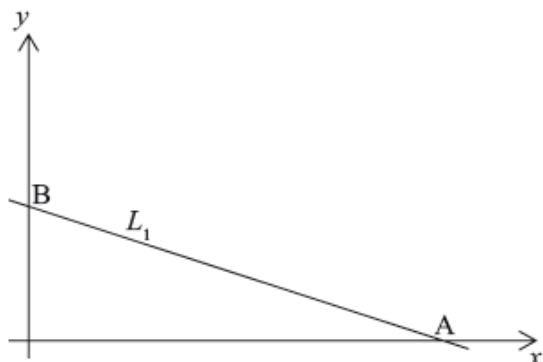**Homework:** Review problems of linear & quadratic functions and models

1a. The diagram shows the straight line L_1, which intersects the x-axis at $A(6, \ 0)$ and the y-axis at $B(0, \ 2)$.

Write down the coordinates of M, the midpoint of line segment AB.   *[2 marks]*

1b. Calculate the gradient of L_1.   *[2 marks]*

1c. The line L_2 is parallel to L_1 and passes through the point $(3, \ 2)$.

Find the equation of L_2. Give your answer in the form $y = mx + c$.   *[2 marks]*

2a. The equation of the line L_1 is $2x + y = 10$.
  Write down
  (i) the gradient of L_1;
  (ii) the y-intercept of L_1.   *[2 marks]*
2b. The line L_2 is parallel to L_1 and passes through the point $P(0,\ 3)$.
  Write down the equation of L_2.   *[2 marks]*
2c. Find the x-coordinate of the point where L_2 crosses the x-axis.   *[2 marks]*

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3a. 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.

Find the value of m.   *[2 marks]*

3b. State what m represents **in this context**.   *[1 mark]*

3c. Find the value of n.   *[2 marks]*

3d. State what n represents **in this context**.   *[1 mark]*

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4a. An iron bar is heated. Its length, L, in millimetres can be modelled by a linear function, $L = mT + c$, where T is the temperature measured in degrees Celsius (°C).

At 150°C the length of the iron bar is 180 mm.

Write down an equation that shows this information.   *[1 mark]*

4b. At 210°C the length of the iron bar is 181.5 mm.

Write down an equation that shows this second piece of information.   *[1 mark]*

4c. Hence, find the length of the iron bar at 40°C.   *[4 marks]*

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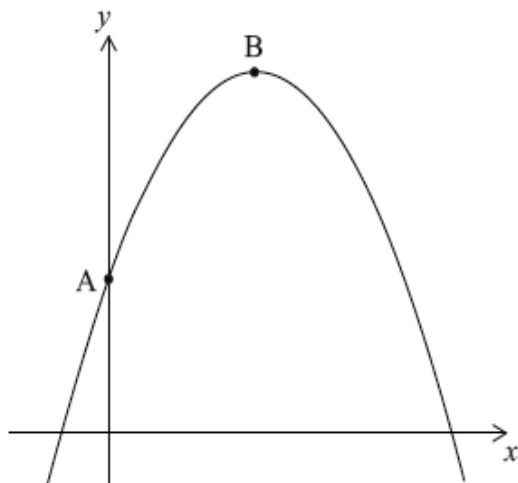
5a. The graph of the quadratic function $f(x) = ax^2 + bx + c$ intersects the y-axis at point A (0, 5) and has its vertex at point B (4, 13).

Write down the value of c *[1 mark]*

5b. By using the coordinates of the vertex, B, or otherwise, write down **two** equations in a and b *[3 marks]*

5c. Find the value of a and of b *[2 marks]*

6a. Consider the quadratic function, $f(x) = px(q - x)$, where p and q are positive integers.

The graph of $y = f(x)$ passes through the point $(6, \ 0)$.

Calculate the value of q.   *[2 marks]*

6b. The vertex of the function is $(3, \ 27)$.

