

Topic 1 Part 9 [177 marks]

$$U = \{x | x \text{ is an integer, } 2 < x < 10\}$$

A and B are subsets of U such that $A = \{\text{multiples of } 3\}$, $B = \{\text{factors of } 24\}$.

1a. [2 marks]

Markscheme

(i) 3, 4, 5, 6, 7, 8, 9 (AI)

(ii) 3, 4, 6, 8 (AI)(ft) (C2)

Notes: Follow through from part (a)(i).

[2 marks]

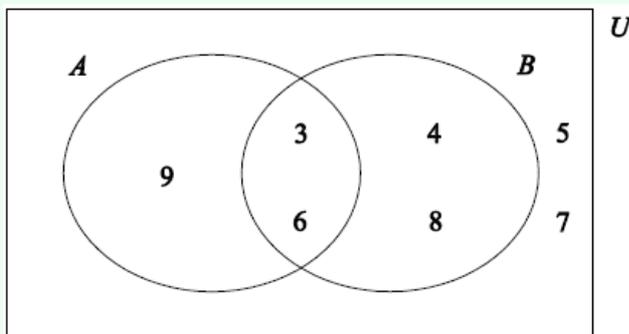
Examiners report

Many candidates were unable to write down correctly the universal set which was integers between 2 and

10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

1b. [3 marks]

Markscheme



(AI)(ft) for their 3, 6

(AI)(ft) for their 4, 8, 9

(AI)(ft) for their 5, 7 (AI)(ft)(AI)(ft)(AI)(ft) (C3)

Note: Follow through from their universal set and set B in part (a).

[3 marks]

Examiners report

Many candidates were unable to write down correctly the universal set which was integers between 2 and

10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

1c. [1 mark]

Markscheme

2 (AI)(ft) (C1)

Note: Follow through from their Venn diagram.

[1 mark]

Examiners report

Many candidates were unable to write down correctly the universal set which was integers between 2 and

10. Some candidates did not read the direction “on the Venn diagram” so complained of lack of space for their answer. It is important candidates read the directions carefully. Many candidates listed the elements of the intersection rather than answering the question to specify the number of elements. The empty set for $(A \cup B)'$ was awarded a maximum of 2 marks as this has simplified the problem.

2a. [2 marks]

Markscheme

p	q	$\neg p$	$\neg p \vee q$
T	T	F	T
T	F	F	F
F	T	T	T
F	F	T	T

(AI) for third column and (AI)(ft) for fourth column (AI)(AI)(ft) (C2)

Examiners report

This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition

$\neg p \vee q$ and following from their truth table the candidates could state if this was true or false.

2b. [2 marks]

Markscheme

x is greater than or equal to (not less than) 10 or x^2 is greater than 100. (AI)(AI) (C2)

Note: Award (AI) for “greater than or equal to (not less than) 10”, (AI) for “or x^2 is greater than 100”.

Examiners report

This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition

$\neg p \vee q$ and following from their truth table the candidates could state if this was true or false. In part (c) many candidates either stated the correct answer “true” or stated an answer consistent with their truth table and received follow-through marks. Candidates had difficulty writing down a value of

x for which

$\neg p \vee q$ is false.

2c. [1 mark]

Markscheme

True (AI)(ft) (CI)

Note: Follow through from their answer to part (a).

Examiners report

This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false. In part (c) many candidates either stated the correct answer “true” or stated an answer consistent with their truth table and received follow-through marks. Candidates had difficulty writing down a value of x for which $\neg(p \vee q)$ is false.

2d. [1 mark]

Markscheme

Any value of x such that

$-10 \leq x < 10$. (AI)(ft) (CI)

Note: Follow through from their answer to part (a).

Examiners report

This was provocative in the G2 and the comments indicate that candidates found the wording confusing. Candidates were able to write in words the compound proposition $\neg p \vee q$ and following from their truth table the candidates could state if this was true or false.

$$z = \frac{17x^2}{a-b}.$$

3a. [2 marks]

Markscheme

$$z = \frac{17(12.5)^2}{(0.572-0.447)} \quad (M1)$$

Note: Award (M1) for correct substitution into formula.

$$= 21250 \quad (A1) \quad (C2)$$

[2 marks]

Examiners report

Many candidates calculated

$\frac{17x^2}{a} - b$ instead of

$\frac{17x^2}{a-b}$ on their calculators; however they were able to get follow through points. It is important that candidates learn how to correctly input expressions into their calculators.

3b. [2 marks]

Markscheme

(i) 21000 (AI)(ft)

(ii) 21300 (AI)(ft) (C2)

Note: Follow through from part (a).

[2 marks]

Examiners report

Many candidates calculated

$\frac{17x^2}{a} - b$ instead of

$\frac{17x^2}{a-b}$ on their calculators; however they were able to get follow through points. It is important that candidates learn how to correctly input expressions into their calculators.

3c. [2 marks]

Markscheme

2.13×10^4 (AI)(ft)(AI)(ft) (C2)

Notes: Award (AI)(ft) for 2.13, (AI)(ft) for $\times 10^4$. Follow through from part (b)(ii).

[2 marks]

Examiners report

Although the question explicitly stated in bold to use the answer to **part(b)(ii)** many candidates used their answer to part (a) for part (c). The general notes about rounding in the mark scheme are over-ruled if the question has explicit directions such as in this question.

The fourth term, u_4 , of a geometric sequence is 135. The fifth term, u_5 , is 101.25 .

4a. [2 marks]

Markscheme

$\frac{101.25}{135}$ (M1)

$= \frac{3}{4}(0.75)$ (AI) (C2)

Examiners report

The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

4b.

[2 marks]

Markscheme

$$u_1 \left(\frac{3}{4}\right)^4 = 101.25 \quad (M1)$$

OR

$$u_1 \left(\frac{3}{4}\right)^3 = 135 \quad (M1)$$

OR

(by list)

$$u_3 = 180, u_2 = 240 \quad (M1)$$

Notes: Award *(M1)* for their correct substitution in geometric sequence formula, or stating explicitly u_3 and u_2 .

$$(u_1 =) 320 \quad (A1)(ft) \quad (C2)$$

Note: Follow through from their answer to part (a).

Examiners report

The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

4c.

[2 marks]

Markscheme

$$S_{10} = \frac{320 \left(1 - \left(\frac{3}{4}\right)^{10}\right)}{1 - \left(\frac{3}{4}\right)} \quad (M1)$$

Notes: Award *(M1)* for their correct substitution in geometric series formula.

Accept a list of all their ten geometric terms.

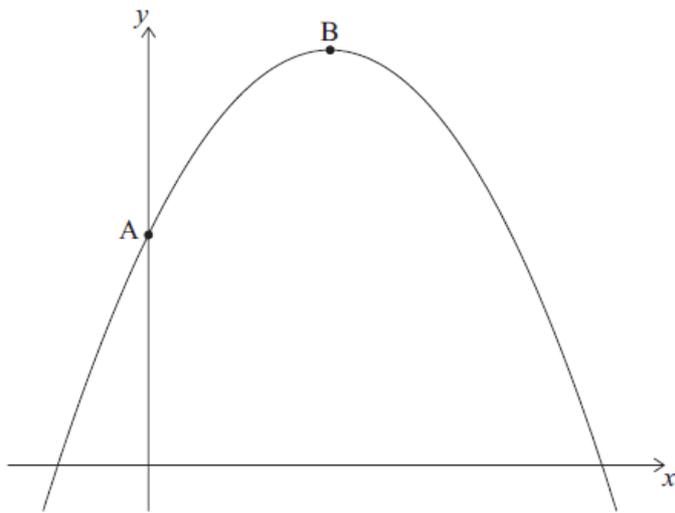
$$= 1210 \text{ (1207.918...)} \quad (A1)(ft) \quad (C2)$$

Note: Follow through from their parts (a) and (b).

