

22147406



**MATHEMATICAL STUDIES  
STANDARD LEVEL  
PAPER 2**

Wednesday 14 May 2014 (morning)

1 hour 30 minutes

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**INSTRUCTIONS TO CANDIDATES**

- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- A clean copy of the **Mathematical Studies SL formula booklet** is required for this paper.
- Answer all the questions.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- The maximum mark for this examination paper is [90 marks].

Please start each question on a new page. You are advised to show all working, where possible. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. Solutions found from a graphic display calculator should be supported by suitable working, for example, if graphs are used to find a solution, you should sketch these as part of your answer.

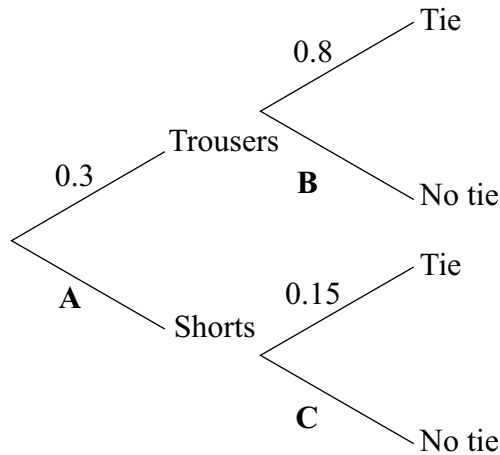
1. [Maximum mark: 16]

Tomek is attending a conference in Singapore. He has both trousers and shorts to wear. He also has the choice of wearing a tie or not.

The probability Tomek wears trousers is 0.3. If he wears trousers, the probability that he wears a tie is 0.8.

If Tomek wears shorts, the probability that he wears a tie is 0.15.

The following tree diagram shows the probabilities for Tomek’s clothing options at the conference.



(a) Find the value of

(i) A;

(ii) B;

(iii) C.

[3]

(b) Calculate the probability that Tomek wears

(i) shorts and no tie;

(ii) no tie;

(iii) shorts given that he is not wearing a tie.

[8]

(This question continues on the following page)

*(Question 1 continued)*

The conference lasts for two days.

- (c) Calculate the probability that Tomek wears trousers on both days. [2]
- (d) Calculate the probability that Tomek wears trousers on one of the days, and shorts on the other day. [3]

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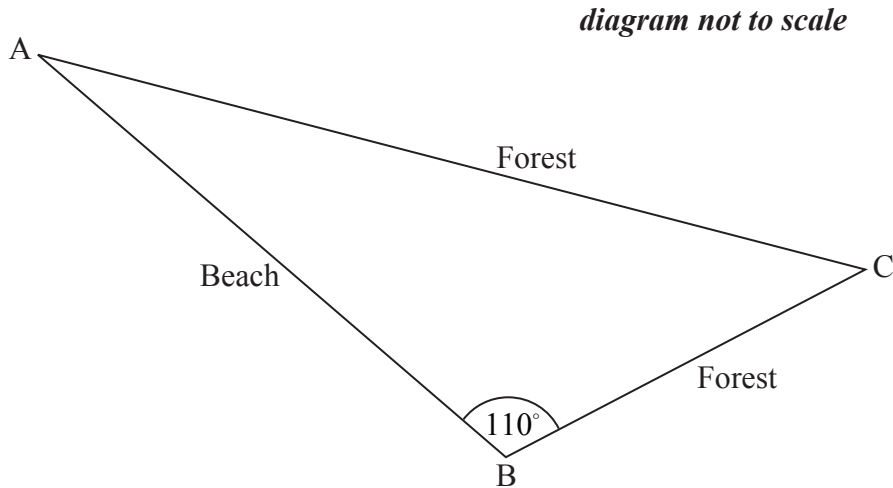
Answers written on this page  
will not be marked.

2. [Maximum mark: 14]

A cross-country running course consists of a beach section and a forest section. Competitors run from A to B, then from B to C and from C back to A.

The running course from A to B is along the beach, while the course from B, through C and back to A, is through the forest.

The course is shown on the following diagram.



Angle ABC is  $110^\circ$ .

It takes Sarah 5 minutes and 20 seconds to run from A to B at a speed of  $3.8 \text{ ms}^{-1}$ .

