

Mathematics
Standard level
Paper 2

Wednesday 13 May 2015 (afternoon)

Candidate session number

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 in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **Mathematics SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[90 marks]**.



Section A

2. [Maximum mark: 5]

Consider the expansion of $(2x + 3)^8$.

(a) Write down the number of terms in this expansion. [1]

(b) Find the term in x^3 . [4]

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3. [Maximum mark: 6]

In an arithmetic sequence $u_{10} = 8$, $u_{11} = 6.5$.

(a) Write down the value of the common difference. [1]

(b) Find the first term. [3]

(c) Find the sum of the first 50 terms of the sequence. [2]

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4. [Maximum mark: 7]

Let $f(x) = \frac{2x-6}{1-x}$, for $x \neq 1$.

(a) For the graph of f

(i) find the x -intercept;

(ii) write down the equation of the vertical asymptote;

(iii) find the equation of the horizontal asymptote.

[5]

(b) Find $\lim_{x \rightarrow \infty} f(x)$.

[2]

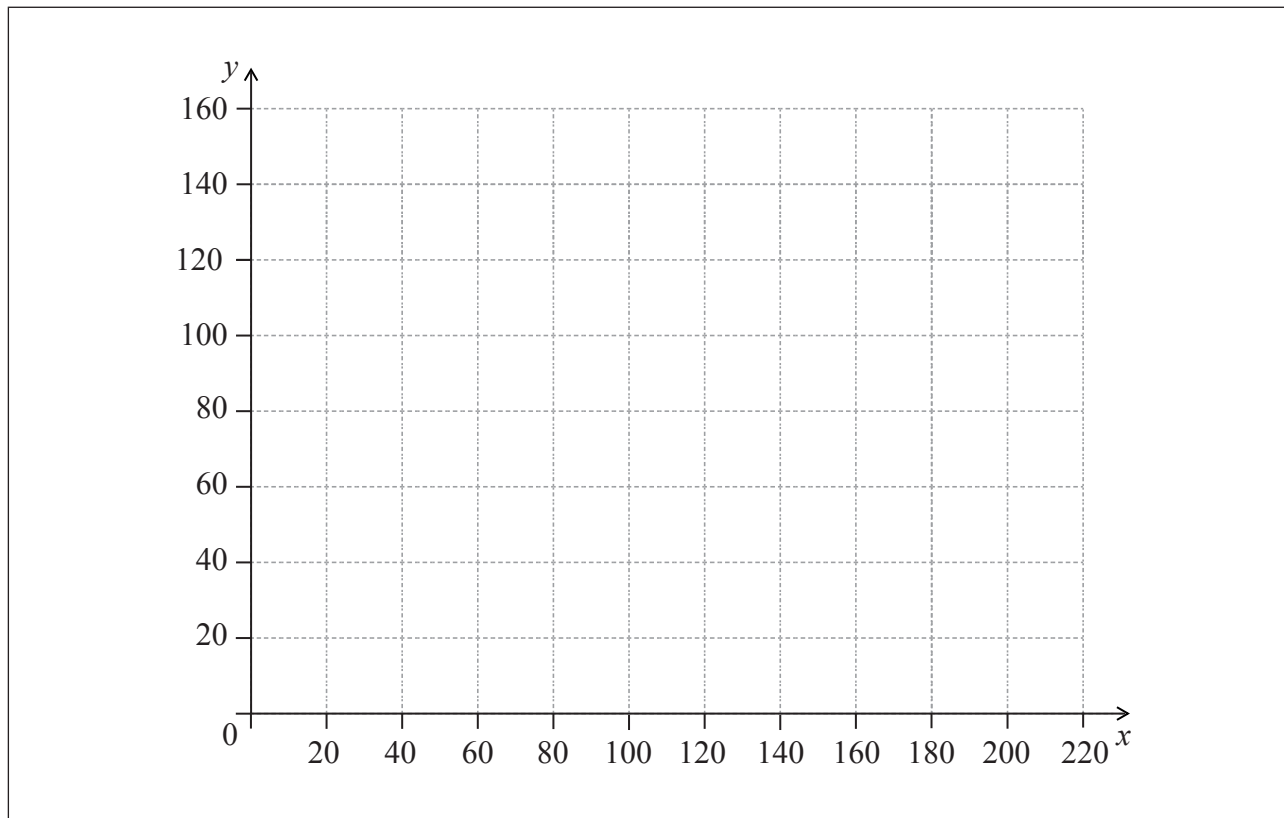


5. [Maximum mark: 6]

Let $G(x) = 95e^{(-0.02x)} + 40$, for $20 \leq x \leq 200$.

