

Pearson Edexcel International GCSE in Mathematics (Specification A) (9-1)

**Exemplar student answers
with examiner comments**

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About this booklet

This booklet has been produced to support mathematics teachers delivering the new International GCSE in Mathematics Specification A.

The booklet looks at questions from the Sample Assessment Materials, and some relevant questions from past papers. It shows real student responses to these questions, and how the examining team follow the mark scheme to demonstrate how the students would be awarded marks on these questions.

How to use this booklet

Our examining team have selected student responses to 20 questions. Following each question you will find the mark scheme for that question and then a range of student responses with accompanying examiner comments on how the mark scheme has been applied and the marks awarded, and on common errors for this sort of question.

Exemplar Question 4


Student Response A

density = $\frac{\text{mass}}{\text{volume}}$

~~mass = $\frac{\text{volume}}{\text{density}}$~~ mass = volume \times density

volume = $\frac{1}{2} \times (10 + 14) \times 9 \times 6$

volume = 378 cm^3

~~mass = $\frac{378}{0.7} = 540$~~

mass = 378×0.7

~~540~~ 264.6

Examiner Comments

M1 Cross sectional area

M1 (Dep) for volume – both Ms gained on 3rd line

M1 for “378” (candidate’s incorrect volume) $\times 0.7$

A0 for incorrect volume – Candidate has a correct full method but is let down by her arithmetic (hence the A0).

Student response

Marks awarded for the question or question parts

Examiner commentary on the student response

Guide on the use of abbreviations

M	method mark awarded for a correct method or partial method
B	unconditional accuracy mark (no method needed)
A	accuracy mark (awarded after a correct method or process; if no method or process is seen then full marks for the question are implied but see individual mark schemes for more details)
oe	or equivalent
cao	correct answer only
ft	follow through (when appropriate as per mark scheme)
sc	special case
dep	dependent (on a previous mark)
indep	independent
awrt	answer which rounds to
isw	ignore subsequent working
ee	each error
oo	or omission
cc	correct conclusion
ncc	not corrected correctly
dp	decimal place

Foundation Paper 1

Exemplar Question 1

1. The cost of an adult ticket to a zoo is \$13.50.
 A teacher buys 4 adult tickets and 24 pupil tickets.
 The total cost of the tickets is \$270.
 Work out the cost, in dollars (\$), of a ticket for one pupil.

(Total for Question 1 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
1.	$13.50 \times 4 (=54)$ or $270 - 13.5 \times 4 (=216)$ $(270 - "54") \div 24$	9	3	M1 M1 dep on M1 above A1 SC: Award B2 for 267.75 with or without working

Student Response A

1. The cost of an adult ticket to a zoo is \$13.50.
A teacher buys 4 adult tickets and 24 pupil tickets.
The total cost of the tickets is \$270.

Work out the cost, in dollars (\$), of a ticket for one pupil.

~~270 - 52.5~~

$$4 \times 13.50 = 54$$

$$270 - 54 = 216$$

$$\frac{216}{24} = 9$$

\$ 9

(Total for Question 1 is 3 marks)

3/3

Examiner Comments

As per mark scheme: 1st line M1.
3rd line M1(Dependent).
3rd line and answer line A1.

Student Response B

1. The cost of an adult ticket to a zoo is \$13.50.
A teacher buys 4 adult tickets and 24 pupil tickets.
The total cost of the tickets is \$270.

Work out the cost, in dollars (\$), of a ticket for one pupil.

$$\begin{array}{r} 1 \overline{) 13.50} \\ \underline{4} \\ 54 \end{array}$$

$$270 - 54 =$$

\$ 21.6

(Total for Question 1 is 3 marks)

1/3

Examiner Comments

1st line: M1

2nd line: nothing yet as per mark scheme (has not divided by 24 nor completed the subtraction).

Incorrect answer: M0 (Dep) A0

Student Response C

1. The cost of an adult ticket to a zoo is \$13.50.
A teacher buys 4 adult tickets and 24 pupil tickets.
The total cost of the tickets is \$270.