- (a) Using ‘*distance = speed  $\times$  time*’, show that the distance from A to B is 1220 metres correct to 3 significant figures. [2]

The distance from B to C is 850 metres. Running this part of the course takes Sarah 5 minutes and 3 seconds.

- (b) Calculate the speed, in  $\text{ms}^{-1}$ , that Sarah runs from B to C. [1]
- (c) Calculate the distance, in metres, from C to A. [3]
- (d) Calculate the total distance, in metres, of the cross-country running course. [2]
- (e) Find the size of angle BCA. [3]
- (f) Calculate the area of the cross-country course bounded by the lines AB, BC and CA. [3]

3. [Maximum mark: 10]

A survey was conducted to determine the length of time,  $t$ , in minutes, people took to drink their coffee in a café. The information is shown in the following grouped frequency table.

Time, $t$ (minutes)	Number of People
$0 < t \leq 5$	3
$5 < t \leq 10$	5
$10 < t \leq 15$	12
$15 < t \leq 20$	14
$20 < t \leq 25$	16
$25 < t \leq 30$	10

- (a) Write down the total number of people who were surveyed. [1]
- (b) Write down the mid-interval value for the  $10 < t \leq 15$  group. [1]
- (c) Find an estimate of the mean time people took to drink their coffee. [2]

The information above has been rewritten as a cumulative frequency table.

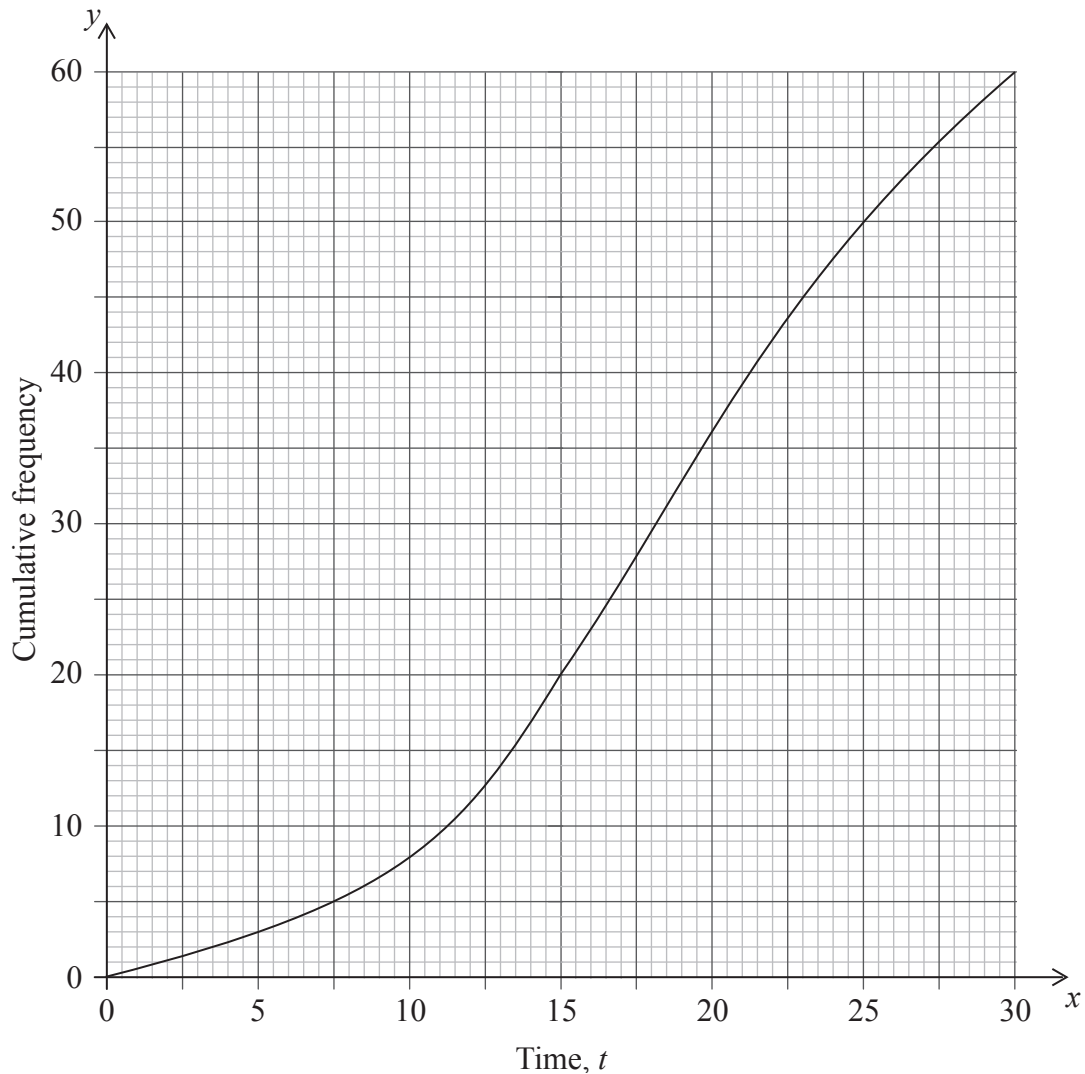
Time, $t$ (minutes)	$t \leq 5$	$t \leq 10$	$t \leq 15$	$t \leq 20$	$t \leq 25$	$t \leq 30$
Cumulative frequency	3	8	20	$a$	50	$b$