(a) On the following grid, sketch the graph of G .

[3]



(b) Robin and Pat are planning a wedding banquet. The cost per guest, G dollars, is modelled by the function $G(n) = 95e^{(-0.02n)} + 40$, for $20 \leq n \leq 200$, where n is the number of guests.

Calculate the **total** cost for 45 guests.

[3]

(This question continues on the following page)



(Question 5 continued)

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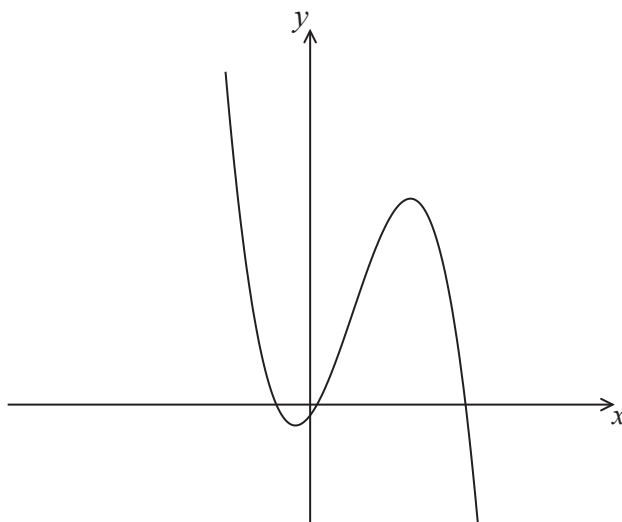
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7. [Maximum mark: 7]

The following diagram shows part of the graph of $f(x) = -2x^3 + 5.1x^2 + 3.6x - 0.4$.



- (a) Find the coordinates of the local minimum point. [2]
- (b) The graph of f is translated to the graph of g by the vector $\begin{pmatrix} 0 \\ k \end{pmatrix}$. Find all values of k so that $g(x) = 0$ has exactly one solution. [5]

[illegible]

Do **not** write solutions on this page.

9. [Maximum mark: 16]

A company makes containers of yogurt. The volume of yogurt in the containers is normally distributed with a mean of 260 ml and standard deviation of 6 ml.

A container which contains less than 250 ml of yogurt is **underfilled**.

(a) A container is chosen at random. Find the probability that it is underfilled. [2]

The company decides that the probability of a container being underfilled should be reduced to 0.02. It decreases the standard deviation to σ and leaves the mean unchanged.

(b) Find σ . [4]

The company changes to the new standard deviation, σ , and leaves the mean unchanged. A container is chosen at random for inspection. It passes inspection if its volume of yogurt is between 250 and 271 ml.

(c) (i) Find the probability that it passes inspection.

(ii) Given that the container is **not** underfilled, find the probability that it passes inspection. [6]

(d) A sample of 50 containers is chosen at random. Find the probability that 48 or more of the containers pass inspection. [4]



