

Question	Scheme	Marks	AOs
<b>11(a)</b>	$\frac{300-1500}{50-30} = (-60)$	M1	3.1b
	$y - 1500 = "-60"(x - 30)$	dM1	1.1b
	$y = 3300 - 60x$	A1	3.3
		(3)	
<b>(b)</b>	Either $x("3300 - 60x")$ or $-10("3300 - 60x")$ seen	M1	1.1b
	$(P =) \frac{x("3300 - 60x") - 10("3300 - 60x") - 8000}{1000}$	dM1	3.3
	$P = 3.3x - 0.06x^2 - 33 + 0.6x - 8$ $P = -0.06x^2 + 3.9x - 41^*$	A1*	2.1
		(3)	
<b>(c)</b>	$\frac{-3.9 \pm \sqrt{3.9^2 - 4(-0.06)(-41)}}{2 \times -0.06}$	M1	3.1b
	$13.18 < x < 51.82$ (or $13.19 \leq x \leq 51.81$ )	A1	3.2a
		(2)	
<b>(d)</b>	£32.50	B1ft	3.4
		(1)	
<b>(e)</b>	$(P =) -0.06(35)^2 + 3.9(35) - 41 = \dots$	M1	3.4
	£22 000 which is close to £21 750 so the model is suitable.	A1	3.5a
		(2)	

(11 marks)

Notes

<p><b>(a)</b></p> <p>M1: Attempts the gradient of the straight line either way round.</p> <p>Look for <math>\frac{300-1500}{50-30} = (-60)</math> o.e. or <math>\frac{50-30}{300-1500} = \left(-\frac{1}{60}\right)</math> o.e.</p> <p>Condone 1 sign/copying slip only if a correct formula is seen or implied e.g. <math>\frac{y_2 - y_1}{x_2 - x_1}</math></p> <p>Alternatively, sets up simultaneous equations <math>1500 = 30a + b</math> and <math>300 = 50a + b</math> (or <math>30 = 1500a + b</math> and <math>50 = 300a + b</math>) and attempts to solve, leading to a value for <math>a</math> and/or <math>b</math>.</p> <p>If using simultaneous equations, condone slips.</p> <p>dM1: Attempts the equation relating <math>x</math> and <math>y</math> with either coordinate (50, 300) or (30, 1500) used correctly. Look for <math>y - 1500 = "-60"(x - 30)</math> or <math>x - 30 = "-\frac{1}{60}"(y - 1500)</math></p> <p>or using (50, 300). Note that e.g. <math>y - 30 = "-60"(x - 1500)</math> scores dM0 as the values have been used incorrectly. If using <math>y = mx + c</math> they must proceed to <math>c = \dots</math></p> <p>If using simultaneous equations, they must proceed to values for <b><math>a</math> and <math>b</math></b></p> <p>(Note for reference <math>x</math> in terms of <math>y</math> is <math>x = -\frac{1}{60}y + 55</math>)</p> <p>If they use e.g. <math>\frac{y-300}{1500-300} = \frac{x-50}{30-50}</math> both M's can be scored together.</p> <p>Condone 1 sign/copying slip only if a correct formula is seen or implied.</p> <p>A1: cao Either <math>y = 3300 - 60x</math> or <math>y = -60x + 3300</math> or equivalent with <math>y</math> in terms of <math>x</math></p> <p>The correct equation with no working scores full marks.</p>
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**(b)**

**M1:** Attempts either  $\pm x("3300 - 60x")$  or  $\pm 10("3300 - 60x")$  with or without dividing by 1000.

May see both in one step, i.e.,  $\pm(x \pm 10)("3300 - 60x")$

Alternatively, allow  $(P =) \pm xy \pm 10y \pm 8000$  with or without dividing by 1000.

Allow their model for  $y$  to be any expression in  $x$  (i.e. it does not need to be linear) for M1.

**dM1:** Full attempt to find  $P$  in terms of  $x$  only. There is no need to see a LHS for this mark.

$$(P =) \frac{x("3300 - 60x") - 10("3300 - 60x") - 8000}{1000} \text{ or } (P =) \frac{(x - 10)("3300 - 60x") - 8000}{1000}$$

Condone the consistent absence of division by 1000 e.g.

$$(P =) x("3300 - 60x") - 10("3300 - 60x") - 8000 \text{ or } (P =) (x - 10)("3300 - 60x") - 8000$$

Condone invisible brackets if recovered. Dependent on the previous method mark.

