes to sow 2220 m\(^2\) of wheat in the triangular piece \( qrx \) and potatoes in the remainder. Calculate the required distance of \( x \) from \( q \).
Find, correct to two significant figures, the length \( |pr| \) and hence calculate, as accurately as the tables allow, the area sown under potatoes.

INTERMEDIATE CERTIFICATE EXAMINATION, 1981

MATHEMATICS - HIGHER COURSE - PAPER II (300 marks)

SECTION A (100 marks)

1. \( 120_3 + 12_3 \) is
   (a) \( 10_{10} \)  (b) \( 10_3 \)  (c) \( 101_3 \)  (d) \( 133_3 \)

2. \( \frac{5}{12} \) of a sum of money is \( \text{IR} 500 \). The sum of money in \( \text{IR} \) is
   (a) \( 25 \)  (b) \( 20 \)  (c) \( \frac{300}{12} \)  (d) \( 168 \)

3. If \( p : q = 3 : 7 \) and \( q : r = 3 : 7 \), then \( p : r \) is
   (a) \( 3 : 7 \)  (b) \( 9 : 21 \)  (c) \( 9 : 49 \)  (d) \( 21 : 49 \)

4. \( (0.4)^2 \) lies between
   (a) \( 0.4 \) and \( 1 \)  (b) \( 0.2 \) and \( 1 \)  (c) \( 0.1 \) and \( 0.2 \)  (d) \( 0 \) and \( 0.1 \)

5. If the radius of a sphere is doubled, then the volume of the sphere is increased \( x \) times. \( x \) is
   (a) \( 2 \)  (b) \( 4 \)  (c) \( 6 \)  (d) \( 8 \)

6. \( (1 + \frac{r}{100})^2 = 1.44 \). Then \( r \) is
   (a) \( 20 \)  (b) \( 2 \)  (c) \( 200 \)  (d) \( 0.2 \)

7. Each term of a sequence is to be an odd number. The \( n \)th term is
   (a) \( n + 1 \)  (b) \( 3n \)  (c) \( 3n + 1 \)  (d) \( 2n + 1 \)
If \( \# A \) is 7 and \( \# B \) is 5, where \( A, B \) are sets, then \( \# (A \cap B) \) can not be

(a) 0 (b) 3 (c) 5 (d) 7

Which of the following is not a function?

(a) \((p, p), (q, q), (r, r)\)
(b) \((p, q), (q, p), (r, r)\)
(c) \((p, p), (q, r), (r, p)\)
(d) \((p, p), (q, q), (p, r)\)

The set of values of \( x \) for which \((3x + 2)(3 - 2x) = 0\) is

(a) \(-1\frac{1}{2}, -\frac{3}{2}\)  (b) \(1\frac{1}{2}, -\frac{3}{2}\)  (c) \(1\frac{1}{2}, \frac{3}{2}\)  (d) \(-1\frac{1}{2}, \frac{3}{2}\)

8 1\(\frac{1}{2}\) is

(a) 16  (b) 10  (c) 2  (d) 6\(\frac{4}{3}\)

\(\log_x p\) = 3. Then \(x\) is

(a) \(p\frac{1}{3}\)  (b) \(p\frac{-3}{2}\)  (c) \(p\frac{3}{2}\)  (d) \(p^{18}\)

Two taps together fill a bath in 9 minutes. One tap flows twice as fast as the other. The slower tap alone would fill the bath in \(y\) minutes. \(y\) is

(a) 12  (b) 18  (c) 27  (d) 3

\((x^6 - 1) + (x^2 - 1)\) is

(a) \(x^3 + 1\)  (b) \(x^3 - 1\)  (c) \(x^4 - x^2 + 1\)  (d) \(x^4 + x^2 + 1\)

If \(f : x \rightarrow x - 2\) then a sketch of \(f^{-1}\) is

(a)  
(b)  
(c)  
(d)  

If \(A \cup B = \{1, 2\}\) and \(B \cup C = \{2, 3\}\), then \(A \cap B \cap C\) can be

(a) \(\{2\}\)  (b) \(\{2, 3\}\)  (c) \(\{1, 2, 3\}\)  (d) \(\{1\}\)

If \(f(x^2 + 7) = 2x^2 + 7\), then \(f\) is \(x \rightarrow\)

(a) \(2x - 7\)  (b) \(2x^2\)  (c) \(2x^2 + 7\)  (d) \(x + 7\)

If \(w = \frac{1 - 2v}{7}\), then \(v\) is

(a) \(7w - t\)  (b) \(\frac{1 - 7w}{2}\)  (c) \(\frac{7w - t}{2}\)  (d) \(\frac{7w}{t - 2}\)

The range of values of \(x\) for which \((x - 1)(x + 2) < 0\) is

(a) \(-2 < x < 1\)  (b) \(x < -2\) and \(x > 1\)
(c) \(-2 < x < 1\)  (d) \(-2 < x < 1\)

Let \(u \cdot \nu = (u + \nu)(u - \nu)\). Then \(u \cdot \nu = 0\) always implies

(a) \(u + \nu = u - \nu\)  (b) \(u = 0\) and \(\nu = 0\)
(c) \(u = 0\) or \(\nu = 0\)  (d) \(u = \nu\) or \(u = -\nu\)
1. (a) The water surface in a canal lock is 21 m in length and 10 m in width. The level of water is raised 3.5 m in ten minutes by a flow of water into the lock. Calculate the rate of flow in litres per second.

