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MATHEMATICAL STUDIES
STANDARD LEVEL
PAPER 1

Wednesday 4 May 2011 (afternoon)

1 hour 30 minutes

Candidate session number

0	0								

Examination code

2	2	1	1	–	7	4	0	3

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.
- Answer all the questions in the spaces provided.
- Unless otherwise stated in the question, all numerical answers must be given exactly or correct to three significant figures.

Maximum marks will be given for correct answers. Where an answer is wrong, some marks may be given for correct method, provided this is shown by written working. Working may be continued below the box, if necessary. 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.

1.   Given $p = x - \dfrac{\sqrt{y}}{z}$, $x = 1.775$, $y = 1.44$ and $z = 48$,

   (a)   calculate the value of p.   *[2 marks]*

   Barry **first** writes x, y and z correct to one significant figure and **then** uses these values to estimate the value of p.

   (b)   (i)   Write down x, y and z each correct to one significant figure.

           (ii)   Write down Barry's estimate of the value of p.   *[2 marks]*

   (c)   Calculate the percentage error in Barry's estimate of the value of p.   *[2 marks]*

Working:

Answers:

(a)   . . . .

(b)   (i) $x =$ . . . .

              $y =$ . . . .

              $z =$ . . . .

       (ii)   . . . .

(c)   . . . .

2.   The table below shows the frequency distribution of the number of dental fillings for
a group of 25 children.

Number of fillings	0	1	2	3	4	5
Frequency	4	3	8	q	4	1

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

(b)   Use your graphic display calculator to find

(i)   the mean number of fillings;

(ii)   the median number of fillings;

(iii)   the standard deviation of the number of fillings. *[4 marks]*

Working:

Answers:

(a)   . . . .

(b)   (i)   . . . .

(ii)   . . . .

(iii)   . . . .

3. (a) List the elements of the set $A = \{x \mid -4 \le x \le 2,\ x$ is an integer$\}$. *[1 mark]*

A number is chosen at random from set A .

Write down the probability that the number chosen is

(b) a negative integer; *[2 marks]*

(c) a positive even integer; *[1 mark]*

(d) an odd integer less than -1 . *[2 marks]*

Working:

Answers:

(a) . . . .

(b) . . . .

(c) . . . .

(d) . . . .

4. Police in a town are investigating the theft of mobile phones one evening from three cafés, "Alan's Diner", "Sarah's Snackbar" and "Pete's Eats".

They interviewed two suspects, Matthew and Anna about that evening.

Matthew said:

"I visited Pete's Eats and visited Alan's Diner and I did not visit Sarah's Snackbar"

Let p, q and r be the statements:

p: I visited Alan's Diner
q: I visited Sarah's Snackbar
r: I visited Pete's Eats

(a)   Write down Matthew's statement in symbolic logic form.   *[3 marks]*

What Anna said was lost by the police, but in symbolic form it was

$$(q \vee r) \Rightarrow \neg p$$

(b)   Write down, in words, what Anna said.   *[3 marks]*

Working:

Answers:

(a) ....

(b) ....

....

....

Turn over

5. A satellite travels around the Earth in a circular orbit 500 kilometres above the Earth's surface. The radius of the Earth is taken as 6400 kilometres.

(a) Write down the radius of the satellite's orbit. *[1 mark]*

(b) Calculate the distance travelled by the satellite in one orbit of the Earth. Give your answer correct to the nearest km. *[3 marks]*