Their model for  $y$  must now be a linear expression in  $x$  for dM1.

**A1\*:** Achieves the given answer through rigorous argument with all elements pulled together clearly. Requires  $P =$  (not just "profit =") at some point which may be on a previous line. Any brackets seen must have been expanded in an intermediate line before the given answer.

Allow otherwise correct work leading to  $P = -60x^2 + 3900x - 41000$  followed by

$$P = -0.06x^2 + 3.9x - 41 \text{ (without justifying the division by 1000).}$$

Allow recovery if they write e.g. 800 but it is recovered before the given answer.

**Note:** Attempts by verification are unlikely to score any marks. If unsure, send to review.

e.g.  $x = 10 \rightarrow P = -0.06(10)^2 + 3.9(10) - 41 = -8$  without an accompanying argument involving the  $(x, y)$  values (50, 300) and (30, 1500) scores M0dM0A0\*.

**(c)**

**M1:** Attempts to find either end point of the interval which may come from a calculator.

The exact values are  $\frac{195 \pm 5\sqrt{537}}{6}$  but may just be seen in the quadratic formula, e.g.,

$$\frac{-3.9 \pm \sqrt{3.9^2 - 4(-0.06)(-41)}}{2 \times -0.06} \text{ or using completing the square – see general marking principles.}$$

Accept awrt 13.2 or awrt 51.8 for this mark.

**A1:** Either  $13.18 < x < 51.82$  or  $13.19 \leq x \leq 51.81$  No units are required but 2d.p. are required.

Correct answer scores both marks. Allow e.g.  $13.18 < x \leq 51.81$  or  $13.19 \leq x < 51.82$

Allow e.g. " $x > 13.18$  and  $x < 51.82$ " or " $x > 13.18 \cap x < 51.82$ " but not use of exact values and not " $x > 13.18, x < 51.82$ " or " $x > 13.18 \cup x < 51.82$ " or " $x > 13.18$  or  $x < 51.82$ "

Must be  $x$  or e.g. "selling price" for the range, not  $y$  or  $P$ .

**(d)**

**B1ft:** £32.50. Units and 2dp required. Not £32.50p. Ignore attempts to find maximum profit.

Allow FT on the mean of their end points from (c) (their end points must be  $> 0$ , their answer requires £ and 2dp).

$$\text{May come directly from the given answer to (b) using } x = -\frac{b}{2a} = -\frac{3.9}{2 \times -0.06} = £32.50$$

or from  $\frac{dP}{dx} = -0.12x + 3.9 = 0$  or directly from a calculator. No working required.

**Note:** Following use of 13.2 and/or 51.8 (not e.g. 51.80) with either type of inequality in part (c), £32.5 will score B1ft so that the missing decimal place(s) is only penalised once.

(e)

M1: Attempts to substitute 35 (and not any other value) into the given equation for  $P$  to find a value for  $P$ .

May be implied by 22 or 22000. Condone slips.

Alternatively, substitutes  $P = 21.75$  into the model, and solves via any acceptable method, including by calculator, to find a value for  $x$ . If using 21750 it must be substituted into their  $(P =) -60x^2 + 3900x - 41000$ . Note  $x = 35.73$  or  $29.27$

A1: Requires:

- A correct value. Usually (£)22 000 but accept, e.g., 22 thousand (pound). If using 22 they must compare with 21.75. The alternative requires  $x = \text{awrt } 35.7$  to be compared to 35.
- A correct comparison. Some examples below:
  - “Close to (£)21 750” o.e. e.g. “the model predicts 22000 and they make close to this amount”
  - “Agree to 2sf”. Do not condone “it rounds to 22 000” without mention of the degree of accuracy.
  - 1.1% error (accept approx. 1%) Do not be concerned about the mechanics of any percentage error calculation seen.
  - “The difference is small”
  - Condone e.g.  $22 \approx 21.75$  o.e.
  - “**Only** £250 off”. However, just stating “£250 off” without suggesting this is a (relatively) small difference is not sufficient for this component. Similarly, “£350 off is a small difference” is incorrect (requires correct £250).
- A conclusion. e.g. Concludes it (the model) is suitable / reliable / good / fairly accurate / accurate.