Examiners report

The weakest candidates erroneously used an arithmetic sequence rather than a geometric sequence as specified in the question.

The graph of the quadratic function $f(x) = c + bx - x^2$ intersects the y -axis at point A(0, 5) and has its vertex at point B(2, 9).



5a. [1 mark]

Markscheme

5 (A1) (C1)

Examiners report

Many candidates did not see the connection between the x -intercepts and the factored form of a quadratic function. The syllabus explicitly states that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

5b. [2 marks]

Markscheme

$$\frac{-b}{2(-1)} = 2 \quad (M1)$$

Note: Award (M1) for correct substitution in axis of symmetry formula.

OR

$$y = 5 + bx - x^2$$

$$9 = 5 + b(2) - (2)^2 \quad (M1)$$

Note: Award (M1) for correct substitution of 9 and 2 into their quadratic equation.

$$(b =)4 \quad (A1)(ft) \quad (C2)$$

Note: Follow through from part (a).

Examiners report

Many candidates did not see the connection between the x -intercepts and the factored form of a quadratic function. The syllabus explicitly states that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

5c. [2 marks]

Markscheme

$$5, -1 \quad (A1)(ft)(A1)(ft) \quad (C2)$$

Notes: Follow through from parts (a) and (b), irrespective of working shown.

Examiners report

Many candidates did not see the connection between the x -intercepts and the factored form of a quadratic function. The syllabus explicitly states that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

5d. [1 mark]

Markscheme

$$f(x) = -(x - 5)(x + 1) \quad (A1)(ft) \quad (C1)$$

Notes: Follow through from part (c).

Examiners report

Many candidates did not see the connection between the x -intercepts and the factored form of a quadratic function. The syllabus explicitly states that the graphs of quadratics should be linked to solutions of quadratic equations by factorizing and vice versa. This was one of the most challenging questions for candidates.

Neung is going home to Vietnam after working in Singapore.

She has 5000 Singapore dollars (SGD) and changes these into American dollars (USD) to take home.

The exchange rate between Singapore dollars (SGD) and American dollars (USD) is

$$1 \text{ USD} = 1.2945 \text{ SGD.}$$

There is also a 2.4 % commission on the exchange.

6a. [2 marks]

Markscheme

$$5000 \times 0.024 \quad (M1)$$

Note: Award $(M1)$ for multiplication by 0.024.

$$=120 \quad (A1) \quad (C2)$$

Examiners report

Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

6b.

[2 marks]

Markscheme

$$4880 \times \frac{1}{1.2945} \quad (M1)$$

Note: Award (M1) for multiplication by $\frac{1}{1.2945}$.

$$= 3769.80 \quad (A1)(ft) \quad (C2)$$

Note: Correct answer to 2 dp only. Follow through from their part (a).

Examiners report

Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

6c.

[2 marks]

Markscheme

$$150 \times 19495 \quad (M1)$$

Note: Award (M1) for $\times 19495$.

$$= 2924000 \quad (A1) \quad (C2)$$

Notes: Correct answer to nearest 1000 only. Do not penalize incorrect accuracy in (c) if this has already been penalized in part (b).

Examiners report

Marks were awarded in part (a) for multiplication by 0.024 in part (b) for division by 1.2945 and in part (c) for multiplication by 19495. Candidates did not follow specified levels of accuracy. Candidates were able to answer later parts of the question even if they did not answer the first parts correctly.

Give your answers to parts (a) to (e) to the nearest dollar.

On Hugh's 18th birthday his parents gave him options of how he might receive his monthly allowance for the next two years.

Option A

\$60 each month for two years

Option B

\$10 in the first month,

\$15 in the second month,

\$20 in the third month, increasing by

\$5 each month for two years

Option C

\$15 in the first month and increasing by

10% each month for two years

Option D Investing

\$1500 at a bank at the beginning of the first year, with an interest rate of

6% per annum, **compounded monthly**.

Hugh does not spend any of his allowance during the two year period.

7a. [2 marks]

Markscheme

The first time an answer is not given to the nearest dollar in parts (a) to (e), the final (A1) in that part is not awarded.

$$60 \times 24 \quad (M1)$$

Note: Award (M1) for correct product.

$$= 1440 \quad (A1)(G2)$$

[2 marks]

Examiners report

[N/A]

7b. [5 marks]

Markscheme

The first time an answer is not given to the nearest dollar in parts (a) to (e), the final (A1) in that part is not awarded.

(i)

$$10 + (17 - 1)(5) \quad (M1)(A1)$$

Note: Award (M1) for substituted arithmetic sequence formula, (A1) for correct substitution.

$$= 90 \quad (A1)(G2)$$

(ii)

$$\frac{24}{2}(2(10) + (24 - 1)(5)) \quad (M1)$$

OR

$$\frac{24}{2}(10 + 125) \quad (M1)$$

Note: Award (M1) for correct substitution in arithmetic series formula.

$$= 1620 \quad (A1)(ft)(G1)$$

Note: Follow through from part (b)(i).

[5 marks]

Examiners report

[N/A]

7c.

[5 marks]

Markscheme

The first time an answer is not given to the nearest dollar in parts (a) to (e), the final (A1) in that part is not awarded.

(i)

$$15(1.1)^{12} \quad (M1)(A1)$$

Note: Award (M1) for substituted geometric sequence formula, (A1) for correct substitutions.

$$= 47 \quad (A1)(G2)$$

Note: Award (M1)(A1)(A0) for

47.08.

Award (G1) for

47.08 if workings are not shown.

(ii)

$$\frac{15(1.1^{24}-1)}{1.1-1} \quad (M1)$$

Note: Award (M1) for correct substitution in geometric series formula.

$$= 1327 \quad (A1)(ft)(G1)$$

Note: Follow through from part (c)(i).

[5 marks]

Examiners report

[N/A]

7d.

[3 marks]

Markscheme

The first time an answer is not given to the nearest dollar in parts (a) to (e), the final (AI) in that part is not awarded.

$$1500 \left(1 + \frac{6}{100(12)} \right)^{12(2)} \quad (MI)(AI)$$

Note: Award (MI) for substituted compound interest formula, (AI) for correct substitutions.

OR

$$N = 2$$

$$I\% = 6$$

$$PV = 1500$$

$$P/Y = 1$$

$$C/Y = 12 \quad (AI)(MI)$$

Note: Award (AI) for

$C/Y = 12$ seen, (MI) for other correct entries.

OR

$$N = 24$$

$$I\% = 6$$

$$PV = 1500$$

$$P/Y = 12$$

$$C/Y = 12 \quad (AI)(MI)$$

Note: Award (AI) for

$C/Y = 12$ seen, (MI) for other correct entries.

$$= 1691 \quad (AI)(G2)$$

[3 marks]

Examiners report

[N/A]

7e.

[1 mark]

Markscheme

The first time an answer is not given to the nearest dollar in parts (a) to (e), the final (AI) in that part is not awarded.

