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PURE MATH

ALGEBRA AND FUNCTION

Level & Board	EDEXCEL (A-LEVEL)
TOPIC:	LINEAR MODAL
PAPER TYPE:	SOLUTION - 3
TOTAL QUESTIONS	8
TOTAL MARKS	35

Q1.

Find the slope (m):

m = change in y/change in x = $(40,000 - 15,000)/(5 - 2) = 25,000/3$

Now, use one of the points (let's use (2,15)) to find the y-intercept (b):

$y = mx + b$

$15,000 = (25,000/3)(2) + b$

$b = 5,000/3$

So, the equation that models the balance (B) in thousands of dollars over time (t in years) for this savings account is:

$B = (25,000/3)t + 5,000/3$

This equation can be used to predict the balance for any given time in the future. For example, if you want to know the balance after 3 years (t=3):

$B = (25,000/3)(3) + 5,000/3 = 30,000$

Therefore, the balance after 3 years would be $30,000.

Q2.

Find the slope (m):

m = change in y / change in x = $(25,000 - 10,000) / (3 - 1) = 15,000 / 2$

Now, use one of the points (let's use (1,10)) to find the y-intercept (b):

$y = mx + b$

$10,000 = (15,000 / 2)(1) + b$

$b = 10,000 - (15,000 / 2) = -5,000$

So, the equation that models the balance (B) in thousands of dollars over time (t in years) for this savings account is:

$B = (15,000 / 2)t - 5,000$

This equation can be used to predict the balance for any given time in the future. For example, if you want to know the balance after 4 years ($t = 4$):

$$B = (15,000 / 2)(4) - 5,000 = 20,000$$

Therefore, the balance after 4 years would be $20,000.

Q3.

Find the slope (m):

m = change in y/change in x = $(30,000 - 8,000)/(6 - 1) = 22,000/5$

Now, use one of the points (let's use (1, 8)) to find the y-intercept (b):

$$y = mx + b$$

$$8,000 = 22,000/5(1) + b$$

$$b = 4,600$$

So, the equation that models the balance (B) in thousands of dollars over time (t in years) for this savings account is:

$$B = 22,000/5t + 4,600$$

This equation can be used to predict the balance for any given time in the future. For example, if you want to know the balance after 3 years ($t = 3$):

$$B = 22,000/5(3) + 4,600 = 16,520$$

Therefore, the balance after 3 years would be $16,520.

Q4.

To find the slope (m), use the formula:

m = change in y/change in x

In this case, the values are:

$y_2 - y_1 = 42{,}000 - 12{,}000$

$x_2 - x_1 = 5 - 2$

So, the slope is:

$m = (42{,}000 - 12{,}000) / (5 - 2) = 30{,}000 / 3 = 10{,}000$

Next, to find the y-intercept (b), use one of the points, let's use (2,12):

$y = mx + b$

$12{,}000 = 10{,}000(2) + b$

Simplifying the equation, we get:

$b = 12{,}000 - 20{,}000 = -8{,}000$

Therefore, the equation that models the balance (B) in thousands of dollars over time (t in years) for this savings account is:

$B = 10{,}000t - 8{,}000$

This equation can be used to predict the balance for any given time in the future. For example, if you want to know the balance after 3 years ($t = 3$):

$B = 10{,}000(3) - 8{,}000 = 22{,}000$

So, the balance after 3 years would be $22,000.

Q5.

For part (a)

We have two data points, which we can use to create a linear model.

The first data point is interpreted as 5 kilometers, where the time (t) is 10 seconds and the altitude (A) is 10 meters.

The second data point is interpreted as 20 kilometers, where the time (t) is 30 seconds and the altitude (A) is 20 meters.

To create a linear equation, we can use the point-slope form. This is given by:

$(A - A1) = m(t - t1)$, where $(t1, A1)$ is a point on the line, and m is the slope.

Using the first data point (10,5), we can find the slope (m):

$$m = (A - A1)/(t - t1) = (5-10)/(10-10) = -5/0$$

We can't divide by 0, so we need to find another point on the line. Using the second data point (30,20), we can solve for m:

$$m = (A - A1)/(t - t1) = (20-5)/(30-10) = 15/20 = 3/4$$

Now that we have m, we can write the equation in point-slope form:

$$(A - 5) = (3/4)(t - 10)$$

Finally, we simplify and express it in slope-intercept form ($y = mx + c$):

$$A= (3/4)t - 5/2$$

For part (b)

we need to check if the linear model fits the fact that the rocket's altitude was approximately 0 kilometers at the time of launch ($t = 0$). We can substitute $t = 0$ into the equation:

$$A = (3/4)(0) - 5/2 = -5/2$$

Since the result is not close to 0 kilometers, it suggests that the linear model may not be the best fit for the given data.

Q6.

First Data Point: $50,000 (represented as t=3, C=50)

Second Data Point: $120,000 (represented as t=9, C=120)

Use the above data points to create a linear model for the production cost over time. Determine the slope 'm' using the point-slope form and write the equation of the linear model in point-slope form. If needed, simplify and express the equation in slope-intercept form ($y=mx+b$).

To check if the model is accurate, verify if the production cost was approximately $30,000 when production started ($t=0$). Substitute $t=0$ into the equation:

$$C = m(0-3) + 50$$

If the result is close to $30,000, it supports the use of the linear model. If there is a significant difference, it suggests that the linear model may not be the best fit for the given data.

