

## MATHEMATICS STANDARD LEVEL PAPER 2

Thursday 3 November 2011 (morning)

1 hour 30 minutes



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#### **INSTRUCTIONS TO CANDIDATES**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions in the boxes provided.
- Section B: answer all questions on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.

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- At the end of the examination, indicate the number of sheets used in the appropriate box on your cover sheet.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.

Full marks are not necessarily awarded for a correct answer with no working. Answers must be supported by working and/or explanations. In particular, solutions found from a graphic display calculator should be supported by suitable working, e.g. if graphs are used to find a solution, you should sketch these as part of your answer. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. You are therefore advised to show all working.

## **SECTION A**

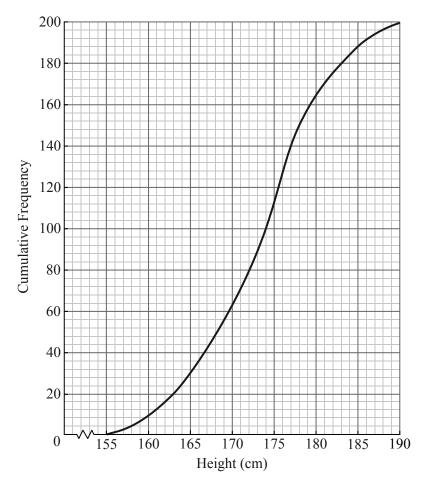
Answer all questions in the boxes provided. Working may be continued below the lines if necessary.

(b) Find $(f \circ g)(x)$ . [2 marks	[Ma.	ximum mark: 7]	
(b) Find $(f \circ g)(x)$ . [2 marks]	Let	$f(x) = 2x + 4$ and $g(x) = 7x^2$ .	
(c) Find $(f \circ g)(3.5)$ . [2 marks]	(a)	Find $f^{-1}(x)$ .	[3 marks]
	(b)	Find $(f \circ g)(x)$ .	[2 marks]
	(c)	Find $(f \circ g)(3.5)$ .	[2 marks]
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# 2. [Maximum mark: 6]

The cumulative frequency curve below represents the heights of 200 sixteen-year-old boys.



Use the graph to answer the following.

(a)	Write down the median value.	[1 mark

(b) A boy is chosen at random. Find the probability that he is shorter than 161 cm. [2 marks]

(c) Given that 82 % of the boys are taller than h cm, find h. [3 marks]

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**Turn over** 

3. [Maximum mark: 6]

Consider the following circle with centre O and radius 6.8 cm.

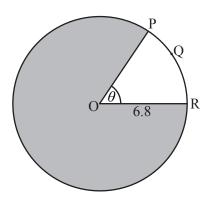


diagram not to scale

The length of the arc PQR is 8.5 cm.

(a) Find the value of  $\theta$ .

[2 marks]

(b) Find the area of the shaded region.

[4 marks]




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4.	[Maximum]	mark:	6/

Consider the triangle ABC, where AB = 10, BC = 7 and  $C\hat{A}B = 30^{\circ}$ .

(a) Find the two possible values of  $\hat{ACB}$ .

[4 marks]

(b) Hence, find  $\hat{ABC}$ , given that it is acute.

[2 marks]




	Con	sider the expansion of $(3x^2 + 2)^9$ .	
(b) Find the term in x <sup>4</sup> . [4 ma.	(a)	Write down the number of terms in the expansion.	[1 mar
	(b)	Find the term in $x^4$ .	[4 mark



6.	[Maximum	mark:	87

Jose takes medication. After t minutes, the concentration of medication left in his bloodstream is given by  $A(t) = 10(0.5)^{0.014t}$ , where A is in milligrams per litre.

(a)	Write down $A(0)$ .	[1 mark]
(b)	Find the concentration of medication left in his bloodstream after 50 minutes.	[2 marks]
(c)	At 13:00, when there is no medication in Jose's bloodstream, he takes his first dose of medication. He can take his medication again when the concentration of medication reaches 0.395 milligrams per litre. What time will Jose be able to take his medication again?	[5 marks]




7. [Maximum mark: 7]

Let  $f(t) = 2t^2 + 7$ , where t > 0. The function v is obtained when the graph of f is transformed by

a stretch by a scale factor of  $\frac{1}{3}$  parallel to the *y*-axis, followed by a translation by the vector  $\begin{pmatrix} 2 \\ -4 \end{pmatrix}$ .

(a) Find v(t), giving your answer in the form  $a(t-b)^2 + c$ .

[4 marks]

(b) A particle moves along a straight line so that its velocity in  $ms^{-1}$ , at time t seconds, is given by v. Find the distance the particle travels between t = 5.0 and t = 6.8.

[3 marks]




Do NOT write solutions on this page. Any working on this page will NOT be marked.

### **SECTION B**

Answer all the questions on the answer sheets provided. Please start each question on a new page.

- **8.** [Maximum mark: 14]
  - (a) Consider an infinite geometric sequence with  $u_1 = 40$  and  $r = \frac{1}{2}$ .
    - (i) Find  $u_4$ .
    - (ii) Find the sum of the infinite sequence.

[4 marks]

Consider an arithmetic sequence with n terms, with first term (-36) and eighth term (-8).

- (b) (i) Find the common difference.
  - (ii) Show that  $S_n = 2n^2 38n$ .

[5 marks]

(c) The sum of the infinite geometric sequence is equal to twice the sum of the arithmetic sequence. Find n.

[5 marks]

Do **NOT** write solutions on this page. Any working on this page will **NOT** be marked.

### **9.** [Maximum mark: 16]

A company produces a large number of water containers. Each container has two parts, a bottle and a cap. The bottles and caps are tested to check that they are not defective.

A cap has a probability of 0.012 of being defective. A random sample of 10 caps is selected for inspection.

(a) Find the probability that exactly one cap in the sample will be defective.

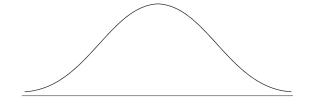
[2 marks]

(b) The sample of caps passes inspection if at most one cap is defective. Find the probability that the sample passes inspection.

[2 marks]

The heights of the bottles are normally distributed with a mean of 22 cm and a standard deviation of 0.3 cm.

(c) (i) **Copy** and complete the following diagram, shading the region representing where the heights are less than 22.63 cm.



(ii) Find the probability that the height of a bottle is less than 22.63 cm.

[5 marks]

- (d) (i) A bottle is accepted if its height lies between 21.37 cm and 22.63 cm. Find the probability that a bottle selected at random is accepted.
  - (ii) A sample of 10 bottles passes inspection if all of the bottles in the sample are accepted. Find the probability that the sample passes inspection.

[5 marks]

(e) The bottles and caps are manufactured separately. A sample of 10 bottles and a sample of 10 caps are randomly selected for testing. Find the probability that both samples pass inspection.

[2 marks]



Do NOT write solutions on this page. Any working on this page will NOT be marked.

**10.** [Maximum mark: 15]

Let 
$$f(x) = \frac{20x}{e^{0.3x}}$$
, for  $0 \le x \le 20$ .

(a) Sketch the graph of f.

[3 marks]

- (b) (i) Write down the x-coordinate of the maximum point on the graph of f.
  - (ii) Write down the interval where f is increasing.

[3 marks]

(c) Show that  $f'(x) = \frac{20-6x}{e^{0.3x}}$ .

[5 marks]

(d) Find the interval where the rate of change of f is increasing.

[4 marks]



Please **do not** write on this page.

Answers written on this page will not be marked.

