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MATHEMATICAL STUDIES
STANDARD LEVEL
PAPER 1

Candidate session number

Wednesday 12 November 2014 (afternoon)

1 hour 30 minutes

Examination code

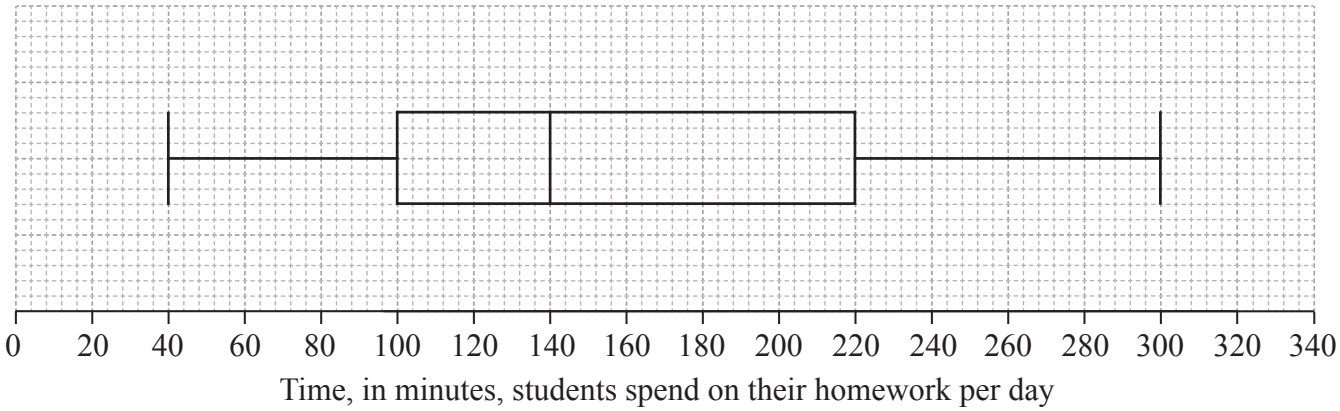
8	8	1	4	–	7	4	0	1

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.
- A clean copy of the ***Mathematical Studies SL*** *formula booklet* is required for this paper.
- Answer all questions.
- Write your answers in the boxes provided.
- 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]*.

Maximum marks will be given for correct answers. Where an answer is incorrect, some marks may be given for a correct method, provided this is shown by written working. Write your answers in the answer boxes provided. 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. The time, in minutes, that students in a school spend on their homework per day is presented in the following box-and-whisker diagram.



(a) Find

(i) the longest amount of time spent on homework per day;

(ii) the interquartile range. *[3]*

(b) State the statistical term corresponding to the value of 140 minutes. *[1]*

(c) Find the percentage of students who spend

(i) between 100 and 140 minutes per day on their homework;

(ii) more than 100 minutes per day on their homework. *[2]*

(This question continues on the following page)

(Question 1 continued)

Working:

Answers:

(a) (i) . . . . . .

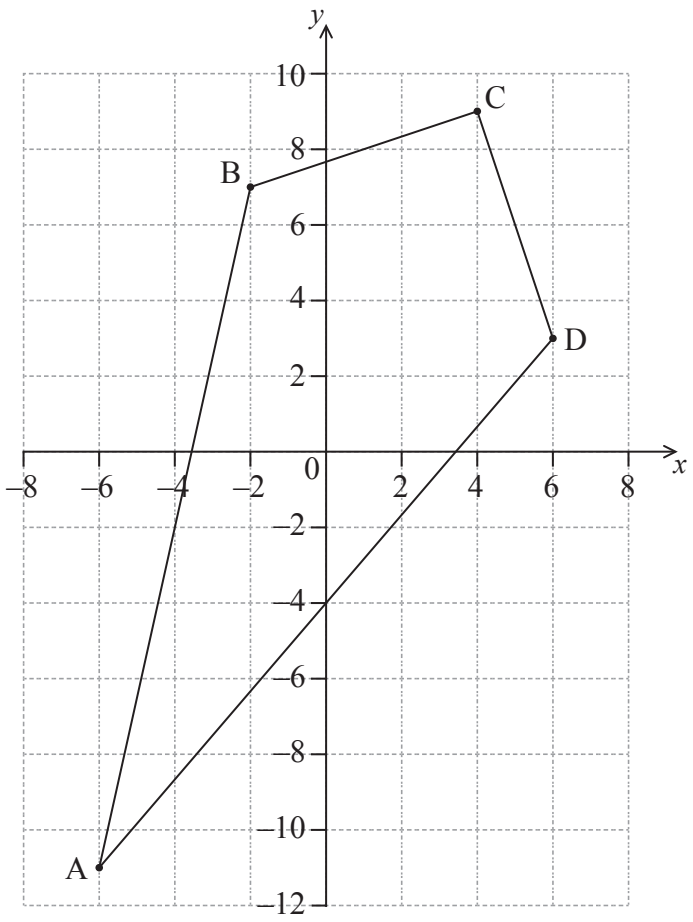
(ii) . . . . . .