Q7.

For part (a)

We can use the given data to create a linear model.

The first data point is when $t=4$ and $H=30$.

The second data point is when $t=10$ and $H=65$.

We can use the point-slope form of a linear equation to find the slope m.

The point-slope form of a linear equation is:

$$(y-y1)=m(x-x1),$$

where $(x1,y1)$ is a point on the line. Using the first data point (4,30), we can find the slope m.

The slope is $m=(H2-H1)/(t2-t1)=(65-30)/(10-4)=5$.

The equation of the line in point-slope form is: $(y-30)=5(x-4)$.

We can simplify this to slope-intercept form, $y=5x+10$, if needed.

For part (b)

we need to check if the model fits the fact that the plant's height was approximately 10 centimeters when it was planted, which means $t=0$.

We can substitute $t=0$ into the equation to get $H=5(0)+10=10$.

Since the result is close to 10 centimeters, it supports the use of the linear model.

If there is a significant difference between the predicted value and the actual value, it suggests that the linear model may not be the best fit for the given data.

Q8.

For part (a)

We have been provided with two data points, where the height of a tree is represented as 'H' in meters, and the time since planting is represented as 't' in years.

The data points are as follows:

1. The height of the tree was 2.35 meters at 3 years ($H=2.35$, $t=3$).
2. The height of the tree was 3.28 meters at 6 years ($H=3.28$, $t=6$).

To determine the equation of the linear model, we will use the point-slope form of a linear equation:

$$(H - H1) = m (t - t1)$$

Here, ($t1$, $H1$) is a point on the line, and 'm' is the slope. By using the first data point ($t1=3$, $H1=2.35$), we can determine the slope 'm' as follows:

$$m = (H - 2.35) / (t - 3)$$

Next, we will substitute the second data point (t=6, H=3.28) into the equation:

$$3.28 - 2.35 = m (6 - 3)$$

Solving for 'm', we get:

$$m = 0.31$$

Now, we can write the equation in point-slope form by using the slope and any point on the line. Let's use the point (3, 2.35):

$$(H - 2.35) = 0.31 (t - 3)$$

Finally, we can simplify the equation and write it in slope-intercept form:

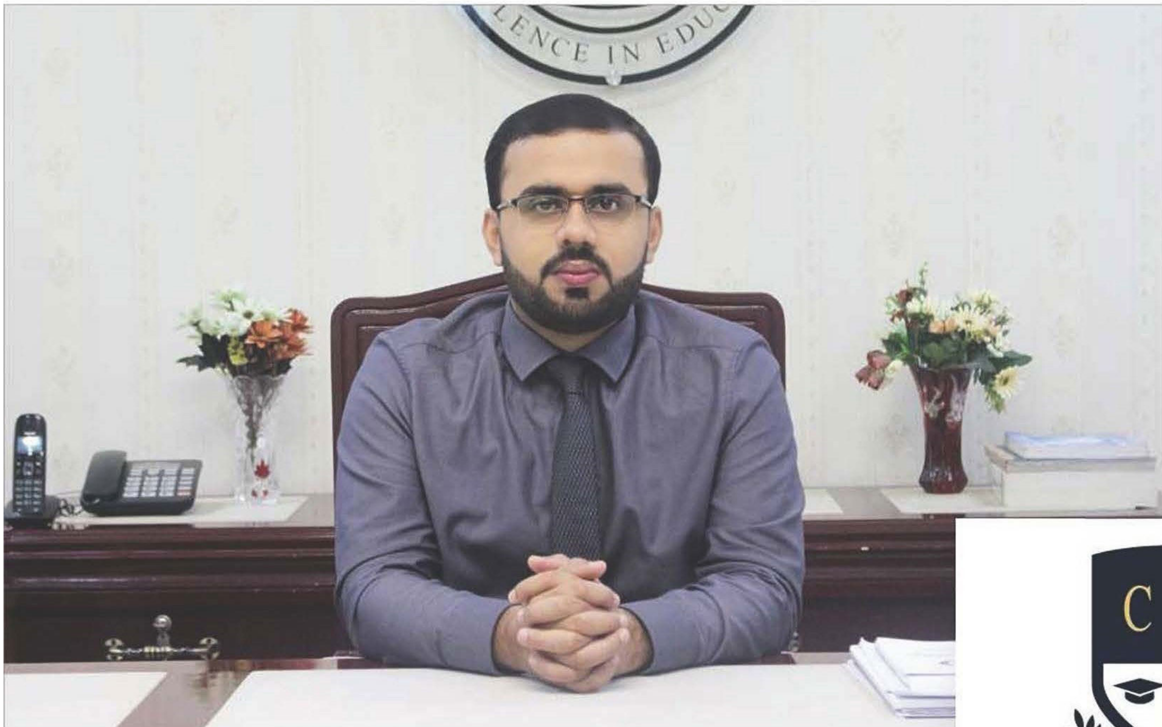
$$H = 0.31t - 0.28$$

For part (b)

we are given that the height of the tree was approximately 140 cm when it was planted (t=0). To check if this fact supports the use of the linear model, we substitute t=0 into the equation:

$$H = 0.31(0) - 0.28$$

This gives us a height of -0.28 meters, which is not close to 140 cm. Therefore, the linear model may not be the best fit for the given data.



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