Option D (AI)(ft)

Note: Follow through from their parts (a), (b), (c) and (d). Award (AI)(ft) only if values for the four options are seen and only if their answer is consistent with their parts (a), (b), (c) and (d).

[1 mark]

Examiners report

[N/A]

7f.

[3 marks]

Markscheme

$$1750 = 1500\left(1 + \frac{r}{100}\right)^2 \quad (MI)(AI)$$

Note: Award *(MI)* for substituted compound interest formula equated to 1750, *(AI)* for correct substitutions into formula.

OR

$$N = 2$$

$$PV = 1500$$

$$FV = -1750$$

$$P/Y = 1$$

$$C/Y = 1 \quad (AI)(MI)$$

Note: Award *(AI)* for

$FV = 1750$ seen, *(MI)* for other correct entries.

$$= 8.01\% \text{ (8.01234... \% , 0.0801)} \quad (AI)(G2)$$

[3 marks]

Examiners report

[N/A]

A parcel is in the shape of a rectangular prism, as shown in the diagram. It has a length l cm, width w cm and height of 20 cm. The total volume of the parcel is 3000 cm^3 .

8a.

[1 mark]

Markscheme

$$20lw \quad \text{OR}$$

$$V = 20lw \quad (AI)$$

[1 mark]

Examiners report

[N/A]

8b.

[2 marks]

Markscheme

$$3000 = 20lw \quad (MI)$$

Note: Award *(MI)* for equating their answer to part (a) to 3000.

$$l = \frac{3000}{20w} \quad (MI)$$

Note: Award *(MI)* for rearranging equation to make l subject of the formula. The above equation must be seen to award *(MI)*.

OR

$$150 = lw \quad (MI)$$

Note: Award *(MI)* for division by 20 on both sides. The above equation must be seen to award *(MI)*.

$$l = \frac{150}{w} \quad (AG)$$

[2 marks]

Examiners report

[N/A]

8c.

[2 marks]

Markscheme

$$S = 2l + 4w + 2(20) \quad (MI)$$

Note: Award *(MI)* for setting up a correct expression for S .

$$2\left(\frac{150}{w}\right) + 4w + 2(20) \quad (MI)$$

Notes: Award *(MI)* for correct substitution into the expression for S . The above expression must be seen to award *(MI)*.

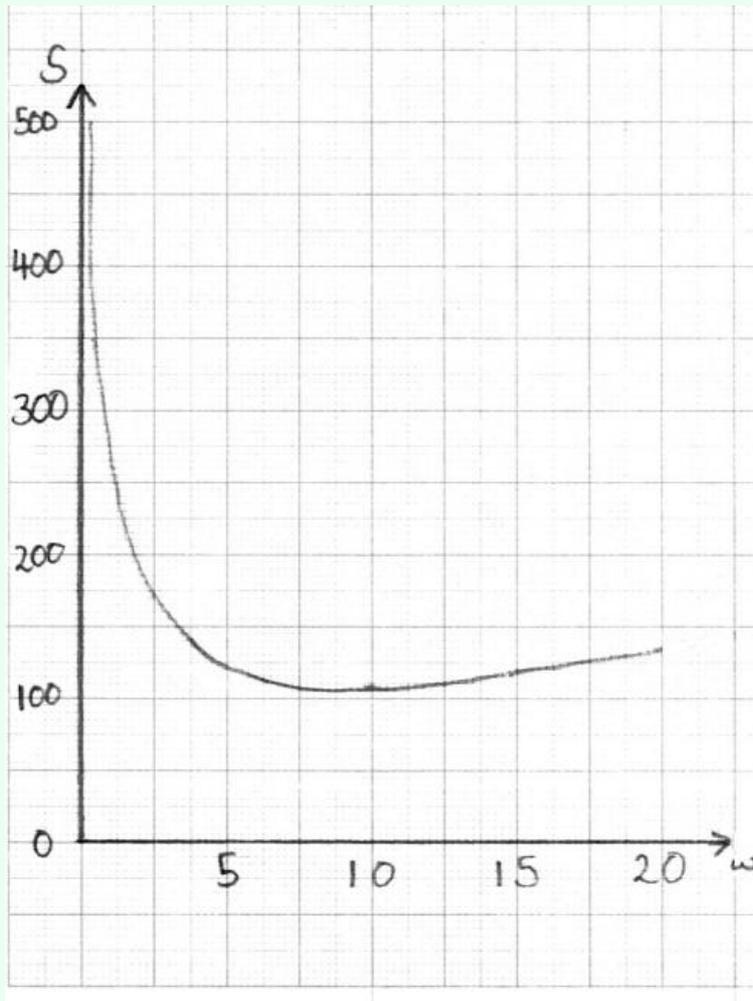
$$= 40 + 4w + \frac{300}{w} \quad (AG)$$

[2 marks]

Examiners report

[N/A]

Markscheme



(AI)(AI)(AI)(AI)

Note: Award (AI) for correct scales, window and labels on axes, (AI) for approximately correct shape, (AI) for minimum point in approximately correct position, (AI) for asymptotic behaviour at $w = 0$.

Axes must be drawn with a ruler and labeled

w and

S .

For a smooth curve (with approximately correct shape) there should be **one** continuous thin line, no part of which is straight and no (one-to-many) mappings of

w .

The

S -axis must be an asymptote. The curve must not touch the

S -axis nor must the curve approach the asymptote then deviate away later.

[4 marks]

Examiners report

[N/A]

8e. [3 marks]

Markscheme

$$4 - \frac{300}{w^2} \quad (AI)(AI)(AI)$$

Notes: Award *(AI)* for

4, *(AI)* for

-300 , *(AI)* for

$\frac{1}{w^2}$ or

w^{-2} . If extra terms present, award at most *(AI)(AI)(A0)*.

[3 marks]

Examiners report

[N/A]

8f. [2 marks]

Markscheme

$$4 - \frac{300}{w^2} = 0 \quad \text{OR}$$

$$\frac{300}{w^2} = 4 \quad \text{OR}$$

$$\frac{dS}{dw} = 0 \quad (MI)$$

Note: Award *(MI)* for equating their derivative to zero.

$$w = 8.66 \left(\sqrt{75}, 8.66025\dots \right) \quad (AI)(ft)(G2)$$

Note: Follow through from their answer to part (e).

[2 marks]

Examiners report

[N/A]

8g. [1 mark]

Markscheme

$$17.3 \left(\frac{150}{\sqrt{75}}, 17.3205\dots \right) \quad (AI)(ft)$$

Note: Follow through from their answer to part (f).

[1 mark]

Examiners report

[N/A]

8h.

[2 marks]

Markscheme

$$40 + 4\sqrt{75} + \frac{300}{\sqrt{75}} \quad (M1)$$

Note: Award (M1) for substitution of their answer to part (f) into the expression for S .

$$= 110 \text{ (cm)} \quad (40 + 40\sqrt{3}, 109.282\dots) \quad (A1)(ft)(G2)$$

Note: Do not accept
109.

Follow through from their answers to parts (f) and (g).

[2 marks]

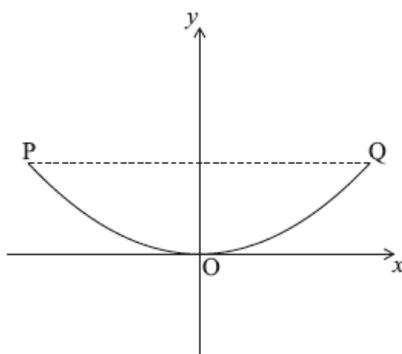
Examiners report

[N/A]

The front view of the edge of a water tank is drawn on a set of axes shown below.