(b) . . . . . .

(c) (i) . . . . . .

(ii) . . . . . .

2. The four points $A(-6, -11)$, $B(-2, 7)$, $C(4, 9)$ and $D(6, 3)$ define the vertices of a kite.



(a) Calculate the distance between points B and D. *[2]*

The distance between points A and C is $\sqrt{500}$.

(b) Calculate the area of the kite ABCD. *[4]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

3. In a particular week, the number of eggs laid by each hen on a farm was counted. The results are summarized in the following table.

Number of eggs	1	2	3	4	5	6
Frequency	4	7	12	10	14	13

(a) State whether these data are discrete or continuous. *[1]*

(b) Write down

(i) the number of hens on the farm;

(ii) the modal number of eggs laid. *[2]*

(c) Calculate

(i) the mean number of eggs laid;

(ii) the standard deviation. *[3]*

Working:

Answers:

(a) . . . . . .

(b) (i) . . . . . .

(ii) . . . . . .

(c) (i) . . . . . .

(ii) . . . . . .

4. ***In this question give all answers correct to two decimal places.***

Albena travels to Bulgaria on a business trip. She is paid 3550 Bulgarian levs (BGN) at the end of her trip. She converts all her BGN into euros (EUR), at an exchange bureau that sells 1 EUR for 1.95 BGN and charges 3 % commission.

(a) Calculate the amount that Albena receives in EUR. *[4]*

At the airport shop, Albena buys chocolates that cost 34.50 BGN. She uses 20 EUR to pay for the chocolates but receives her change in BGN. The shop's exchange rate is 1 EUR = 1.90 BGN.

(b) Find how many BGN she receives as change. *[2]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

5. Consider the statement $p \Rightarrow q$.

If I break my arm, then it will hurt.

(a) Write down in words, the inverse of $p \Rightarrow q$. *[2]*

(b) Complete the following truth table. *[2]*

p	q	$p \Rightarrow q$	Inverse of $p \Rightarrow q$	Converse of $p \Rightarrow q$
T	T	T		
T	F	F		
F	T	T		
F	F	T		

(c) State whether the converse and the inverse of an implication are logically equivalent. Justify your answer. *[2]*

Working:

Answers:

(a) . . . . . .

. . . . . .

. . . . . .

(c) . . . . . .

. . . . . .

. . . . . .

. . . . . .

6. Mandzur, a farmer, takes out a loan to buy a buffalo. He borrows 900 000 Cambodian riels (KHR) for 2 years. The nominal annual interest rate is 15 %, compounded **monthly**.

(a) Find the amount of the **interest** that Mandzur must pay. Give your answer correct to the nearest 100 KHR. *[4]*

(b) Write down your answer to part (a) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. *[2]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

7. The number of apartments in a housing development has been increasing by a constant amount every year.

At the end of the first year the number of apartments was 150, and at the end of the sixth year the number of apartments was 600.

The number of apartments, y, can be determined by the equation $y = mt + n$, where t is the time, in years.

(a) Find the value of m. *[2]*

(b) State what m represents **in this context**. *[1]*

(c) Find the value of n. *[2]*

(d) State what n represents **in this context**. *[1]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

. . . . . .

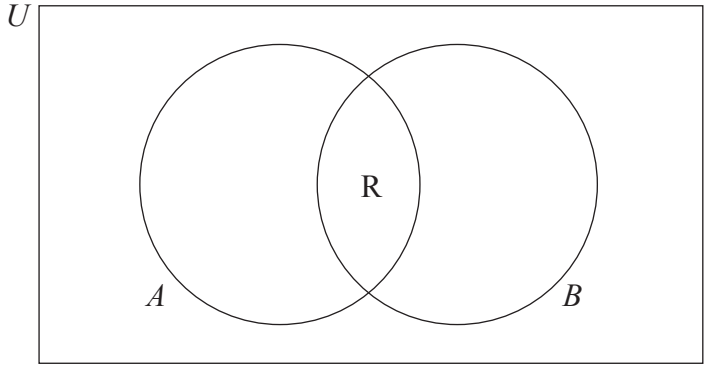
(c) . . . . . .