Work out the cost, in dollars (\$), of a ticket for one pupil.

$$13.50 \times 4 = \underline{54}$$

$$270 \div 54 = 5$$

$$54 + 24 = 78$$

\$ 5

(Total for Question 1 is 3 marks)

1/3

Examiner Comments

1st line: M1

2nd line M0 (as yet)

Answer: M0 (Dep) A0

Student Response D

1. The cost of an adult ticket to a zoo is \$13.50.
A teacher buys 4 adult tickets and 24 pupil tickets.
The total cost of the tickets is \$270.

Work out the cost, in dollars (\$), of a ticket for one pupil.

$$13.5 \times 4 = 54$$

$$270 - 54 = 216$$

$$216 \div 24 = 9$$

\$ 9

(Total for Question 1 is 3 marks)

3/3

Examiner Comments

As per mark scheme: 1st line M1
3rd line M1(Dependent) and A1 (9)
Answer line: candidate's answer confirmed.

Exemplar Question 2

2. Here are the first five terms of a number sequence.

10 14 18 22 26

(a) Write down the next two terms of the sequence.

(2)

(b) Explain how you worked out your answer.

(1)

(c) Find the 12th term of the sequence.

(1)

(d) Explain why 100 cannot be a term of the sequence.

(1)

(Total for Question 2 is 5 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
2.	(a)	30, 34	2	B1 B1
	(b)	Added 4	1	B1 accept +4, 4 more, jumped forward by 4, difference = 4, $4n + 6$ oe
	(c)	54	1	B1
	(d)	98 and/or 102 are terms in sequence	1	B1 “Series would have to start at 4” or “100 is a multiple of 4” or “100 divides by 4” or “100 is in the 4 times table” or “ $4n + 6 = 100$ leading to 23.5 (which is not an integer value)” etc

Student Response A

2. Here are the first five terms of a number sequence.

10 14 18 22 26

- (a) Write down the next two terms of the sequence.

30 34
.....
(2)

- (b) Explain how you worked out your answer.

added 4
.....
(1)

- (c) Find the 12th term of the sequence.

$34 + (5 \times 4) = 54$
.....
54
(1)

- (d) Explain why 100 cannot be a term of the sequence.

because because the sequence increases
by 4
.....
(1)

(Total for Question 2 is 5 marks)

4/5

Examiner Comments

- (a) B1, B1
(b) B1
(c) B1
(d) Not enough explained, B0.

Student Response B

2. Here are the first five terms of a number sequence.

1	2	3	4	5	6	7
10	14	18	22	26		

- (a) Write down the next two terms of the sequence.

$$1 \times 4 = 4 + 6$$

30, 34 (2)

- (b) Explain how you worked out your answer.

$$(n \times 4) + 6$$

(1)

- (c) Find the 12th term of the sequence.

$$(12 \times 4) + 6$$

54 (1)

- (d) Explain why 100 cannot be a term of the sequence.

23.5th term will make 100
which is not a whole number (1)

(Total for Question 2 is 5 marks)

5/5

Examiner Comments

(a) B1, B1

(b) Correct expression B1

(c) B1

(d) ie 100 would be obtained from the 23.5th term, correct conclusion B1

Student Response C

2. Here are the first five terms of a number sequence.

10 14 18 22 26

- (a) Write down the next two terms of the sequence.

..... 30 , 34
(2)

- (b) Explain how you worked out your answer.

..... add two to the previous term
(1)

- (c) Find the 12th term of the sequence.

..... 54
(1)

- (d) Explain why 100 cannot be a term of the sequence.

..... 100 does not equal the sum of a
previous term plus 4
(1)

(Total for Question 2 is 5 marks)

3/5

Examiner Comments

- (a) B1, B1
(b) Incorrect explanation, B0
(c) B1
(d) Insufficient explanation – what was the previous term? B0

Student Response D

2. Here are the first five terms of a number sequence.

1	2	3	4	5
1	2	3	4	5
10	14	18	22	26

- (a) Write down the next two terms of the sequence.