Find the value of p.   *[2 marks]*

6c. The vertex of the function is $(3, \ 27)$.
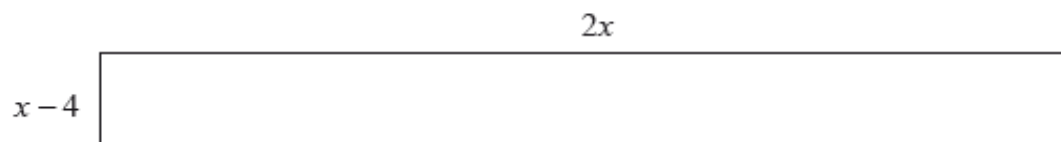
Write down the range of f.   *[2 marks]*

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7a. The surface of a red carpet is shown below. The dimensions of the carpet are in metres.

diagram not to scale

$2x$

$x-4$

Write down an expression for the area, A, in m^2, of the carpet.   *[1 mark]*

7b. The area of the carpet is 10 m^2.

Calculate the value of x.   *[3 marks]*

7c. The area of the carpet is 10 m^2.

Hence, write down the value of the length and of the width of the carpet, in metres.   *[2 marks]*

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8a. The table shows the distance, in km, of eight regional railway stations from a city centre terminus and the price, in $, of a return ticket from each regional station to the terminus.

Distance in km (x)	3	15	23	42	56	62	74	93
Price in $ (y)	5	24	43	56	68	74	86	100

Draw a scatter diagram for the above data. Use a scale of 1 cm to represent 10 km on the x-axis and 1 cm to represent $\$10$ on the y-axis.   *[4 marks]*

8b. *[2 marks]*

Use your graphic display calculator to find

(i) $\bar{x}$, the mean of the distances;

(ii) $\bar{y}$, the mean of the prices.

8c. *[1 mark]*

Plot and label the point $M\left(\bar{x},\ \bar{y}\right)$ on your scatter diagram.

8d. *[3 marks]*

Use your graphic display calculator to find

(i) the product–moment correlation coefficient, r ;

(ii) the equation of the regression line y on x.

8e. *[2 marks]*

Draw the regression line y on x on your scatter diagram.

8f. *[3 marks]*

A ninth regional station is 76 km from the city centre terminus.

Use the equation of the regression line to estimate the price of a return ticket to the city centre terminus from this regional station. **Give your answer correct to the nearest $.**

8g. *[1 mark]*

Give a reason why it is valid to use your regression line to estimate the price of this return ticket.

8h. *[2 marks]*

The actual price of the return ticket is $80.

Using your answer to part (f), calculate the percentage error in the estimated price of the ticket.

9a. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Distance, x (metres)	5	12	17	21	24	30	34	44	47
Circumference, y (centimetres)	82	76	70	68	67	60	62	50	50

State whether *distance from the river bank* is a continuous **or** discrete variable.   *[1 mark]*

9b. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

On graph paper, draw a scatter diagram to show Barry's results. Use a scale of 1 cm to represent 5 m on the *x*-axis and 1 cm to represent 10 cm on the *y*-axis.   *[4 marks]*

9c. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Write down

(i) the mean distance, $\bar{x}$, of the trees from the river bank;

(ii) the mean circumference, $\bar{y}$, of the trees.   *[2 marks]*

9d. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Plot and label the point $M(\bar{x}, \bar{y})$ on your graph.   *[2 marks]*

9e. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Write down

(i) the Pearson's product–moment correlation coefficient, r, for Barry's results;

(ii) the equation of the regression line y on x, for Barry's results.   *[4 marks]*

9f. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Draw the regression line y on x on your graph.   *[2 marks]*

9g. As part of his IB Biology field work, Barry was asked to measure the circumference of trees, in centimetres, that were growing at different distances, in metres, from a river bank. His results are summarized in the following table.

Use the equation of the regression line y on x to estimate the circumference of a tree that is 40 m from the river bank.   *[2 marks]*