The edge is modelled by

$$y = ax^2 + c.$$



Point

P has coordinates

$(-3, 1.8)$, point

O has coordinates

$(0, 0)$ and point

Q has coordinates

$(3, 1.8)$.

9a.

[1 mark]

Markscheme

$$0 \quad (A1)(G1)$$

[1 mark]

Examiners report

[N/A]

9b. [2 marks]

Markscheme

$$1.8 = a(3)^2 + 0 \quad (MI)$$

OR

$$1.8 = a(-3)^2 + 0 \quad (MI)$$

Note: Award *(MI)* for substitution of

$$y = 1.8 \text{ or}$$

$x = 3$ and their value of

c into equation.

0 may be implied.

$$a = 0.2$$

$$\left(\frac{1}{5}\right) \quad (AI)(ft)(GI)$$

Note: Follow through from their answer to part (a).

Award *(GI)* for a correct answer only.

[2 marks]

Examiners report

[N/A]

9c. [1 mark]

Markscheme

$$y = 0.2x^2 \quad (AI)(ft)$$

Note: Follow through from their answers to parts (a) and (b).

Answer must be an equation.

[1 mark]

Examiners report

[N/A]

9d. [2 marks]

Markscheme

$$0.2 \times (2.4)^2 \quad (MI)$$

$$= 1.15 \text{ (m)}$$

$$(1.152) \quad (AI)(ft)(GI)$$

Notes: Award *(MI)* for correctly substituted formula, *(AI)* for correct answer. Follow through from their answer to part (c).

Award *(GI)* for a correct answer only.

[2 marks]

Examiners report

[N/A]

9e. [2 marks]

Markscheme

y is the height (AI)

positive value of

x is half the width (or equivalent) (AI)

[2 marks]

Examiners report

[N/A]

9f. [2 marks]

Markscheme

$$0.9 = 0.2x^2 \quad (M1)$$

Note: Award (M1) for setting their equation equal to 0.9.

$$x = \pm 2.12 \text{ (m)}$$

$$\left(\pm \frac{3}{2}\sqrt{2}, \pm \sqrt{4.5}, \pm 2.12132\dots\right) \quad (AI)(ft)(GI)$$

Note: Accept

2.12. Award (GI) for a correct answer only.

[2 marks]

Examiners report

[N/A]

9g.

[2 marks]

Markscheme

(i)

$$2.55 \times 5 \quad (M1)$$

Note: Award *(M1)* for correct substitution in formula.

$$= 12.8 \text{ (m}^3\text{)}$$

$$(12.75 \text{ (m}^3\text{)}) \quad (A1)(G2)$$

[2 marks]

(ii)

$$\frac{12.75}{36} \times 100 \quad (M1)$$

Note: Award *(M1)* for correct quotient multiplied by 100.

$$= 35.4(\%)$$

$$(35.4166\dots) \quad (A1)(ft)(G2)$$

Note: Award *(G2)* for

$$35.6(\%)(35.5555\dots(\%)).$$

Follow through from their answer to part (g)(i).

[2 marks]

Examiners report

[N/A]

U is the set of **positive** integers less than or equal to

10.

A ,

B and

C are subsets of

U .

$$A = \{\text{even integers}\}$$

$$B = \{\text{multiples of 3}\}$$

$$C = \{6, 7, 8, 9\}$$

10a.

[1 mark]

Markscheme

$$2, 4, 6, 8, 10 \quad (A1) \quad (C1)$$

Note: Do not penalize the use of

{ }.

[1 mark]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

10b.

[1 mark]

Markscheme

3,6,9 (AI) (CI)

Note: Do not penalize the use of

{ }.

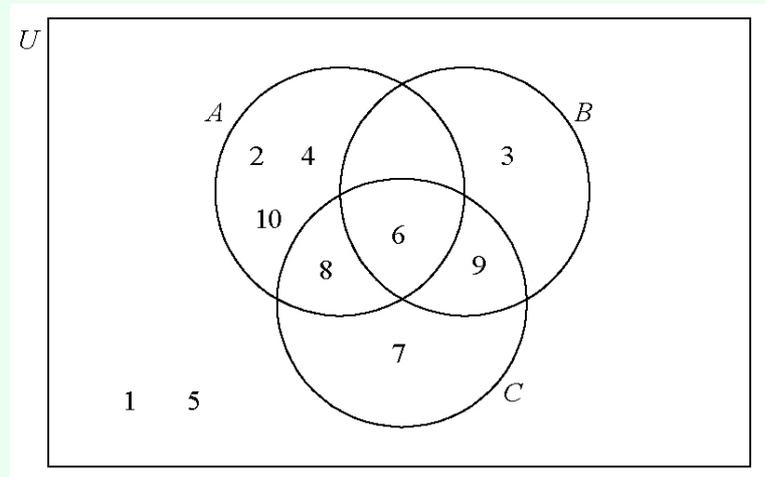
Follow through from part (a) only if their U is listed.

[1 mark]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

Markscheme



(AI)(ft)(AI)(ft)(AI)(ft)(AI)(ft) (C4)

Notes: Award (AI)(ft) for the correct placement of

6.

Award (AI)(ft) for the correct placement of

8 and

9 and the empty region.

Award (AI)(ft) for the correct placement of

2,

4,

3,

7, and

10.

Award (AI)(ft) for the correct placement of

1 and

5.

If an element is in more than one region, award (A0) for that element.

Follow through from their answers to parts (a) and (b).

[4 marks]

Examiners report

This question was done well by most candidates. The most frequent error was to omit the placement of 1 and 5 or to include 0 in the set of even integers.

The first term,

u_1 , of an arithmetic sequence is

145. The fifth term,

u_5 , of the sequence is

113.

11a. [2 marks]

Markscheme

$$145 + (5 - 1)d = 113 \quad (M1)$$

Note: Award *(M1)* for correctly substituted AP formula.

OR

$$\frac{113-145}{4} \quad (M1)$$

$$= -8 \quad (A1) \quad (C2)$$

[2 marks]

Examiners report

Many candidates gave an answer of 8 rather than -8 but were awarded follow through marks in parts (b) and (c) where working was shown. Some candidates appeared unaware that the common difference in both the AP formula for a term and for a sum is multiplied rather than added or subtracted. Candidates who used a list to answer this question were able to gain full marks.

11b. [2 marks]

Markscheme

$$145 + (n - 1) \times -8 = -7 \quad (M1)$$

Note: Award *(M1)* for their correctly substituted AP formula.

If a list is used award *(M1)* for their correct values down to -7 .

$$n = 20 \quad (A1)(ft) \quad (C2)$$

Note: Follow through from their part (a).

[2 marks]

Examiners report

Many candidates gave an answer of 8 rather than -8 but were awarded follow through marks in parts (b) and (c) where working was shown. Some candidates appeared unaware that the common difference in both the AP formula for a term and for a sum is multiplied rather than added or subtracted. Candidates who used a list to answer this question were able to gain full marks.

11c.

[2 marks]

Markscheme

$$S_{20} = \frac{20}{2}(2 \times 145 + (20 - 1) \times -8) \quad (M1)$$

Note: Award *(M1)* for their correctly substituted sum of an AP formula.

If a list is used award *(M1)* for their correct terms up to 1380

$$= 1380 \quad (A1)(ft)$$

Note: Follow through from their part (a).