3 ~~3n+8~~ $4n+6$ 31 35
(2)

- (b) Explain how you worked out your answer.

~~By adding 4 to the previous term.~~ By adding 4 to the previous term.
(1)

- (c) Find the 12th term of the sequence.

~~n+12~~ $U_{12} = n + 4$ $n = 12$
 $= 12 + 4$
 $= 16$
 $n + 4 = 48$

$4n + 6$
 $4(12) + 6 = 54$

~~48~~ 54
(1)

- (d) Explain why 100 cannot be a term of the sequence.

100 cannot be a term in the sequence because its in
 between of two numbers as the sequence follows ~~n+4~~ $4n+6$
(1)

(Total for Question 2 is 5 marks)

3/5

Examiner Comments

(a) B0, B0

(b) B1

(c) B1

(d) Correct statement of 100 being “in between two numbers of the sequence” and award B1.

Exemplar Question 3

3. The diagram shows the floor plan of a room in Kate's house.

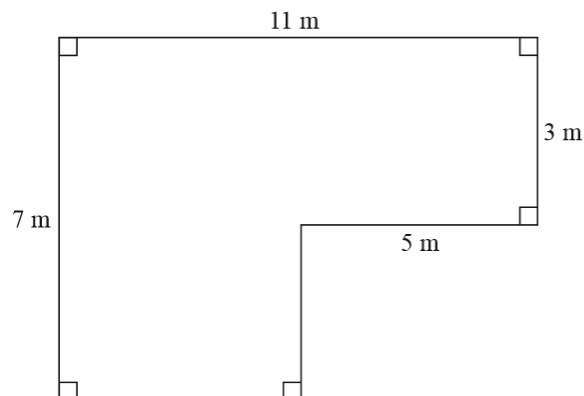


Diagram **NOT**
accurately drawn

Kate is going to cover the floor with tiles.

She is going to buy some packs of tiles.

The tiles in each pack of tiles cover 2 m^2 of floor.

Each pack of tiles costs £24.80.

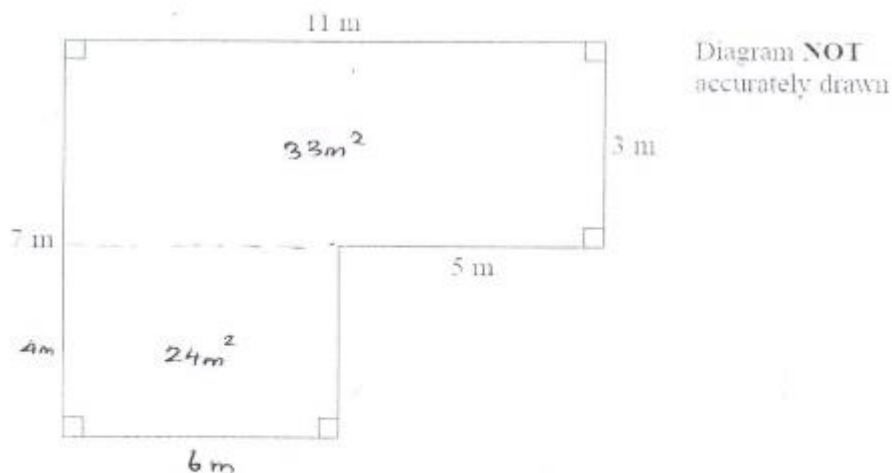
Work out how much it will cost Kate to buy the packs of tiles she needs.