(b) Using tables, P.20 - P.27, or otherwise, evaluate as accurately as the tables allow
\[
\sqrt{\frac{1}{t} + \sqrt{u} + w^2}
\]
where \( t = 0.2959 \), \( u = 841 \) and \( w = 6.856 \).

2. (a) Factorise
   (i) \( x^2 - 49 \)
   (ii) \( 8x^2 - 27 \)
   (iii) \( 6x^2 - 29x + 28 \).

(b) Evaluate \( x \) in each of the following, giving your answers correct to one place of decimals
   (i) \( 3x^2 + x - 1 = 0 \)
   (ii) \( 3(x + 1)^2 + x = 0 \).

3. \( f \) is a function defined on \( \mathbb{R} \):
\[
f : x \rightarrow ax^2 + bx + c.
\]
If \( f(0) = 1 \), find the value of \( c \).
If \( f(1) = 0 \) and \( f(-1) = 0 \), find the value of \( a \) and the value of \( b \).

\( g \) is another function defined on \( \mathbb{R} \):
\[
g : x \rightarrow x - 1.
\]
Express (i) \( gf(x) \) (ii) \( fg(x) \) in terms of \( x \), where \( gf \) and \( fg \) are composite functions.
Indicate on the number line the set of values of \( x \) for which
\[
fg(x) \geq gf(x) + 3.
\]

4. Using the same axis and the same scales draw graphs of the functions
   (i) \( f : x \rightarrow 4x^2 + 8x - 5 \)
   (ii) \( g : x \rightarrow 2x + 5 \)
in the domain \(-3 \leq x \leq 1, \ x \in \mathbb{R}\).
Using the graphs, or otherwise, estimate
   (i) the values of \( x \) for which \( f(x) - g(x) = 0 \)
   (ii) the range of values of \( x > -2 \) for which \( f(x) + g(x) > 0 \)
   (iii) the maximum value of \( f(x) + g(x) \).

5. (a) Find the solution set of
\[
\frac{1}{x + 1} - \frac{3}{x^2 + 3x + 2} = \frac{1}{2x(x + 1)}, \ x \in \mathbb{R}.
\]

(b) Let \( p = \log_{10} 3 \) and \( q = \log_{10} 2 \).
Express (i) \( p + q \) and \( p - q \) in the form \( \log_{10} n \).
Express (ii) \( (\log_{10} 16 + \log_{10} 15) \) and \( \log_{3} 6 \) in terms of \( p \) and \( q \).
6. The number of cars rented out in each of nine months by a firm is:

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<td>34</td>
<td>30</td>
<td>53</td>
<td>61</td>
<td>81</td>
<td>89</td>
<td>46</td>
</tr>
</tbody>
</table>

(i) Calculate the mean number of cars rented out per month.
(ii) Draw a trend graph of the monthly rentals, taking the months along the horizontal axis.
(iii) Calculate the difference between the rentals in each month and the mean. Find the sum of these differences.
(iv) After how many months was half the nine month total of rentals completed?
(v) On the same graph as (ii) draw the graph of the three point moving average of the monthly sales.

7. Write an equation expressing distance in terms of speed and time.

A cyclist races a measured distance downhill in 40 seconds and the same measured distance uphill in 120 seconds.

If the speed uphill is 19 km/hr slower than the speed downhill, calculate both speeds.

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**INTERMEDIATE CERTIFICATE EXAMINATION, 1982**

**MATHEMATICS - HIGHER COURSE - PAPER 1 (300 marks)**

**SECTION A (100 marks)**

1. \((0.01)^2 \times 1000\) is

   (a) 0.1  
   (b) 1  
   (c) 10  
   (d) 100

2. IRE50 was invested for 2 years at 10% per annum compound interest. The interest for the second year in IRE was

   (a) 5  
   (b) 10.50  
   (c) 5.50  
   (d) 60.50

3. If 60% of a certain number is \(\frac{2x}{5}\), then 40% of the same number is

   (a) \(\frac{2x}{5}\)  
   (b) \(\frac{3x}{4}\)  
   (c) \(\frac{3x}{25}\)  
   (d) \(\frac{x}{3}\)

4. Each edge of a cube measures 8 cm. The number of cubes of edge 2 cm that can be made from this cube is

   (a) 8  
   (b) 16  
   (c) 32  
   (d) 64

5. 700 cm\(^3\) in litres is

   (a) 7.0  
   (b) 0.7  
   (c) 0.007  
   (d) 700

6. \(p\) is the centre of a couple \((q, k)\) if

   (a) \(\frac{1}{2}|qk| = p\)  
   (b) \((q, p) \uparrow (k, p)\)  
   (c) \((q, p) \uparrow (p, k)\)  
   (d) \(|qp| = 2|qk|\)

7. \(S_A\) is the axial symmetry in the line \(A\). Which one of the following is false?

   (a) \(S_A \circ S_A = S_A\)  
   (b) \(S_A \circ S_A = I\)  
   (c) \(S_A^{-1} = S_A\)  
   (d) \(S_A \circ S_A^{-1} = I\)