Coimisiún na Scrúduithe Stáit
State Examinations Commission

JUNIOR CERTIFICATE EXAMINATION, 2013

MATHEMATICS – HIGHER LEVEL

PAPER 1 (300 marks)

FRIDAY, 7 JUNE – AFTERNOON, 2.00 to 4.30

Attempt **ALL** questions.

Each question carries 50 marks.

Graph paper may be obtained from the superintendent.

The symbol ✍ **indicates that supporting work <u>must</u> be shown to obtain full marks.**

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1. **(a)** Adam got 24 marks from a total of 30 marks in a class test.

✎ What percentage mark did Adam get?

(b) **(i)** Place the following numbers in order, starting with the smallest number:

$$4^{\frac{1}{2}}, \quad 4^{-2}, \quad 2^{0}, \quad 2^{-3}.$$

(ii) ✎ By rounding correct to the nearest whole number,

estimate the value of

$$\frac{7 \cdot 72}{2 \cdot 35} + (3 \cdot 4)^{2} \left(\frac{8 \cdot 65}{2 \cdot 9} - \sqrt{1 \cdot 49} \right).$$

Then, evaluate

$$\frac{7 \cdot 72}{2 \cdot 35} + (3 \cdot 4)^{2} \left(\frac{8 \cdot 65}{2 \cdot 9} - \sqrt{1 \cdot 49} \right),$$

correct to one decimal place.

(c) Ciara invested €30 000 for three years at 3% per annum compound interest.

(i) ✎ Calculate the amount of the investment at the end of two years.

At the end of two years a sum of money was withdrawn. The money which remained amounted to €12 181·81 at the end of the third year.

(ii) ✎ Calculate the sum of money withdrawn at the end of two years.

2. **(a)** The lengths of two pieces of timber are in a ratio of 5 : 2.

The larger piece measures 250 mm.

✍ Find the length of the shorter piece.

(b) Each week David is paid €14 per hour for the first 35 hours worked
and €21 per hour for any hours worked after that.

(i) ✍ Last week he worked 38 hours. Calculate his gross pay for last week.

The standard rate of income tax is 20% and the higher rate is 41%.
The standard rate cut-off point is €230 per week and he has a tax credit
of €62 per week.

(ii) ✍ Calculate David's take-home pay after tax has been deducted.

(iii) ✍ What percentage of his gross pay is his take-home pay?

Give your answer correct to the nearest whole number.

(c) A survey was carried out in a class to find which of the films A, B or C
the students had seen.
The following data was collected:

42% saw film A   41% saw film B   45% saw film C

12% saw both A and B   18% saw both B and C   15% saw both A and C

15% saw none of these films.

(i) ✍ Represent this information on a Venn diagram.

(ii) ✍ What percentage of the students in the class saw all three films?

(iii) ✍ What percentage of the students in the class saw two or more of the
films?

3. **(a)** ✍ Solve for x:

$$3x - [5 - (x - 3)] = 6.$$

(b) **(i)** ✍ Find the largest possible value of n such that

$$5n + 48 > 8n - 6, \ n \in \mathbb{N}.$$

(ii) x represents an even number. Explain why $x + 2$ is the next even number.

(iii) If one third of the smaller even number is subtracted from half of the larger even number the result is 8.

✍ Find the value of x.

(c) **(i)** ✍ Given that $a^2 = \dfrac{bc^2 + a + c}{b}$,

show that $b = \dfrac{1}{a - c}$.

(ii) ✍ If $a = 1\dfrac{1}{2}$ and $c = 2\dfrac{1}{3}$, find the value of b.

4. **(a)** ✍ Express in its simplest form:

$$\frac{5-x}{5} + \frac{x-4}{4}.$$

(b) **(i)** Factorise $8x^2 - 12x$.

(ii) Factorise $4x^2 - 12x + 9$.

(iii) ✍ Simplify $\dfrac{8x^2 - 12x}{4x^2 - 12x + 9}.$

(c) A teacher checks out the cost of calculators for her students on two websites, C and D.

On website C, for €480, she can get a class set of calculators, one for each student.

On website D, for the same price, she can get 4 extra calculators.

If x represents the number of students in her class,

(i) write an expression in x for the cost per calculator on website C

and an expression in x for the cost per calculator on website D.

The cost per calculator on website D is €6 cheaper than the cost per calculator on website C.

(ii) ✍ Use this information to form an equation in x and solve it to find

the number of students in the class.

5. (a) ✍ $g(x) = \sqrt{5x - 2}$, $x \in \mathbb{N}$. Find $g(2)$.