(Total for Question 3 is 5 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
3	$5 \times 3 (=15)$ or $7 \times (11 - 5)(=42)$ or $11 \times 7 (=77)$ or $5 \times (7 - 3)(=20)$ or $11 \times 3 (=33)$ or $(11 - 5) \times (7 - 3)(=24)$ $5 \times 3 + 7 \times (11 - 5)(=57)$ or $11 \times 7 - 5 \times (7 - 3)(=57)$ or $11 \times 3 + (11 - 5) \times (7 - 3)(=57)$ $'57' \div 2 (28.5)$ $'29' \times 24.8$	719.20	5	M1 method to find area of part of floor M1 complete method to find area M1 dep on at least M1 M1 A1

Student Response A



Kate is going to cover the floor with tiles. She is going to buy some packs of tiles.

$$£24.80 = 1 \text{ pack} \rightarrow 2 \text{ m}^2$$

The tiles in each pack of tiles cover 2 m^2 of floor.
Each pack of tiles costs £24.80.

Work out how much it will cost Kate to buy the packs of tiles she needs.

$$33 \text{ m}^2 + 24 \text{ m}^2 = 57 \text{ m}^2$$

$$57 \div 2 = 28.5 \text{ packs}$$

29 packs

$$24.80 \times 29 = £719.2$$

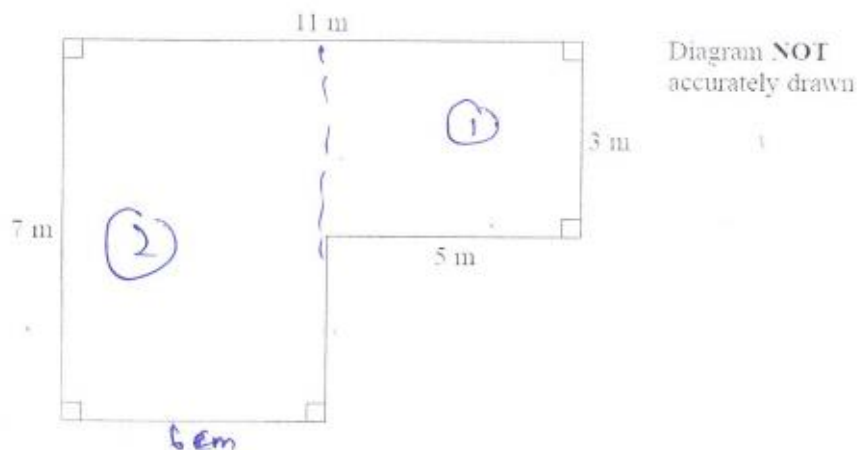
£ 719.2

5/5

Examiner Comments

Diagram shows one correct area M1.
Complete area method M1
2nd line M1(Dep) for “57/2”.
Rounding to 29 and multiplication M1.
Answer A1 – Full marks.

Student Response B



Kate is going to cover the floor with tiles.
She is going to buy some packs of tiles.

The tiles in each pack of tiles cover 2 m^2 of floor.
Each pack of tiles costs £24.80.

Work out how much it will cost Kate to buy the packs of tiles she needs.

(1) area = $3 \times 5 = 15 \text{ m}^2$
 (2) area = $7 \times 6 = 42 \text{ m}^2$

57 m^2 ~~$42 + 15 = 57$~~

$(57 \div 2) \times 24.80$
 $= 706.8$

£ 706.8

3/5

Examiner Comments

M1 for partial area

M1 for total area

M1 (Dep) for “57/2”

M0 for failing to round “28.5” up to 29

A0 for incorrect answer

Student Response C

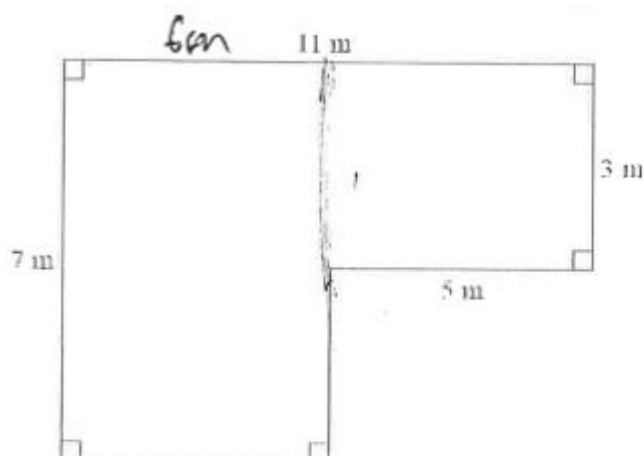


Diagram NOT
accurately drawn

Kate is going to cover the floor with tiles.
She is going to buy some packs of tiles.