- (d) Write down the value of  $a$  and the value of  $b$ . [2]

(This question continues on the following page)

(Question 3 continued)

This information is shown in the following cumulative frequency graph.



- (e) For the people who were surveyed, use the graph to estimate
- (i) the time taken for the first 40 people to drink their coffee;
  - (ii) the number of people who take less than 8 minutes to drink their coffee;
  - (iii) the number of people who take more than 23 minutes to drink their coffee.

[4]

4. [Maximum mark: 19]

**Give your answers to parts (a) to (e) to the nearest dollar.**

On Hugh’s 18th birthday his parents gave him options of how he might receive his monthly allowance for the next two years.

**Option A** \$60 each month for two years

**Option B** \$10 in the first month, \$15 in the second month, \$20 in the third month, increasing by \$5 each month for two years

**Option C** \$15 in the first month and increasing by 10% each month for two years

**Option D** Investing \$1500 at a bank at the beginning of the first year, with an interest rate of 6% per annum, **compounded monthly**.

Hugh does not spend any of his allowance during the two year period.

- (a) If Hugh chooses **Option A**, calculate the total value of his allowance at the end of the two year period. [2]
- (b) If Hugh chooses **Option B**, calculate
  - (i) the amount of money he will receive in the 17th month;
  - (ii) the total value of his allowance at the end of the two year period. [5]
- (c) If Hugh chooses **Option C**, calculate
  - (i) the amount of money Hugh would receive in the 13th month;
  - (ii) the total value of his allowance at the end of the two year period. [5]
- (d) If Hugh chooses **Option D**, calculate the total value of his allowance at the end of the two year period. [3]
- (e) State which of the options, A, B, C or D, Hugh should choose to give him the greatest total value of his allowance at the end of the two year period. [1]

Another bank guarantees Hugh an amount of \$1750 after two years of investment if he invests \$1500 at this bank. The interest is **compounded annually**.

- (f) Calculate the interest rate per annum offered by the bank. [3]



5. [Maximum mark: 17]

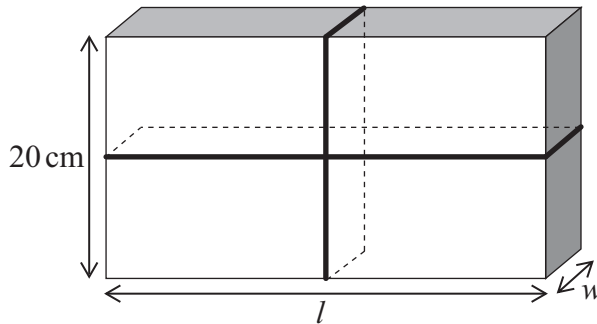
A parcel is in the shape of a rectangular prism, as shown in the diagram. It has a length  $l$  cm, width  $w$  cm and height of 20 cm.

The total volume of the parcel is  $3000 \text{ cm}^3$ .

(a) Express the volume of the parcel in terms of  $l$  and  $w$ . [1]

(b) Show that  $l = \frac{150}{w}$ . [2]

The parcel is tied up using a length of string that fits **exactly** around the parcel, as shown in the following diagram.