(d) . . . . . .

. . . . . .

8. Tuti has the following polygons to classify: rectangle (R), rhombus (H), isosceles triangle (I), regular pentagon (P), and scalene triangle (T).

In the Venn diagram below, set A consists of the polygons that have at least one pair of parallel sides, and set B consists of the polygons that have at least one pair of equal sides.



(a) Complete the Venn diagram by placing the letter corresponding to each polygon in the appropriate region. For example, R has already been placed, and represents the rectangle. *[3]*

(b) State which polygons from Tuti's list are elements of

(i) $A \cap B$;

(ii) $(A \cup B)'$. *[3]*

Working:

Answers:

(b) (i) . . . . . .

. . . . . .

. . . . . .

(ii) . . . . . .

. . . . . .

. . . . . .

9. A hotel has a rectangular swimming pool. Its length is x metres, its width is y metres and its perimeter is 44 metres.

(a) Write down an equation for x and y. *[1]*

The area of the swimming pool is $112\,\text{m}^2$.

(b) Write down a second equation for x and y. *[1]*

(c) Use your graphic display calculator to find the value of x and the value of y. *[2]*

An Olympic sized swimming pool is 50 m long and 25 m wide.

(d) Determine the area of the hotel swimming pool as a percentage of the area of an Olympic sized swimming pool. *[2]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

(c) . . . . . .

(d) . . . . . .

10. Minta surveyed students from her school about their preferred morning snack from a choice of an apple, a fruit salad or a smoothie.

She surveyed 350 students, of whom 210 are female.

She performed a χ^2 test at the 5% significance level to determine whether there is a relationship between the choice of morning snack and gender.

(a) State Minta's null hypothesis. *[1]*

(b) State the number of degrees of freedom. *[1]*

150 students showed a preference for a smoothie.

(c) Calculate the expected number of female students who chose a smoothie. *[2]*

Minta found that the calculated value of the χ^2 test was 3.576. The critical value at the 5% significance level is 5.99.

(d) State Minta's conclusion. Give a reason for your answer. *[2]*

Working:

Answers:

(a) . . . . . .

. . . . . .

(b) . . . . . .

. . . . . .

(c) . . . . . .

(d) . . . . . .

. . . . . .

. . . . . .

11. Consider the functions $f(x) = x + 1$ and $g(x) = 3^x - 2$.

(a) Write down

(i) the x-intercept of the graph of $y = f(x)$;

(ii) the y-intercept of the graph of $y = g(x)$. *[2]*

(b) Solve $f(x) = g(x)$. *[2]*

(c) Write down the interval for the values of x for which $f(x) > g(x)$. *[2]*

Working:

Answers:

(a) (i) . . . . . .

(ii) . . . . . .

(b) . . . . . .

(c) . . . . . .

12. The daily January temperature of Cairns is normally distributed with a mean of 34 °C and a standard deviation of 3.

(a) Calculate the probability that the temperature on a randomly chosen day in January is less than 39 °C. *[2]*

(b) Calculate the expected number of days in January that the temperature will be more than 39 °C. *[2]*

On a randomly chosen day in January, the probability that the temperature is above T °C is 0.7.

(c) Find the value of T. *[2]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

(c) . . . . . .

13. A potato is placed in an oven heated to a temperature of $200\,^{\circ}\text{C}$.

The temperature of the potato, in $^{\circ}\text{C}$, is modelled by the function $p(t) = 200 - 190(0.97)^t$, where t is the time, in minutes, that the potato has been in the oven.

(a) Write down the temperature of the potato at the moment it is placed in the oven. *[2]*

(b) Find the temperature of the potato half an hour after it has been placed in the oven. *[2]*

After the potato has been in the oven for k minutes, its temperature is $40\,^{\circ}\text{C}$.