The tiles in each pack of tiles cover 2 m^2 of floor.
Each pack of tiles costs £24.80.

Work out how much it will cost Kate to buy the packs of tiles she needs.

$$3 \times 5 = 15 \text{ m}^2$$

$$7 \times 6 = 42 \text{ m}^2$$

$$15 + 42 = 57 \text{ m}^2$$

$$57 \div 2 = 28.5 = 29$$

$$24.80 \times 29 =$$

$$£ 1241.2$$

4/5

Examiner Comments

M1 for partial area (15 or 42)

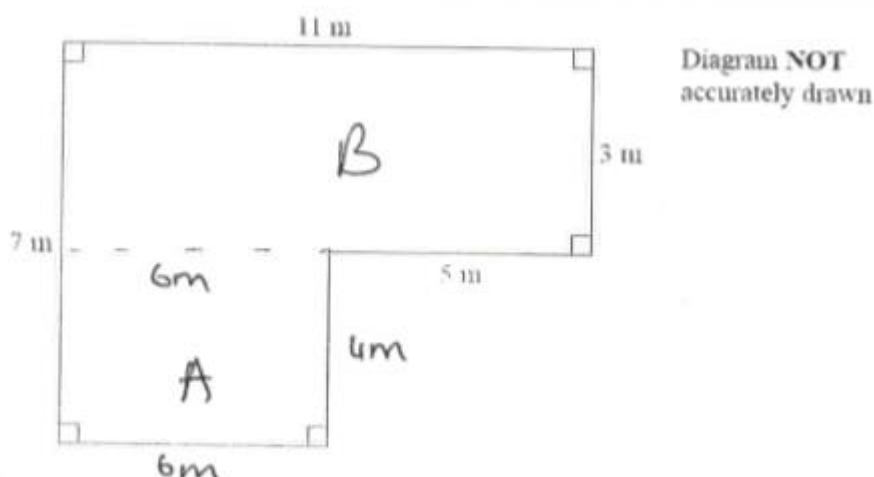
M1 for total area

M1 (Dep) for "57/2"

M1 for $29 \times "24.80"$

A0 for incorrect answer

Student Response D



Kate is going to cover the floor with tiles.
She is going to buy some packs of tiles.

The tiles in each pack of tiles cover 2 m^2 of floor.
Each pack of tiles costs £24.80.

Work out how much it will cost Kate to buy the packs of tiles she needs.

$$\text{Area of A} = 24 \text{ m}^2$$

$$\text{Area of B} = 33 \text{ m}^2$$

$$24 + 33 = \underline{57 \text{ m}^2}$$

$$57 \div 2 = 28.5 \text{ p}$$

$$28.5 \times 24.80$$

$$\rightarrow \underline{\underline{£706.80}}$$

£ 706.80

(Total for Question 3 is 5 marks)

3/5

Examiner Comments

M1 for partial area ("24" or "33")

M1 for total area

M1 (Dep) for " $57 \div 2$ "

M0 for " 28.5×24.80 "

A0 for incorrect answer

Exemplar Question 4

4.

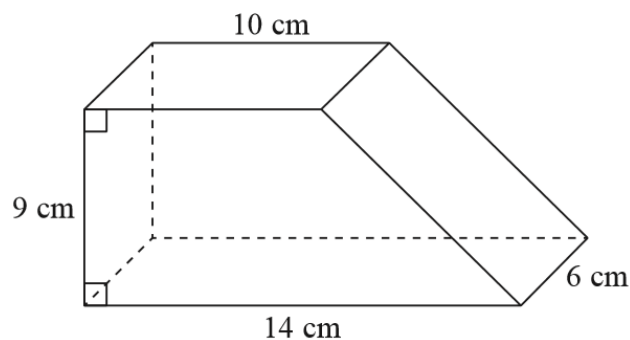


Diagram **NOT**
accurately drawn

The diagram shows a solid prism.

