Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION, 2007

MATHEMATICS – HIGHER LEVEL

PAPER 1 (300 marks)

THURSDAY, 7 JUNE – MORNING, 9:30 to 12:00

Attempt **ALL** questions.

Each question carries 50 marks.

Graph paper may be obtained from the superintendent.

The symbol ✍ indicates that supporting work must be shown to obtain full marks.

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1. **(a)** ✍ Express the speed 72 km/h in metres per second.

(b) **(i)** ✍ In 1981 the population of Peru was approximately $1{\cdot}8\times10^7$.

By 1988 the population had increased by 2·5 million.

What would be the approximate population of Peru in 1988?

Express your answer in the form $a \times 10^n$, where $n \in \mathbf{Z}$ and $1 \le a < 10$.

(ii) ✍ A snowman has a mass of 12 kg.

It melts at a rate of 0·2% of its mass per minute.

What will be the mass of the snowman after 3 minutes?

Give your answer correct to 2 decimal places.

(c) **(i)** ✍ Simplify

$$\frac{2^5 \times 8^{\frac{2}{3}}}{64^{\frac{1}{2}} \times 4^2}.$$

Give your answer in the form 2^n, where $n \in \mathbf{N}$.

(ii) ✍ Simplify $(\sqrt{6}-2\sqrt{3})(5\sqrt{3}-3\sqrt{6})$,

without the use of a calculator.

Express your answer in the form $a\sqrt{2}+b$, where $a, b \in \mathbf{Z}$.

2. **(a)** ✍ An auctioneer sells a house for €830,000. The auctioneer's fee is 1·5% on the first €500,000 and 2·5% on the remainder.
Calculate the auctioneer's fee.

(b) **(i)** ✍ By putting the smallest number first, place the following numbers in order: $\frac{10}{7}$, $\sqrt{2}$, $\frac{7}{2\sqrt{6}}$, $(1{\cdot}19)^2$.

(ii) ✍ What sum of money invested at 2% per annum compound interest would produce interest of €306·04 after three years?

(c) A survey of 40 students was carried out to find how many owned an MP3 player, a digital camera or a CD player.
1 student does not own any of these.
x students own all three, while $2x$ own an MP3 player and a digital camera but not a CD player.
10 own an MP3 player and a CD player, while 11 own a digital camera and a CD player.
22 own an MP3 player, 22 own a digital camera and 24 own a CD player.

(i) ✍ Construct a Venn diagram and solve for x.

(ii) ✍ Hence, calculate the percentage of students who own one item only.

3. **(a)** ✍ Solve $\frac{3-2m}{5} = 3$, where $m \in \mathbf{Z}$.

(b) **(i)** ✍ Simplify

$$\frac{2x^2+4x-30}{x-3}.$$

(ii) ✍ Solve $3x^2+9x+10=(2x+2)^2-1$ and give your answers correct to one decimal place.

(c) **(i)** ✍ Solve the equation $3a^2+5a=2$.

(ii) ✍ Hence, or otherwise, find the two values of $t \in \mathbf{R}$ for which

$$3\left(\frac{1}{t}\right)^2+5\left(\frac{1}{t}\right)=2.$$

(iii) ✍ Verify your values for t from part **(ii)**, above.

4. **(a)** ✍ When $x = \frac{1}{3}$, find the value of $\frac{3}{x+1} + \frac{4}{x+5}$.

(b) **(i)** ✍ Factorise $6c + 12bd - 8d - 9bc$.

(ii) ✍ Simplify

$(7x - 2)(7x + 2) - (5y - 2)(5y + 2)$

and fully factorise the simplified expression.

(c) The distance from town A to town B is half the distance from town B to town C. The total journey from town A to town C, through town B, is 60 km.

A car travels at x km/h from town A to town B. It increases its speed by 20 km/h on the journey from town B to town C.

The total time for the journey is 50 minutes.

✍ Find the value of x.

5. **(a)** ✍ Graph on the number line the solution set of

$$-98 \leq 10 - 12x,\ x \in \mathbf{N}.$$

(b) **(i)** Let f be the function $f: x \to 2x^2 - 4x + 5$.

✍ Draw the graph of f for $-2 \leq x \leq 4,\ x \in \mathbf{R}$.

(ii) ✍ Use your graph to find the values of x for which $f(x) = 7$.

(c) **(i)** Let f be the function $f: x \to 2x - 1$ and g be the function $g: x \to 4x - 4$.

✍ Using the same axes and scales, draw the graph of f

and the graph of g, for $0 \leq x \leq 2,\ x \in \mathbf{R}$.

(ii) From your graphs, write down the co-ordinates of the point of intersection of the two lines.

(iii) ✍ Check your answer to part **(ii)** by solving the simultaneous equations

$$y = 2x - 1$$
$$y = 4x - 4.$$

6. **(a)** ✍ Given that $f: x \to 3x + 1$ and $g: x \to 1 + x^2$,

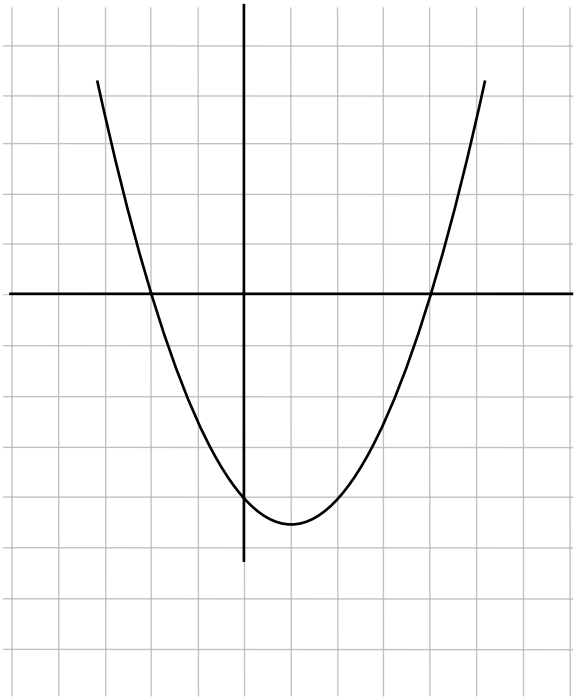
solve for x: $f(x) = g(x)$, $x \in \mathbf{N}$.

(b) **(i)** ✍ Given that $x = 2a + 1$ and $y = 2ax - 4a^2$, express y in terms of a.

(ii) ✍ Hence, or otherwise, find the value of x for which $y = 4$.

(c) The diagram shows part of the graph of the function

$f: x \to x^2 + bx + c$, where $x \in \mathbf{R}$ and $b, c \in \mathbf{Z}$.



The graph intersects the x-axis at (-1, 0) and (2, 0).

(i) ✍ Calculate the value of b and the value of c.

(ii) ✍ $(k, -k+14)$ is a point on the graph, where $k \in \mathbf{Z}$.

Find the values of k.

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