(c) Find the value of k. *[2]*

Working:

Answers:

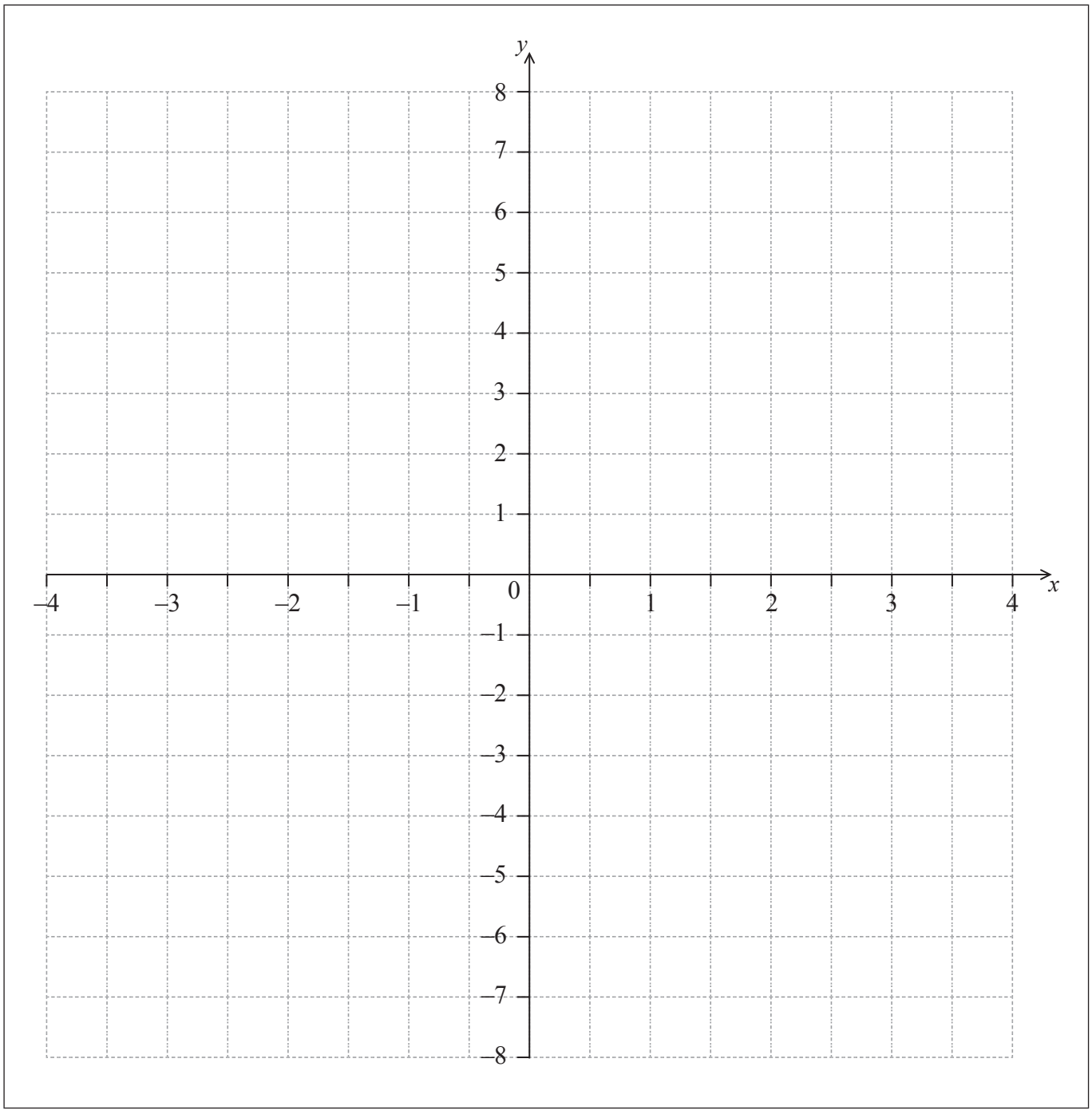
(a) . . . . . .

(b) . . . . . .

(c) . . . . . .

14. The axis of symmetry of the graph of a quadratic function has the equation $x = -\frac{1}{2}$.

(a) Draw the axis of symmetry on the following axes. *[1]*



The graph of the quadratic function intersects the x-axis at the point $\mathrm{N}(2, 0)$. There is a second point, M, at which the graph of the quadratic function intersects the x-axis.

(This question continues on the following page)

(Question 14 continued)

(b) Clearly mark and label point M on the axes. *[1]*

The graph of the function has an equation $y = x^2 + bx + c$.

(c) (i) Find the value of b and the value of c.

(ii) Draw the graph of the function on the axes. *[4]*

Working:

Answers:

(c) (i) . . . . . .

15. Consider the curve $y = x^2 + \frac{a}{x} - 1$, $x \neq 0$.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. *[3]*

The gradient of the tangent to the curve is -14 when $x = 1$.

(b) Find the value of a. *[3]*

Working:

Answers:

(a) . . . . . .

(b) . . . . . .

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