The cross section of the prism is a trapezium.

The prism is made from wood with density 0.7 g/cm^3

Work out the mass of the prism.

(Total for Question 4 is 4 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
4	$\frac{1}{2} \times (10 + 14) \times 9$ oe (= 108) “108” $\times 6$ (=648) “648” $\times 0.7$	453.6	4	M1 for area of cross section M1 (dep on previous M1) for volume of prism M1 (independent) A1 accept 454

Student Response A

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{mass} = \frac{\text{volume}}{\text{density}} \quad \text{mass} = \text{volume} \times \text{density}$$

$$\text{volume} = \frac{1}{2} \times (10 + 14) \times 9 \times 6$$

$$\text{volume} = \underline{\underline{378 \text{ cm}^3}}$$

$$\text{mass} = \frac{378}{0.7} = 540$$

$$\text{mass} = 378 \times 0.7$$

$$\underline{\underline{540 \quad 264.6 \text{ g}}}$$

3/4

Examiner Comments

M1 Cross sectional area

M1 (Dep) for volume – both Ms gained on 3rd line

M1 for “378” (candidate’s incorrect volume) $\times 0.7$

A0 for incorrect volume – Candidate has a correct full method but is let down by her arithmetic (hence the A0).

Student Response B

Work out the mass of the prism.

$$\frac{1}{2}(9 \times 4) = 18$$

$$18 \times 6 = 108$$

$$9 \times 10 \times 6 = 540$$

$$108 \times 540 = 58320$$

$$58320 \times 0.7 = 40824$$

$$\frac{1}{2}(10+14) \times 9$$

$$= 108$$

$$108 \times 6 = 648$$

..... 40824 g

2/4

Examiner Comments

M1 Cross sectional area

M1 (Dep) for volume

M0 – Incorrect attempt at mass

A0

Student Response C

$$\text{mass} = \frac{\text{density}}{\text{volume}}$$

$$\text{mass} = \frac{0.7}{108}$$

$$= 0.0065\text{g}$$

$$\begin{aligned}\text{Area} &= \frac{1}{2}(a+b)h \\ &= \frac{1}{2}(10+14)9 \\ &= 108\text{m}^2\end{aligned}$$

..... 0.0065g

1/4

Examiner Comments

M1 Cross sectional area

M0 – no volume attempt

Therefore M0 (Dep) for mass

A0

Student Response D

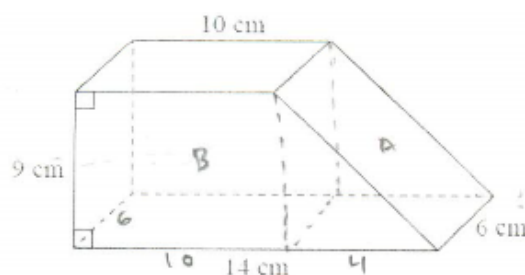


Diagram NOT
accurately drawn

The diagram shows a solid prism.
The cross section of the prism is a trapezium.

The prism is made from wood with density 0.7 g/cm^3

Work out the mass of the prism.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{mass} = \text{density} \times \text{volume}$$

$$14 - 10 = 4$$

$$\text{Volume of B} = 10 \times 9 \times 6 = \underline{540 \text{ cm}^3}$$

Volume of A =

$$\frac{1}{2} \times 9 \times 4 = 18$$

$$18 \times 6 = \underline{108 \text{ cm}^3}$$

$$\text{mass} = 0.7 \times 648$$

$$\text{mass} = \underline{453.6 \text{ g}}$$

$$A + B = 108 + 540$$

$$\text{Total volume} = \underline{648 \text{ cm}^3}$$

$$\underline{453.6}$$

4/4

Examiner Comments

Line 4 or line 6 for M1 for a cross sectional area

M1 in line 8 for volume method

1st line, right hand column scores M1 for mass

A1 for correct answer

Exemplar Question 5

- 5 (a) Factorise fully $18e^3f + 45e^2f^4$

(2)

- (b) Solve $x^2 - 4x - 12 = 0$

Show clear algebraic working.

