IB MATHS AI SL · UNIT 2

Linear Modelling: exam practice

10 questions · 35 marks · worked solutions and markschemes

Name _____ Date _____ Score / 35

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/linear-modelling-exam-practice

1. **3 marks · Paper 1 style · calculator allowed**

Two mobile phone plans charge different amounts based on the number of minutes of calls, m, made in a month. Plan A models its monthly cost in euros by $C_A(m) = 0.08m + 12.00$. Plan B models its monthly cost by $C_B(m) = 0.05m + 19.50$. Find the exact number of minutes m for which both plans charge the same amount.

2. **3 marks · Paper 1 style · calculator allowed**

The line L passes through the points $(2, k)$ and $(6, 3)$, and is perpendicular to the line $y = 2x + 1$. Find the value of k.

3. **3 marks · Paper 1 style · calculator allowed**

A car rental company charges a flat daily rate of €40 plus €0.15 for every kilometre driven.

1. Write down a linear function $C(x)$ to model the total daily cost of renting the car and driving it for x kilometres.
2. Calculate the total cost of renting the car for one day and driving exactly $250\ \text{km}$.

4. **3 marks · Paper 1 style · calculator allowed**

A gym charges a fixed joining fee plus a regular monthly membership fee. The total cost, C, in euros, for m months of membership is given by the function $C(m) = 35m + 50$.

1. Write down the cost of the joining fee.
2. Calculate the total cost of a membership lasting 18 months.

5. **3 marks · Paper 1 style · calculator allowed**

A car worth €$18\,000$ loses €1500 of value each year.

(a) Write down a linear model for its value V after t years. **[1]**

(b) Find when the car will be worth €6000. **[2]**

6. 3 marks · Paper 1 style · calculator allowed

A tank holds 600 litres. It drains so that the volume after t minutes is $V = 600 - 25t$.

(a) Interpret the value -25. **[1]**

(b) Find the time for the tank to empty. **[2]**

7. 4 marks · Paper 1 style · calculator allowed

The points $A(1, 2)$ and $B(5, 10)$ are given.

a. Find the gradient of $[AB]$. **[1]**

b. Find the equation of the perpendicular bisector of $[AB]$. **[3]**

8. 4 marks · Paper 1 style · calculator allowed

A line passes through $A(2, 5)$ and $B(6, 13)$.

(a) Find the equation of the line in the form $y = mx + c$. **[2]**

(b) Find the equation of the line through B perpendicular to $[AB]$. **[2]**

9. **4 marks · Paper 1 style · calculator allowed**

The line L_1 has equation $3x - 4y = 12$.

(a) Find the coordinates of the points where L_1 crosses the axes. **[2]**

(b) The line L_2 is parallel to L_1 and passes through $(0, 5)$. Write down the equation of L_2. **[2]**

10. **5 marks · Paper 1 style · calculator allowed**

Phone plan A costs €15 a month plus €0.05 per minute. Plan B costs €25 a month plus €0.02 per minute.

(a) Write down an expression for the monthly cost of each plan for m minutes. **[2]**

(b) Find the least whole number of minutes for which plan B is cheaper. **[3]**

Answers and worked solutions

Question 1

3 marks

Answer: 250

Equate the two cost models:

$0.08m + 12.00 = 0.05m + 19.50$ M1

Collect terms:

$0.08m - 0.05m = 19.50 - 12.00 \implies 0.03m = 7.50$ A1

$m = \frac{7.50}{0.03} = 250$ minutes A1

Question 2

3 marks

Answer: $k = 5$

gradient of L is $-\frac{1}{2}$ (A1)

$\frac{3-k}{6-2} = -\frac{1}{2}$ (M1)

$k = 5$ A1

Question 3

3 marks

Answer: (a) $0.15x + 40$; (b) 77.50

1. Gradient is the cost per km, intercept the daily rate:
   $C(x) = 0.15x + 40$ A1A1
2. Substitute $x = 250$:
   $C(250) = 0.15(250) + 40 = 37.5 + 40 = €77.50$
   A1

Question 4

3 marks

Answer: (a) 50; (b) 680

1. Constant term of the model: $€50$
   A1
2. Substitute $m = 18$:
   $C(18) = 35(18) + 50$ M1
   $= 630 + 50 = €680$ A1

Question 5

3 marks

Answer: (a) $V = 18\,000 - 1500t$; (b) after 8 years

(a)

$V = 18\,000 - 1500t$ A1

(b)

$18\,000 - 1500t = 6000$ (M1)

$t = 8$ years A1

Question 6

3 marks

Answer: (b) 24 minutes

(a)

the volume falls by 25 litres each minute A1

(b)

$600 - 25t = 0$ (M1)

24 minutes A1

Question 7

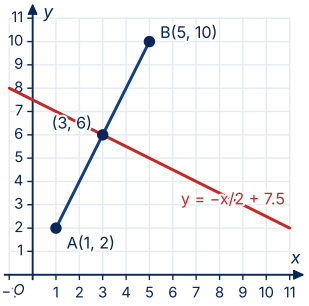
4 marks

Answer: (a) 2; (b) $y = -x/2 + 7.5$

a. $\frac{10-2}{5-1} = 2$ A1

b. midpoint $(3, 6)$, gradient $-\frac{1}{2}$ (A1)(A1)

$y = -\frac{1}{2}x + 7.5$ A1



Gradient 2, so the bisector has gradient $-\frac{1}{2}$

Question 8

4 marks

Answer: (a) $y = 2x + 1$; (b) $y = -\frac{1}{2}x + 16$

(a)

$m = 2$ (A1)

$y = 2x + 1$ A1

(b)

gradient $-\frac{1}{2}$ (M1)

$y = -\frac{1}{2}x + 16$ A1

Question 9

4 marks

Answer: (a) $(4, 0)$ and $(0, -3)$; (b) $y = \frac{3}{4}x + 5$

(a)

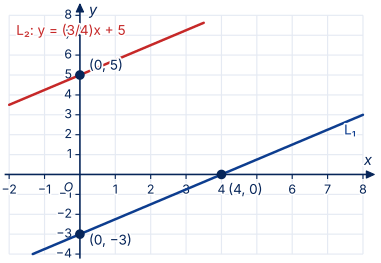
$(4, 0)$ A1

$(0, -3)$ A1

(b)

gradient $\frac{3}{4}$ (A1)

$y = \frac{3}{4}x + 5$ A1



Same gradient, $\frac{3}{4}$

Question 10

5 marks

Answer: (b) 334 minutes

(a)

$A = 15 + 0.05m$ A1

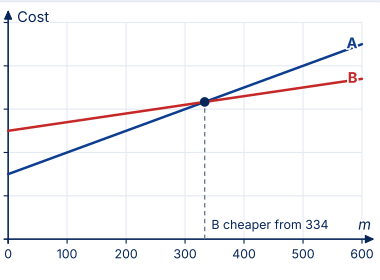
$B = 25 + 0.02m$ A1

(b)

$25 + 0.02m < 15 + 0.05m$ (M1)

$m > 333.3\ldots$ (A1)

334 minutes A1



The lines cross at $m = 333.3\ldots$

Every solution is also on ibmathrevision.com/slai/linear-modelling-exam-practice
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