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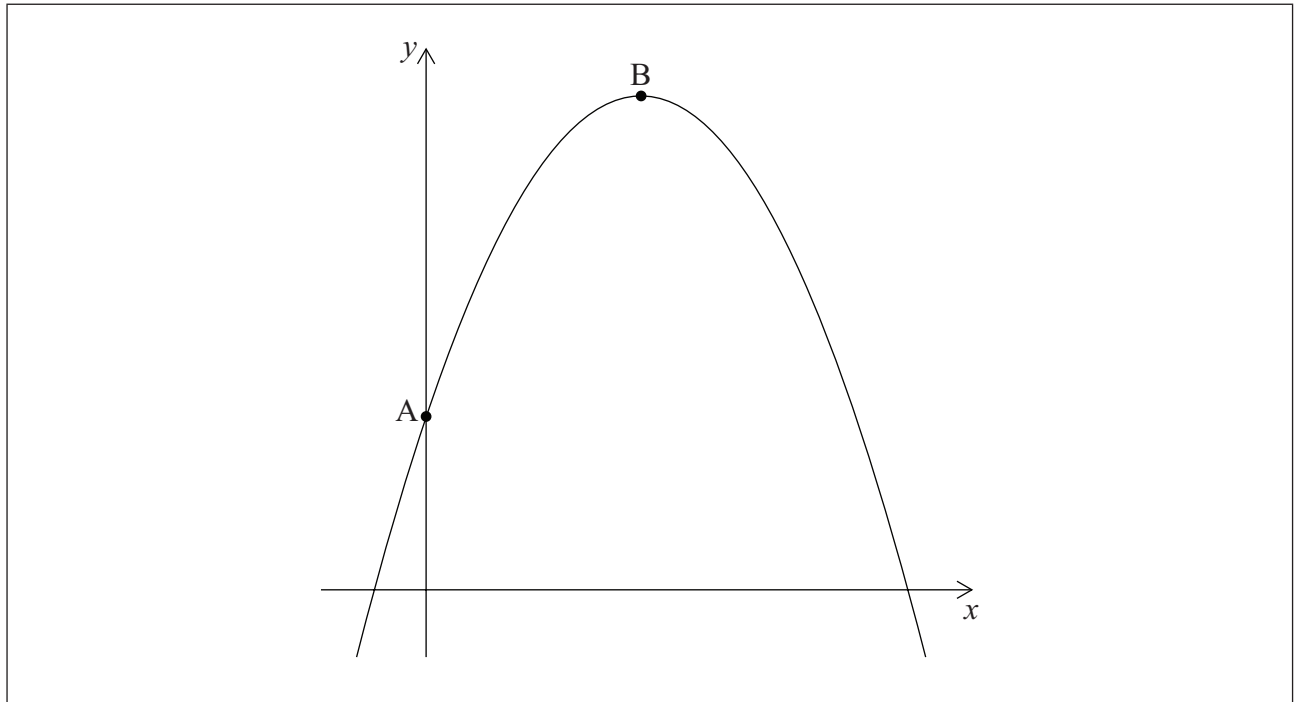
Working:

Answers:

(a) ....

(b) ....

(c) ....

6. The graph of the quadratic function $f(x) = 3 + 4x - x^2$ intersects the y-axis at point A and has its vertex at point B.

(a)   Find the coordinates of B. *[3 marks]*

Another point, C, which lies on the graph of $y = f(x)$ has the same y-coordinate as A.

(b)   (i)   Plot and label C on the graph above.
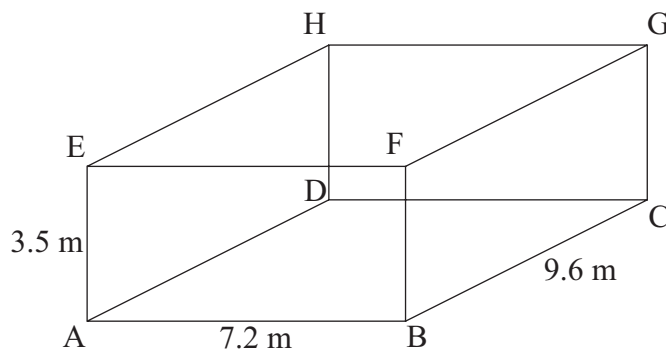
(ii)   Find the x-coordinate of C. *[3 marks]*

Working:

Answers:

(a)   . . . .

(b)   (ii)   . . . .

Turn over

7. A room is in the shape of a cuboid. Its floor measures 7.2 m by 9.6 m and its height is 3.5 m.

diagram not to scale

(a) Calculate the length of AC. *[2 marks]*

(b) Calculate the length of AG. *[2 marks]*

(c) Calculate the angle that AG makes with the floor. *[2 marks]*

Working:

Answers:

(a) ....