OR

$$S_{20} = \frac{20}{2}(145 + (-7)) \quad (M1)$$

Note: Award *(M1)* for correctly substituted sum of an AP formula.

$$= 1380 \quad (A1) \quad (C2)$$

Note: If candidates have listed the terms correctly and given the common difference as

8, award *(M1)(A0)* for part (a), *(M1)(A0)* for an answer of

−18 or

18 for part (b) and *(M1)(A1)(ft)* for an answer of

4420 in part (c) with working seen.

[2 marks]

Examiners report

Many candidates gave an answer of 8 rather than −8 but were awarded follow through marks in parts (b) and (c) where working was shown. Some candidates appeared unaware that the common difference in both the AP formula for a term and for a sum is multiplied rather than added or subtracted. Candidates who used a list to answer this question were able to gain full marks.

12a.

[2 marks]

Markscheme

$$2x^4 - x \quad (A1)(A1) \quad (C2)$$

Note: Award *(A1)* for

$2x^4$, *(A1)* for

$-x$.

[2 marks]

Examiners report

A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

12b.

[2 marks]

Markscheme

$$8x^3 - 1 \quad (AI)(ft)(AI)(ft) \quad (C2)$$

Note: Award $(AI)(ft)$ for

$8x^3$, $(AI)(ft)$ for

–1. Follow through from their part (a).

Award at most $(AI)(A0)$ if extra terms are seen.

[2 marks]

Examiners report

A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

12c.

[2 marks]

Markscheme

$$8x^3 - 1 = 0 \quad (MI)$$

Note: Award (MI) for equating their part (b) to zero.

$$(x =) \frac{1}{2} \quad (0.5) \quad (AI)(ft) \quad (C2)$$

Notes: Follow through from part (b).

0.499 is the answer from the use of trace on the GDC; award $(A0)(A0)$.

For an answer of

$(0.5, -0.375)$, award $(MI)(A0)$.

[2 marks]

Examiners report

A surprising number of candidates were unable to correctly expand the expression given in part (a). Most candidates were able to differentiate their function but a considerable number were unable to find the x-coordinate of the minimum point. Candidates must read the questions correctly as answers giving ordered pairs were not awarded the final mark. A number of candidates did not use calculus to determine the local minimum but graphed the function, often achieving full marks for part (c), even when parts (b) or (a) were incorrect or left blank.

512 competitors enter round 1 of a tennis tournament, in which each competitor plays a match against one other competitor.

The winning competitor progresses to the next round (round 2); the losing competitor leaves the tournament.

The tournament continues in this manner until there is a winner.

13a.

[3 marks]

Markscheme

$$512\left(\frac{1}{2}\right)^5 \quad (MI)(AI)$$

Note: Award *(MI)* for substituted geometric progression formula, *(AI)* for correct substitution.

If a list is used, award *(MI)* for a list of at least six terms, beginning with 512 and *(AI)* for first six terms correct.

$$16 \quad (AI) \quad (C3)$$

[3 marks]

Examiners report

The first part of this question was answered quite well, especially by candidates who used a list. Part (b) was poorly answered.

Common errors in part (b) were to find the number of rounds rather than the total number of matches played or to take the first term as 512 rather than 256.

13b.

[3 marks]

Markscheme

$$S_9 = 256 \left(\frac{1 - \left(\frac{1}{2}\right)^9}{1 - \frac{1}{2}} \right) \quad \text{OR}$$

$$\frac{(2^9 - 1)}{2 - 1} \quad (MI)(AI)$$

Note: Award *(MI)* for substituted sum of a GP formula, *(AI)* for correct substitution.

If a list is used, award *(AI)* for at least 9 correct terms, including 1, and *(MI)* for their 9 terms, including 1, added together.

$$511 \quad (AI) \quad (C3)$$

[3 marks]

Examiners report

The first part of this question was answered quite well, especially by candidates who used a list. Part (b) was poorly answered.

Common errors in part (b) were to find the number of rounds rather than the total number of matches played or to take the first term as 512 rather than 256.

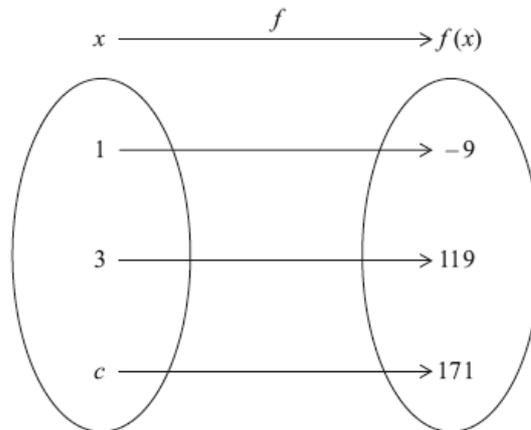
A quadratic function

$f: x \mapsto ax^2 + b$, where

a and

$b \in \mathbb{R}$ and

$x \geq 0$, is represented by the mapping diagram.



14a.

[2 marks]

Markscheme

$$a(1)^2 + b = -9 \quad (A1)$$

$$a(3)^2 + b = 119 \quad (A1) \quad (C2)$$

Note: Accept equivalent forms of the equations.

[2 marks]

Examiners report

This question was answered reasonably well with many candidates able to write down the two equations and solve them for a and b . Errors such as mistaking the equation given for

$3a^2 + b = 119$ meant that marks were lost even though the candidates appeared to know what they needed to do. Most candidates who were able to set up the equation in part (c) solved it correctly. Follow through marks were awarded to many candidates for correct working with their substituted values from part (b).

14b.

[2 marks]

Markscheme

(i)

$$a = 16 \quad (A1)(ft)$$

(ii)

$$b = -25 \quad (A1)(ft) \quad (C2)$$

Note: Follow through from part (a) irrespective of whether working is seen.

If working is seen follow through from part (i) to part (ii).

[2 marks]

Examiners report

This question was answered reasonably well with many candidates able to write down the two equations and solve them for a and b . Errors such as mistaking the equation given for $3a^2 + b = 119$ meant that marks were lost even though the candidates appeared to know what they needed to do. Most candidates who were able to set up the equation in part (c) solved it correctly. Follow through marks were awarded to many candidates for correct working with their substituted values from part (b).

14c. [2 marks]

Markscheme

$$16c^2 - 25 = 171 \quad (M1)$$

Note: Award *(M1)* for correct quadratic with their a and b substituted.

$$c = 3.5 \quad (A1)(ft) \quad (C2)$$

Note: Accept x instead of c .

Follow through from part (b).

Award *(A1)* only, for an answer of ± 3.5 with or without working.

[2 marks]

Examiners report

This question was answered reasonably well with many candidates able to write down the two equations and solve them for a and b . Errors such as mistaking the equation given for $3a^2 + b = 119$ meant that marks were lost even though the candidates appeared to know what they needed to do. Most candidates who were able to set up the equation in part (c) solved it correctly. Follow through marks were awarded to many candidates for correct working with their substituted values from part (b).