(3)

(Total for Question 5 is 5 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
5 a		$9e^2f(2e + 5f^3)$	2	M1 Any correct partially factorised expression A1
b	$(x \pm 6)(x \pm 2)$ $(x - 6)(x + 2)$	$6, -2$	3	M1 or correct substitution into quadratic formula (condone one sign error) M1 or $\frac{4 \pm \sqrt{64}}{2}$ A1 dep. on at least M1

Student Response A

5. (a) Factorise fully $18e^3f + 45e^2f^4$

$$9e^2f(2e + 5f^3)$$

$$9e^2f(2e + 5f^3)$$

(2)

- (b) Solve $x^2 - 4x - 12 = 0$
Show clear algebraic working.

$$x^2 - 6x + 2x - 12 = 0$$

$$x(x-6) + 2(x-6) = 0$$

$$(x+2)(x-6) = 0$$

$$x = -2 \quad x = 6$$

$$x = -2, \quad x = 6$$

(3)

(Total for Question 5 is 5 marks)

5/5

Examiner Comments

(a) Correct factorisation M1 A1

(b) Line 3 scores M1 (attempt at factorisation – line 1 of mark scheme) then M1 for a correct factorisation

A1 for correct answer

Student Response B

- (a) Factorise fully $18e^3f + 45e^2f^4$

$$9e^2f(2e + 5f^3)$$

$$9e^2f(2e + 5f^3) \dots\dots\dots (2)$$

- (b) Solve $x^2 - 4x - 12 = 0$

Show clear algebraic working.

$$(x-6)(x+2) = 0$$

$$x-6=0 \quad \text{or} \quad x+2=0$$

$$x=6 \quad \text{or} \quad x=-2$$

$$x=6 \quad \text{or} \quad x=-2 \dots\dots\dots (3)$$

(Total for Question 5 is 5 marks)

4/5

Examiner Comments

(a) Correct factorisation M1 A1

(b) M1 and M1 for a correct factorisation but A0 for incorrect answer (" $x = 2$ ")

Student Response C

5. (a) Factorise fully $18e^3f + 45e^2f^4$

$$3e^2f(6e + 15f^3) \quad (2)$$

- (b) Solve $x^2 - 4x - 12 = 0$
Show clear algebraic working.

$$12 < \frac{6}{2}$$

$$\begin{matrix} x-4 \\ (x-6) \end{matrix} (x+2)$$

$$(x-6)(x+2) \quad (3)$$

(Total for Question 5 is 5 marks)

3/5

Examiner Comments

- (a) M1 for a partial factorisation (the numerical coefficients have not been factorised), A0.
(b) Correct factorisation seen so (M1 M1) but no solution given (A0).

Exemplar Question 6

6. In a sale, all normal prices are reduced by 15%
The normal price of a mixer is reduced by 22.50 dollars.

Work out the normal price of the mixer.

(Total for Question 6 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
6	$22.50 \div 15 (=1.5)$ or $100 \div 15 (=6.6\dots)$ $'1.5' \times 100 (=150)$ or $'6.6\dots' \times 22.5(0)$	150	3	M1 M2 for $22.5 \div 0.15$ M1 dep A1

Student Response A

6.

In a sale, all normal prices are reduced by 15%
The normal price of a mixer is reduced by 22.50 dollars.

Work out the normal price of the mixer.

~~$$\begin{aligned}
 0.85x &= x - 22.5 \\
 85x - 100x &= -2250 \\
 15x &= 2250 \\
 x &= 150
 \end{aligned}$$~~

$$\begin{aligned}
 0.85x &= x - 22.5 \\
 85x - 100x &= -2250 \\
 15x &= 2250 \\
 x &= 150
 \end{aligned}$$

.....150.....dollars

(Total for Question 6 is 3 marks)

3/3

Examiner Comments

An alternative method: “ x ” is the normal price so M1 for the correct statement in line 1.
M1 (Dep) for isolating x
A1 for correct answer – full marks.