(b) ....

(c) ....

8.   A teacher earns an annual salary of 45 000 USD for the first year of her employment.
Her annual salary increases by 1750 USD each year.

(a)   Calculate the annual salary for the fifth year of her employment.   *[3 marks]*

She remains in this employment for 10 years.

(b)   Calculate the **total** salary she earns in this employment during these 10 years.   *[3 marks]*
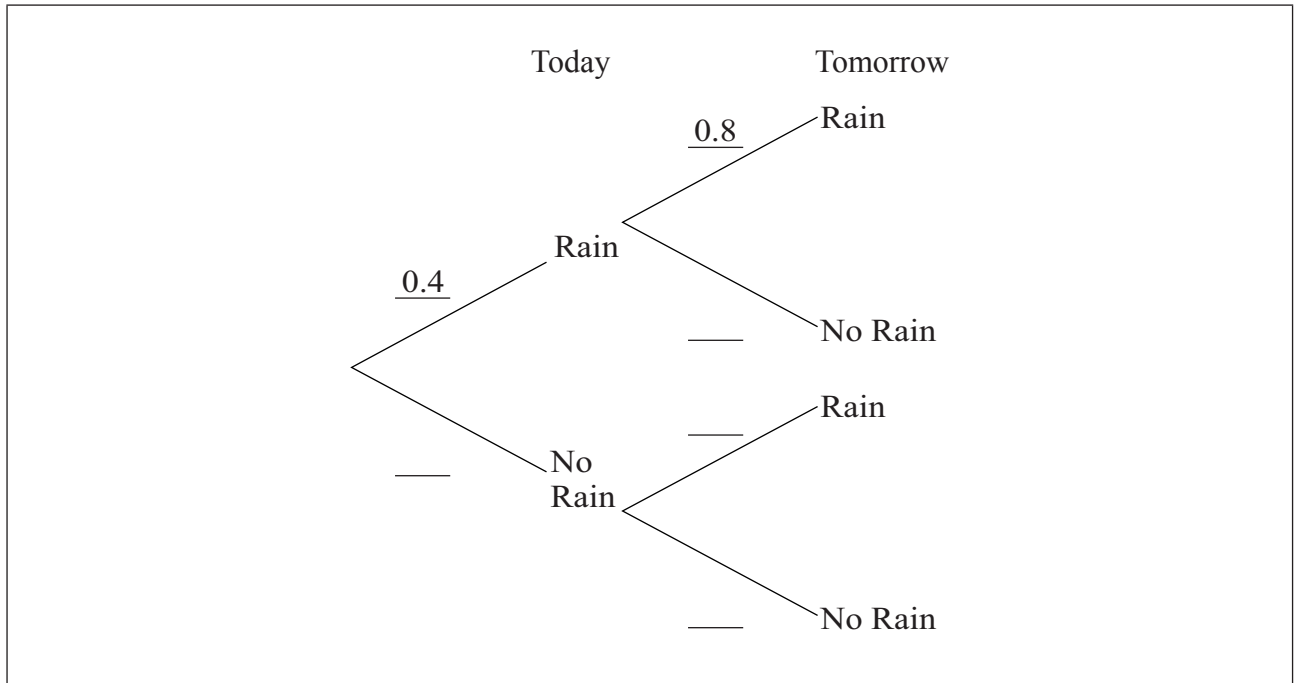
Working:

Answers:

(a)   . . . .

(b)   . . . .

Turn over

9.   The probability that it rains today is 0.4. If it rains today, the probability that it will rain tomorrow is 0.8. If it does not rain today, the probability that it will rain tomorrow is 0.7.