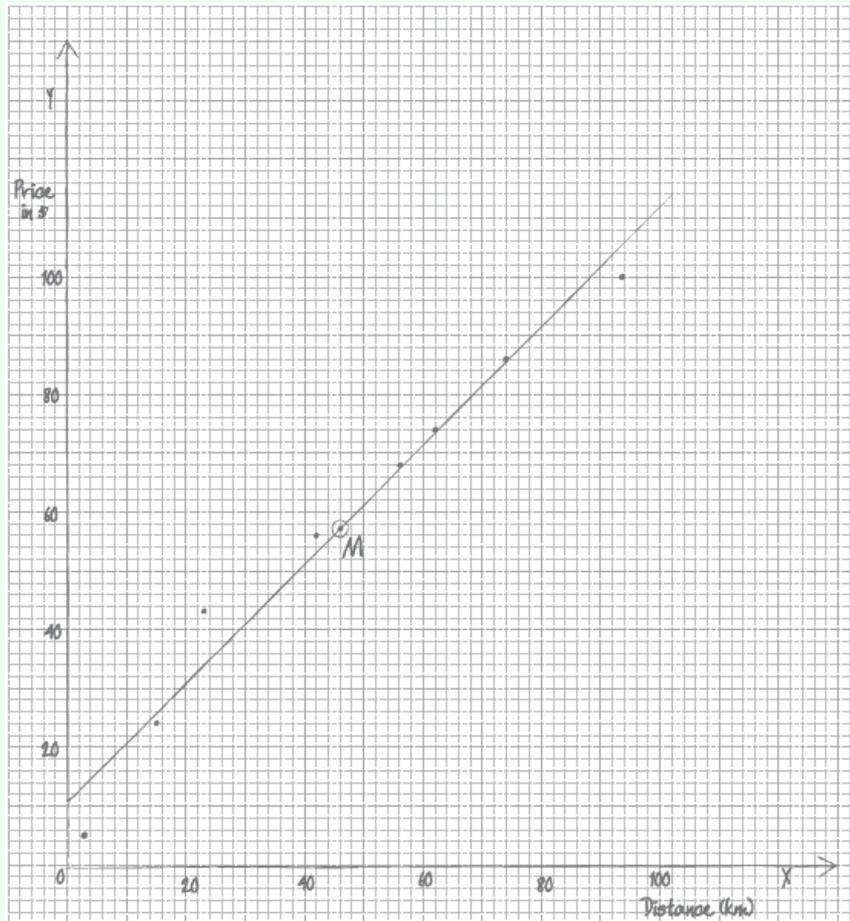
The table shows the distance, in km, of eight regional railway stations from a city centre terminus and the price, in \$, of a return ticket from each regional station to the terminus.

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

15a.

[4 marks]

Markscheme



(A4)

Notes: Award (A1) for correct scale and labels (accept x and y).

Award (A3) for
7 or
8 points plotted correctly.

Award (A2) for
5 or
6 points plotted correctly.

Award (A1) for
3 or
4 points plotted correctly.

Award at most (A1)(A2) if points are joined up.

If axes are reversed, award at most (A0)(A3).

If graph paper is not used, award at most (A1)(A0).

[4 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15b. [2 marks]

Markscheme

(i)

$$(\bar{x} =) 46 \quad (G1)$$

(ii)

$$(\bar{y} =) 57 \quad (G1)$$

[2 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15c. [1 mark]

Markscheme

$M(46, 57)$ plotted and labelled on the scatter diagram $(A1)(ft)$

Notes: Follow through from their part (b).

Accept

(\bar{x}, \bar{y}) as the label.

[1 mark]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15d.

[3 marks]

Markscheme

(i)

0.986

(0.986322...) (GI)

(ii)

$y = 1.01x + 10.3$

$(y = 1.01431\dots x + 10.3412\dots)$ (GI)(GI)

Notes: Award (GI) for

1.01x, (GI) for

10.3.

Award (GI)(G0) if not written in the form of an equation.

OR

$(y - 57) = 1.01(x - 46)$

$(y - 57 = 1.01431\dots(x - 46))$ (GI)(GI)(ft)

Note: Award (GI) for

1.01, (GI) for their

57 and

46.

[3 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

Markscheme

straight line drawn on the scatter diagram (AI)(ft)(AI)(ft)

Notes: The line must be straight for either of the two marks to be awarded.

Award (AI)(ft) passing through their

M plotted in (c).

Award (AI)(ft) for correct

y -intercept (between

9 and

12).

Follow through from their

y -intercept found in part (d).

If part (d) is used, award (AI)(ft) for their intercept

(± 1).

[2 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15f.

[3 marks]

Markscheme

$$y = 1.01431\dots \times 76 + 10.3412\dots \quad (M1)$$

Note: Award *(M1)* for substitution of 76 into their regression line.

$$= 87.4295\dots \quad (A1)(ft)$$

Note: Follow through from part (d). If 3 sf values are used the value is 87.06.

$$\$87 \quad (A1)(ft)(G2)$$

Notes: The final *(A1)* is awarded for their answer given correct to the nearest dollar.

Method, followed by the answer of 87 earns *(M1)(G2)*. It is not necessary to see the interim step.

Where the candidate uses their graph instead of the equation, and arrives at an answer other than 87, award, at most, *(G1)(ft)*.

If the candidate uses their graph and arrives at the required answer of 87, award *(G2)(ft)*.

[3 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point *M*, a significant number of candidates seemed to draw their line ‘by eye’ rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and ‘within the data range’ or a ‘strong correlation’ were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15g.

[1 mark]

Markscheme

76 is within the range of distances given in the data **OR** the correlation coefficient is close to 1. *(R1)*

Notes: Award *(R1)* if **either** condition is given.

Sufficient to indicate that 76 is ‘within the data range’ and the correlation is ‘strong’.

Allow r^2 close to

1.

Do **not** accept “within the range of prices”.

[1 mark]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

15h.

[2 marks]

Markscheme

$$\text{Percentage error} = \frac{87-80}{80} \times 100 \quad (M1)$$

Note: Award $(M1)$ for correct substitution into formula.

8.75% $(A1)(ft)(G2)$

Notes: Follow through from their answer to part (f).

Accept either the rounded or unrounded answer to part (f).

If no integer value seen in part (f), follow through from their unrounded answer to part (f).

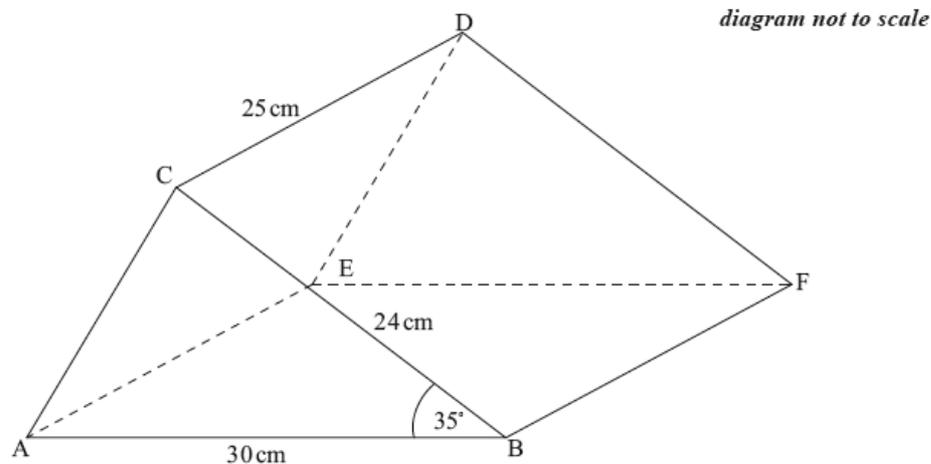
Answer must be positive.