(c) Show that the length of string,  $S$  cm, required to tie up the parcel can be written as

$$S = 40 + 4w + \frac{300}{w}, 0 < w \leq 20. \quad [2]$$

(d) Draw the graph of  $S$  for  $0 < w \leq 20$  and  $0 < S \leq 500$ , clearly showing the local minimum point. Use a scale of 2 cm to represent 5 units on the horizontal axis  $w$  (cm), and a scale of 2 cm to represent 100 units on the vertical axis  $S$  (cm). [4]

(e) Find  $\frac{dS}{dw}$ . [3]

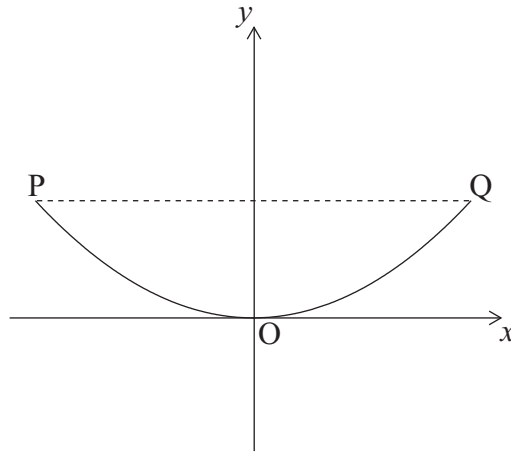
(f) Find the value of  $w$  for which  $S$  is a minimum. [2]

(g) Write down the value,  $l$ , of the parcel for which the length of string is a minimum. [1]

(h) Find the minimum length of string required to tie up the parcel. [2]

6. [Maximum mark: 14]

The front view of the edge of a water tank is drawn on a set of axes shown below. The edge is modelled by  $y = ax^2 + c$ .



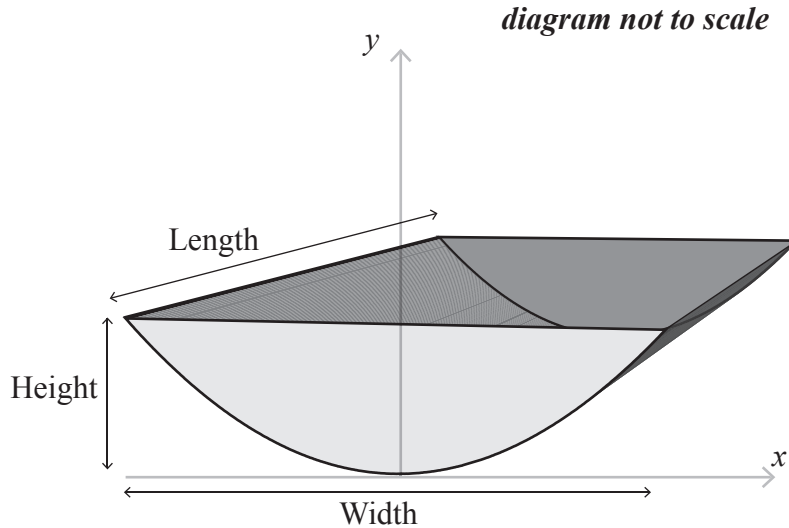
Point P has coordinates  $(-3, 1.8)$ , point O has coordinates  $(0, 0)$  and point Q has coordinates  $(3, 1.8)$ .

- (a) Write down the value of  $c$ . [1]
- (b) Find the value of  $a$ . [2]
- (c) Hence write down the equation of the quadratic function which models the edge of the water tank. [1]

*(This question continues on the following page)*

(Question 6 continued)

The water tank is shown below. It is partially filled with water.



- (d) Calculate the value of  $y$  when  $x = 2.4$  m. [2]
- (e) State what the value of  $x$  and the value of  $y$  represent for this water tank. [2]
- (f) Find the value of  $x$  when the height of water in the tank is 0.9 m. [2]

The water tank has a length of 5 m.

- (g) When the water tank is filled to a height of 0.9 m, the front cross-sectional area of the water is  $2.55 \text{ m}^2$ .
  - (i) Calculate the volume of water in the tank. [2]

The total volume of the tank is  $36 \text{ m}^3$ .

- (ii) Calculate the percentage of water in the tank. [2]