(a)   Complete the tree diagram below.   *[3 marks]*

```
                          Today                Tomorrow
                                               Rain
                                        0.8  ⟋
                           Rain  ⟋
                    0.4  ⟋            ⟍
                  ⟋                     ____  No Rain

                  ⟍            ____  ⟋ Rain
          ____      No  ⟋
                    Rain  ⟍
                            ____  ⟍ No Rain
```
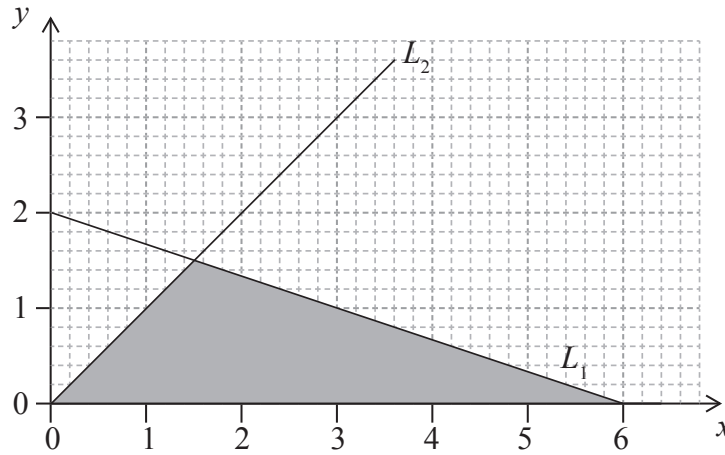
(b)   Calculate the probability of rain tomorrow.   *[3 marks]*

Working:

Answers:

(b)   . . . .

10. The diagram shows the straight lines L_1 and L_2. The equation of L_2 is $y = x$.

(a)   Find

(i)   the gradient of L_1;

(ii)   the equation of L_1. *[3 marks]*

(b)   Find the area of the shaded triangle. *[3 marks]*

Working:

Answers:

(a)   (i)   . . . .

(ii)   . . . .

(b)   . . . .

Turn over

11. The seventh term, u_7, of a geometric sequence is 108. The eighth term, u_8, of the sequence is 36.

(a) Write down the common ratio of the sequence. *[1 mark]*

(b) Find u_1. *[2 marks]*

The sum of the first k terms in the sequence is 118 096.

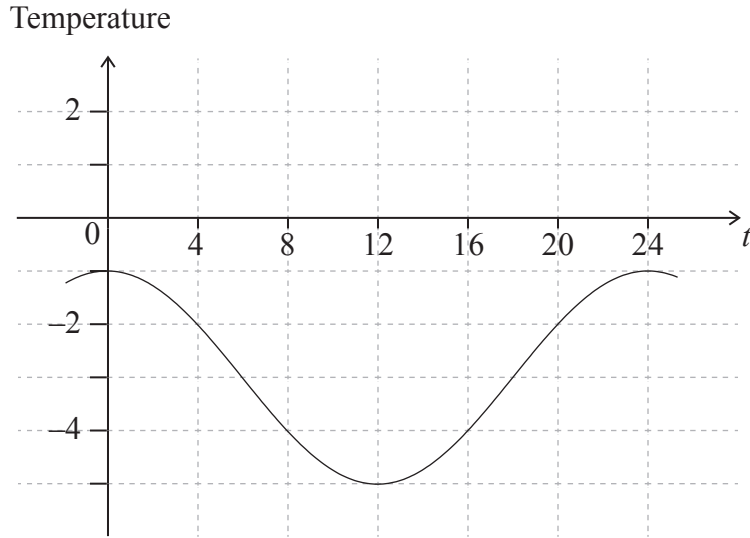(c) Find the value of k. *[3 marks]*

Working:

Answers:

(a) ....

(b) ....

(c) ....

12. The temperature in degrees Celsius during a 24 hour period is shown on the graph and is given by the function $f(t) = a\cos(bt) + c$, where a, b and c are constants, t is the time in hours and (bt) is measured in degrees.

Temperature

(a) Write down the value of a. *[1 mark]*

(b) Find the value of b. *[2 marks]*

(c) Write down the value of c. *[1 mark]*

(d) Write down the interval of time during which the temperature is increasing from $-4\,°C$ to $-2\,°C$. *[2 marks]*

Working:

Answers:

(a) ....