[2 marks]

Examiners report

This question was very well attempted by a significant majority of candidates. Many good and accurate attempts at plotting a scatter diagram were seen in part (a). However, a minority of candidates chose not to use graph paper but instead used their answer book. These candidates achieved, at most, one mark for that part question. Many correct answers were seen in parts (b) and (d) reflecting good use of the graphic display calculator. Whilst many candidates realized that the line of regression passes through the point M , a significant number of candidates seemed to draw their line 'by eye' rather than using the equation found in part (d) and, as a consequence for many, their straight line (or projected line) did not fall within the required tolerances for the second mark. Many candidates understood the requirements for part (f) and full marks were seen on a majority of scripts. Those candidates, however, who used their graph instead scored, at most, two marks here. Many candidates seemed to be well-drilled in giving a suitable reason in part (f) and 'within the data range' or a 'strong correlation' were frequently seen. Percentage error caused very few problems for candidates and many correct answers were seen in part (h).

A manufacturer has a contract to make 2600 solid blocks of wood. Each block is in the shape of a right triangular prism, ABCDEF, as shown in the diagram. $AB = 30$ cm, $BC = 24$ cm, $CD = 25$ cm and angle $\hat{A}BC = 35^\circ$.



16a. [3 marks]

Markscheme

$$AC^2 = 30^2 + 24^2 - 2 \times 30 \times 24 \times \cos 35^\circ \quad (M1)(A1)$$

Note: Award (M1) for substituted cosine rule formula, (A1) for correct substitutions.

$$AC = 17.2 \text{ cm} \\ (17.2168\dots) \quad (A1)(G2)$$

Notes: Use of radians gives 52.7002... Award (M1)(A1)(A0).

No marks awarded in this part of the question where candidates assume that angle $ACB = 90^\circ$.

[3 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle $ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for $\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

16b.

[3 marks]

Markscheme

Units are required in part (b).

Area of triangle

$$ABC = \frac{1}{2} \times 24 \times 30 \times \sin 35^\circ \quad (M1)(A1)$$

Notes: Award *(M1)* for substitution into area formula, *(A1)* for correct substitutions.

Special Case: Where a candidate has assumed that angle

$ACB = 90^\circ$ in part (a), award *(M1)(A1)* for a correct alternative substituted formula for the area of the triangle (ie $\frac{1}{2} \times \text{base} \times \text{height}$).

$$= 206 \text{ cm}^2$$

$$(206.487\dots \text{cm}^2) \quad (A1)(G2)$$

Notes: Use of radians gives negative answer,

$-154.145\dots$ Award *(M1)(A1)(A0)*.

Special Case: Award *(A1)(ft)* where the candidate has arrived at an area which is correct to the standard rounding rules from their lengths (units required).

[3 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle

$ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for

$\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

16c.

[2 marks]

Markscheme

$$206.487\dots \times 25 \times 2600 \quad (M1)$$

Note: Award *(M1)* for multiplication of their answer to part (b) by 25 and 2600.

$$13\,421\,688.61 \quad (A1)$$

Note: Accept unrounded answer of 13 390 000 for use of 206.

$$13\,400\,000 \quad (AG)$$

Note: The final *(A1)* cannot be awarded unless both the unrounded and rounded answers are seen.

[2 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle $ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for $\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

16d. [2 marks]

Markscheme

$$1.34 \times 10^7 \quad (A2)$$

Notes: Award (A2) for the correct answer.

Award (A1)(A0) for

1.34 and an incorrect index value.

Award (A0)(A0) for any other combination (including answers such as 13.4×10^6).

[2 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle $ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for $\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

16e.

[3 marks]

Markscheme

$$2 \times 206.487\dots + 24 \times 25 + 30 \times 25 + 17.2168\dots \times 25 \quad (MI)(MI)$$

Note: Award *(MI)* for multiplication of their answer to part (b) by 2 for area of two triangular ends, *(MI)* for three correct rectangle areas using 24, 30 and their 17.2.

$$2193.26\dots \quad (AI)$$

Note: Accept 2192 for use of 3 sf answers.

$$2190 \quad (AG)$$

Note: The final *(AI)* cannot be awarded unless both the unrounded and rounded answers are seen.

[3 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle $ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for $\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

16f.

[3 marks]

Markscheme

$$\frac{2190 \times 2600}{22 \times 10\,000} \quad (MI)(MI)$$

Notes: Award *(MI)* for multiplication by 2600 and division by 22, *(MI)* for division by 10 000.

The use of 22 may be implied *ie* division by 2200 would be acceptable.

$$25.9 \text{ litres} \\ (25.8818\dots) \quad (AI)(G2)$$

Note: Accept 26.

[3 marks]

Examiners report

Some candidates assumed that triangle ACB was a right angled triangle with angle $ACB = 90^\circ$. Such candidates earned no marks for part (a) but were able to recover most of the marks in the remainder of the question. For those candidates who correctly used the cosine rule for part (a), most achieved all 3 marks for this part and used a correct formula for the area of the triangle in part (b) to obtain at least 2 marks for this part. The final mark was not awarded, however, if no units or the incorrect units were given. Parts (c) and (e) were generally well done with many candidates showing the unrounded answer before the required answer. Part (f) proved to be quite problematic for many candidates. Whilst many were able to earn a method mark for $\frac{2190 \times 2600}{22}$, a significant number of these candidates were unable to convert the units correctly and very few correct answers were seen. Indeed, the most popular answer seemed to be 2590 litres.

Give all answers in this question correct to two decimal places.

Arthur lives in London. On

1st August 2008 Arthur paid

37 500 euros (

EUR) for a new car from Germany. The price of the same car in London was

34 075 British pounds (

GBP).

The exchange rate on

1st August 2008 was

1 EUR = 0.7234 GBP.

17a.

[2 marks]

Markscheme

The first answer not given to two decimal places is not awarded the final (A1). Incorrect rounding is not penalized thereafter.

$$37\,500 \times 0.7234 \quad (M1)$$

$$= 27\,127.50 \quad (A1)(G2)$$

[2 marks]

Examiners report

Despite the fact that “Give all answers in this question correct to two decimal places” was written in bold at the top of the question, many candidates lost one (and only one) mark for giving at least one answer to only a single decimal place. There was a lot of reading in this question and some candidates seemed to lose their way as their solution developed and, as a consequence, lost marks in the latter part of the question. A significant number of candidates obtained nearly full marks for parts (a) through to (d). The marks which tended to not be awarded were not giving the required answer to two decimal places and not adding the amount invested onto the interest earned in part (c). Indeed, many candidates were able to correctly determine the depreciated value of the car on 1st August 2009 by simply finding 91% of the original price. However, part (e) proved to be elusive for many candidates as some simply treated the problem as a ‘reverse simple interest problem’ and subtracted 9% for each of a further 3 years. As a consequence, erroneous answers of the form 17,361.60, from $(27127.50 \times (1 - 0.09 \times 4))$, were often conveniently ignored and rounded to the required answer of 18,600 GBP. Such a method earned no marks at all. There was a lot of information given in the stem to the last part of the question and, as a consequence, many candidates were unable to achieve full marks here. There was certainly a great deal of confusion as to what to divide by 0.8694 (seeing $\frac{18\,600 + 8198.05 - 30\,500}{0.8694} = -4258.05$ was not uncommon) and even introducing the original exchange rate of 0.7234 caused confusion. As a further example, an incorrect value carried forward from part (c) (1,250.55) led to a negative result. Provided the method was correct (despite an incorrect value carried forward), the three method marks were awarded. However, the negative result of -7,667.53 should have flagged to the candidate that something was wrong somewhere and this could only be in the current part of the question or part (c).