Section A

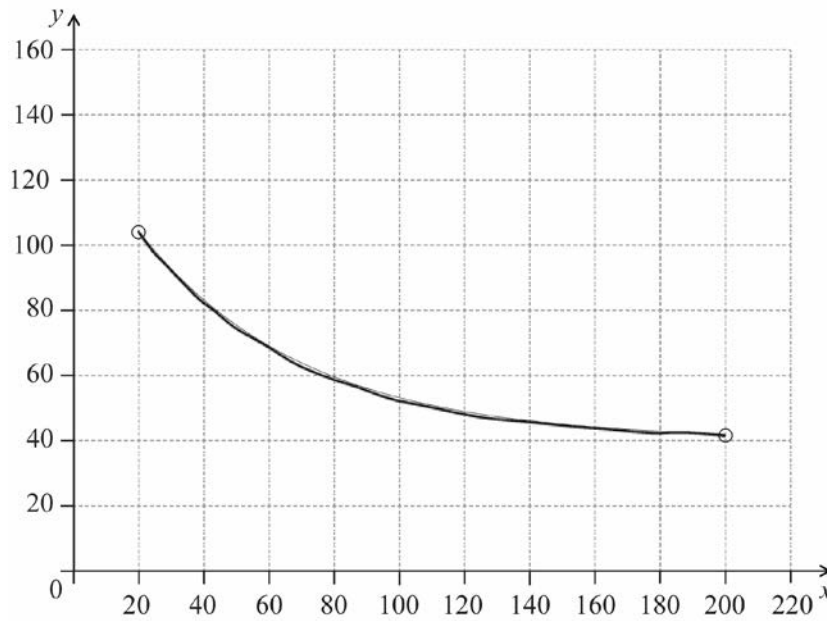
1. (a) (i) evidence of valid approach (M1)
 eg 1 correct value for r , (or for a or b , seen in (ii))
 0.946591
 $r = 0.947$ A1 N2
- (ii) $a = 0.500957$, $b = 0.803544$
 $a = 0.501$, $b = 0.804$ A1A1 N2
 [4 marks]
- (b) substituting $x = 3.7$ into **their** equation (M1)
 eg $0.501(3.7) + 0.804$
 2.65708 (2 hours 39.4252 minutes) (A1)
 $y = 2.7$ (hours)(**must** be correct 1 dp, accept 2 hours 39.4 minutes) A1 N3
 [3 marks]
- Total [7marks]
2. (a) 9 terms A1 N1
 [1 mark]
- (b) valid approach to find the required term (M1)
 eg $\binom{8}{r}(2x)^{8-r}(3)^r$, $(2x)^8(3)^0 + (2x)^7(3)^1 + \dots$, Pascal's triangle to
 8th row
 identifying correct term (may be indicated in expansion) (A1)
 eg 6th term, $r = 5$, $\binom{8}{5}$, $(2x)^3(3)^5$
 correct working (may be seen in expansion) (A1)
 eg $\binom{8}{5}(2x)^3(3)^5$, $56 \times 2^3 \times 3^5$
 $108864x^3$ (accept $109000x^3$) A1 N3
 [4 marks]

Notes: Do not award any marks if there is clear evidence of adding instead of multiplying.
 Do not award final **A1** for a final answer of 108864, even if $108864x^3$ is seen previously.
 If no working shown award **N2** for 108864.

Total [5 marks]

3. (a) $d = -1.5$ A1 N1
[1 mark]
- (b) **METHOD 1**
- valid approach (M1)
- eg $u_{10} = u_1 + 9d$, $8 = u_1 - 9(-1.5)$
- correct working (A1)
- eg $8 = u_1 + 9d$, $6.5 = u_1 + 10d$, $u_1 = 8 - 9(-1.5)$
- $u_1 = 21.5$ A1 N2
- METHOD 2**
- attempt to list 3 or more terms in either direction (M1)
- eg 9.5, 11, 12.5, ...; 5, 3.5, 2, ...
- correct list of 4 or more terms in **correct** direction (A1)
- eg 9.5, 11, 12.5, 14
- $u_1 = 21.5$ A1 N2
[3 marks]
- (c) correct expression (A1)
- eg $\frac{50}{2}(2(21.5) + 49(-1.5))$, $\frac{50}{2}(21.5 - 52)$, $\sum_{k=1}^{50} 21.5 + (k-1)(-1.5)$
- sum = -762.5 (exact) A1 N2
[2 marks]
- Total [6 marks]**
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4. (a) (i) valid approach (M1)
- eg sketch, $f(x) = 0$, $0 = 2x - 6$
- $x = 3$ or $(3, 0)$ A1 N2
- (ii) $x = 1$ (must be equation) A1 N1
- (iii) valid approach (M1)
- eg sketch, $\frac{2x}{-1x}$, inputting large values of x , L'Hopital's rule
- $y = -2$ (must be equation) A1 N2
[5 marks]
- (b) valid approach (M1)
- eg recognizing that $\lim_{x \rightarrow \infty}$ is related to the horizontal asymptote,
- table with large values of x , their y value from (a)(iii), L'Hopital's rule
- $\lim_{x \rightarrow \infty} f(x) = -2$ A1 N2
[2 marks]
- Total [7 marks]**

5. (a)



A1A1A1

N3

Note: Curve must be approximately correct exponential shape (concave up and decreasing). Only if the shape is approximately correct, award the following:
A1 for left endpoint in circle,
A1 for right endpoint in circle,
A1 for asymptotic to $y = 40$ (must not go below $y = 40$).

[3 marks]

(b) attempt to find $G(45)$

(M1)

eg 78.6241, value read from **their** graph

multiplying cost times number of people

(M1)

eg 45×78.6241 , $G(45) \times 45$

3538.08

3540 (dollars)

A1

N2

[3 marks]

Total [6 marks]