(b) ....

(c) ....

(d) ....

Turn over

13. The equation of the line R_1 is $2x + y - 8 = 0$. The line R_2 is perpendicular to R_1.

(a) Calculate the gradient of R_2. *[2 marks]*

The point of intersection of R_1 and R_2 is $(4, k)$.

(b) Find

(i) the value of k;

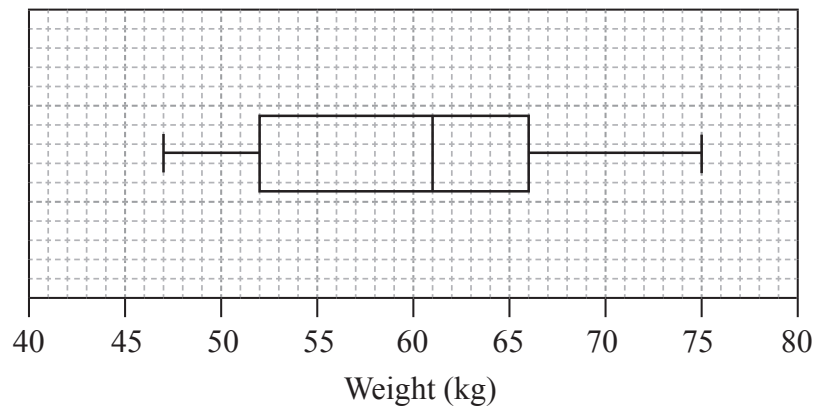(ii) the equation of R_2. *[4 marks]*

Working:

Answers:

(a) . . . .

(b) (i) . . . .

(ii) . . . .

14. The weights in kg, of 80 adult males, were collected and are summarized in the box and whisker plot shown below.

Weight (kg)

(a) Write down the median weight of the males.   *[1 mark]*

(b) Calculate the interquartile range.   *[2 marks]*

(c) Estimate the number of males who weigh between 61 kg and 66 kg.   *[1 mark]*

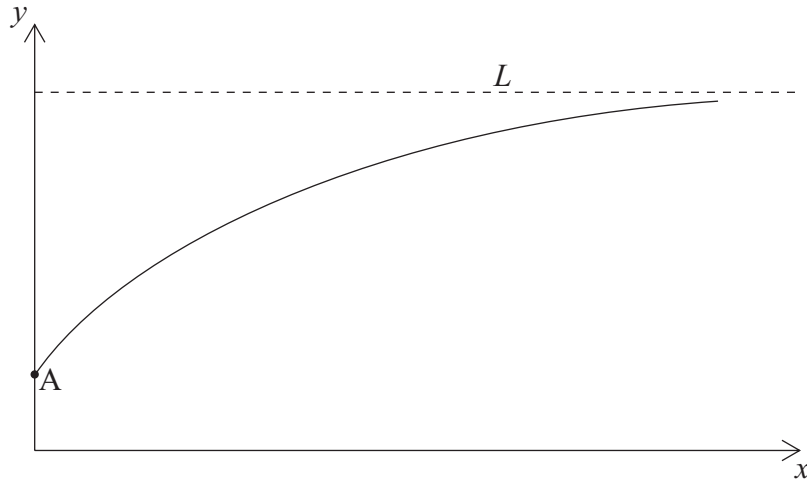(d) Estimate the mean weight of the lightest 40 males.   *[2 marks]*

Working:

Answers:

(a) . . . .

(b) . . . .

(c) . . . .

(d) . . . .

Turn over

15. Consider the function $f(x) = 1.25 - a^{-x}$, where a is a positive constant and $x \geq 0$. The diagram shows a sketch of the graph of f. The graph intersects the y-axis at point A and the line L is its horizontal asymptote.

(a) Find the y-coordinate of A. *[2 marks]*

The point $(2, 1)$ lies on the graph of $y = f(x)$

(b) Calculate the value of a. *[2 marks]*

(c) Write down the equation of L. *[2 marks]*

Working:

Answers:

(a) ....

(b) ....

(c) ....