17b.

[1 mark]

Markscheme

The first answer not given to two decimal places is not awarded the final (A1). Incorrect rounding is not penalized thereafter.
6947.50 (A1)(ft)(G1)

Note: Follow through from part (a) irrespective of whether working is seen.

[1 mark]

Examiners report

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17c.

[3 marks]

Markscheme

The first answer not given to two decimal places is not awarded the final (A1). Incorrect rounding is not penalized thereafter.
 27127.50×0.91 (A1)(MI)

Note: Award (A1) for
0.91 seen or equivalent, (MI) for their
27127.50 multiplied by
0.91

OR

$27127.50 - 0.09 \times 27127.50$ (A1)(MI)

Note: Award (A1) for
 0.09×27127.50 seen, and (MI) for
 $27127.50 - 0.09 \times 27127.50$.

= 24686.03 (A1)(ft)(G2)

Note: Follow through from part (a).

[3 marks]

Examiners report

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(seeing

$\frac{18\,600 + 8198.05 - 30\,500}{0.8694} = -4258.05$ was not uncommon) and even introducing the original exchange rate of 0.7234 caused confusion.

As a further example, an incorrect value carried forward from part (c) (1,250.55) led to a negative result. Provided the method was correct (despite an incorrect value carried forward), the three method marks were awarded. However, the negative result of -7,667.53 should have flagged to the candidate that something was wrong somewhere and this could only be in the current part of the question or part (c).

Markscheme

The first answer not given to two decimal places is not awarded the final (AI). Incorrect rounding is not penalized thereafter.

$$27\,127.50 \times \left(1 - \frac{9}{100}\right)^4 \quad (MI)(AI)(ft)$$

Notes: Award (MI) for substituted compound interest formula, (AI)(ft) for correct substitution.

Follow through from part (a).

OR

$$27\,127.50 \times (0.91)^4 \quad (MI)(AI)(ft)$$

Notes: Award (MI) for substituted geometric sequence formula, (AI)(ft) for correct substitution.

Follow through from part (a).

OR (lists (i))

$$24\,686.03, 22\,464.28\dots, 20\,442.50\dots, 18\,602.67\dots \quad (MI)(AI)(ft)$$

Notes: Award (MI) for at least the

2nd term correct (calculated from their

(a) $\times 0.91$). Award (AI)(ft) for four correct terms (rounded or unrounded).

Follow through from part (a).

Accept list containing the last three terms only (

24 686.03 may be implied).

OR (lists(ii))

$$27\,127.50 - (2441.47\dots + 2221.74\dots + 2021.79\dots + 1839.82\dots) \quad (MI)(AI)(ft)$$

Notes: Award (MI) for subtraction of four terms from

27 127.50.

Award (AI) for four correct terms (rounded or unrounded).

Follow through from part (a).

$$= 18\,602.67 \quad (AI)$$

$$= 18\,600 \quad (AG)$$

Note: The final (AI) is not awarded unless both the unrounded and rounded answers are seen.

[3 marks]

Examiners report

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Nadia designs a wastepaper bin made in the shape of an **open** cylinder with a volume of 8000 cm^3 .

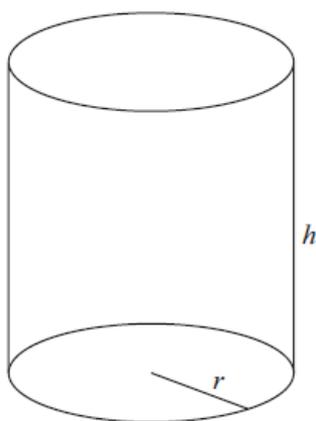


diagram not to scale

Nadia decides to make the radius, r , of the bin 5 cm.

18a.

[7 marks]

Markscheme

(i)

$$\begin{aligned} \text{Area} &= \pi(5)^2 && (M1) \\ &= 78.5 \text{ (cm}^2\text{)} && (\\ 78.5398\dots) &&& (A1)(G2) \end{aligned}$$

Note: Accept
 25π .

(ii)

$$\begin{aligned} 8000 &= 78.5398\dots \times h && (M1) \\ h &= 102 \text{ (cm)} && (\\ 101.859\dots) &&& (A1)(ft)(G2) \end{aligned}$$

Note: Follow through from their answer to part (a)(i).

(iii)

$$\text{Area} = \pi(5)^2 + 2\pi(5)(101.859\dots) \quad (M1)(M1)$$

Note: Award (M1) for their substitution in curved surface area formula, (M1) for addition of their two areas.

$$\begin{aligned} &= 3280 \text{ (cm}^2\text{)} && (\\ 3278.53\dots) &&& (A1)(ft)(G2) \end{aligned}$$

Note: Follow through from their answers to parts (a)(i) and (ii).

Examiners report

[N/A]

18b.

[2 marks]

Markscheme

No, it is too tall/narrow. (A1)(ft)(RI)

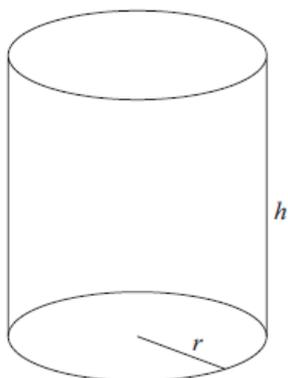
Note: Follow through from their value for
 h .

Examiners report

[N/A]

Merryn also designs a cylindrical wastepaper bin with a volume of 8000 cm^3 . She decides to fix the radius of its base so that the **total external surface area** of the bin is minimized.

diagram not to scale



Let the radius of the base of Merryn's wastepaper bin be r , and let its height be h .

18c. [1 mark]

Markscheme

$$8000 = \pi r^2 h \quad (AI)$$

Examiners report

[N/A]

18d. [2 marks]

Markscheme

$$A = \pi r^2 + 2\pi r \left(\frac{8000}{\pi r^2} \right) \quad (AI)(MI)$$

Note: Award *(AI)* for correct rearrangement of **their** part (c), *(MI)* for substitution of **their** rearrangement into area formula.

$$= \pi r^2 + \frac{16000}{r} \quad (AG)$$

Examiners report

[N/A]

18e. [3 marks]

Markscheme

$$\frac{dA}{dr} = 2\pi r - 16000r^{-2} \quad (AI)(AI)(AI)$$

Note: Award *(AI)* for $2\pi r$, *(AI)* for -16000 *(AI)* for r^{-2} . If an extra term is present award at most *(AI)(AI)(A0)*.

Examiners report

[N/A]

18f. [5 marks]

Markscheme

(i)

$$\frac{dA}{dr} = 0 \quad (M1)$$

$$2\pi r^3 - 16000 = 0 \quad (M1)$$

$$r = 13.7 \text{ cm (}$$

$$13.6556\dots) \quad (A1)(ft)$$

Note: Follow through from their part (e).

(ii)

$$h = \frac{8000}{\pi(13.65\dots)^2} \quad (M1)$$

$$= 13.7 \text{ cm (}$$

$$13.6556\dots) \quad (A1)(ft)$$

Note: Accept

13.6 if

13.7 used.

Examiners report

[N/A]

18g. [2 marks]

Markscheme

Yes or No, accompanied by a consistent and sensible reason. $(A1)(R1)$

Note: Award $(A0)(R0)$ if no reason is given.

Examiners report

[N/A]