Give your answer in the in the form $a\sqrt{a}$, $a \in \mathbb{N}$.
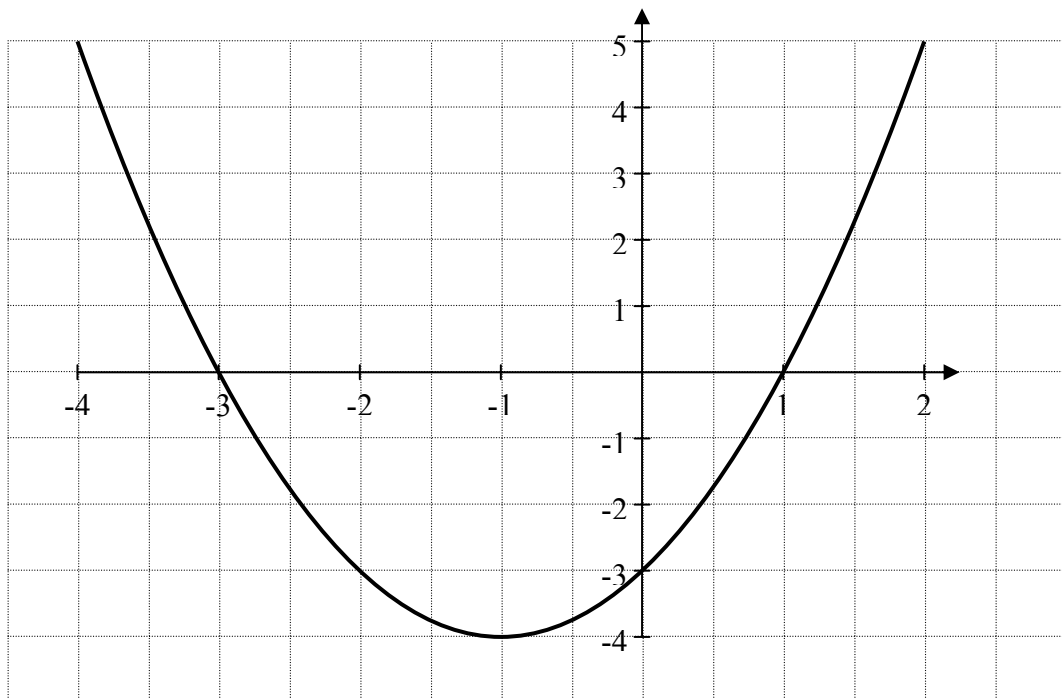
(b) **(i)** ✍ Solve the equation $x^2 = 3x + 2$.

Give your answers correct to two decimal places.

(ii) ✍ Hence, or otherwise, find two values for p for which $p = 3\sqrt{p} + 2$.

Give your answers correct to one decimal place.

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

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

(i) The graph cuts the x axis at $(-3, 0)$ and $(1, 0)$, as shown in the diagram.

✍ Calculate the value of b and the value of c.

(ii) The graph has a minimum point at $(-1, 4)$.
Write down the equation of the axis of symmetry of the function
in the form $x = k$, where $k \in \mathbb{Z}$.

(iii) ✍ Show that $f(x + 1) = x^2 + 4x$.

6. A rectangular site, with one side facing a road, is to be fenced off.

The side facing the road, which does not require fencing, is *l* m in length.

The sides perpendicular to the road are *x* m in length.

The length of fencing that will be used to enclose the rest of the site is 140 m.
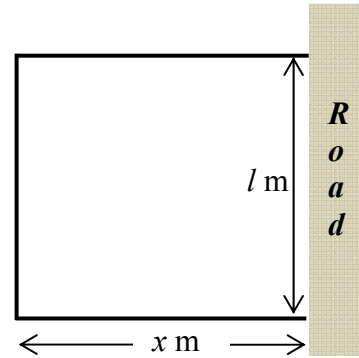
(a) ✎ Write an expression, in terms of *x*, for the length (*l*) of the side facing the road.

(b) (i) ✎ Show that the area of the site, in m², is $-2x^2 + 140x$.

(ii) Let *f* be the function $f : x \rightarrow -2x^2 + 140x$.

✎ Evaluate $f(x)$ when $x = 0, 10, 20, 30, 40, 50, 60, 70$.

Hence, draw the graph of *f* for $0 \leq x \leq 70,\ x \in \mathbb{R}$.

(c) Use your graph from part **(b)** to estimate:

(i) ✎ the maximum possible area of the site

(ii) ✎ the area of the site when the road frontage (*l*) is 30 m long.

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