Student Response B

6. In a sale, all normal prices are reduced by 15%
The normal price of a mixer is reduced by 22.50 dollars.

Work out the normal price of the mixer.

$$\frac{22.5}{?} \times \frac{15}{100}$$

$$\frac{22.5 \times 100}{15} = 150 \text{ dollars}$$

~~26.44~~ 150.....dollars

(Total for Question 6 is 3 marks)

3/3

Examiner Comments

Line 1 collects nothing yet

Line 2 collect both method marks (M1 M1)

Answer collects A1 – full marks.

Student Response C

6. In a sale, all normal prices are reduced by 15%
The normal price of a mixer is reduced by 22.50 dollars.

Work out the normal price of the mixer.

$$100\% - 15\% = 85\%$$

$$\text{normal price } (x) - \$22.50 = \text{new price}$$

$$x \times 85\% = \text{new price}$$

$$x = \frac{\text{new price} + \$22.50}{85\%}$$

$$= \$150 //$$

.....150.....dollars

(Total for Question 6 is 3 marks)

3/3

Examiner Comments

Lines 1, 2 and 3 collect nothing yet
Line 4 collects both method marks (M1 M1)
Answer collects A1 – full marks.

Student Response D

6. In a sale, all normal prices are reduced by 15%
The normal price of a mixer is reduced by 22.50 dollars.

Work out the normal price of the mixer.

$$\text{normal} = 22.50 = 15\%$$

$$\frac{22.50}{15} \times 100 = \boxed{2250}$$

.....2250.....dollars

(Total for Question 6 is 3 marks)

2/3

Examiner Comments

M1 for the cost of a 1% reduction.

M1 (Dep) for method for normal price, A0 for “£250” thus 2/3 marks.

Exemplar Question 7

7.

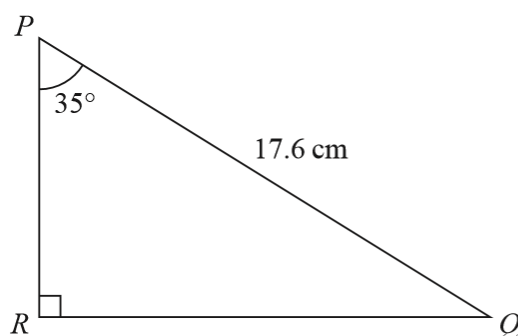


Diagram **NOT**
accurately drawn

Calculate the length of PR .

Give your answer correct to 3 significant figures.

Total for Question 7 is 3 marks

Mark Scheme

Question	Working	Answer	Mark	Notes
7	$\cos 35 = \frac{PR}{17.6}$ $17.6 \times \cos 35$	14.4	3	M1 M1 A1 14.4 ~ 14.42

Student Response A

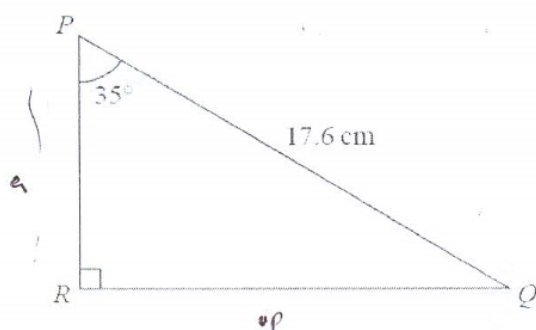


Diagram **NOT**
accurately drawn

Calculate the length of PR .
Give your answer correct to 3 significant figures.

DO HCAT TUA

$$\cos \theta =$$

$$\cos 35^\circ = \frac{a}{17.6}$$

$$17.6 \cos 35 = a$$

$$14.41707548 = a$$

$$14.4$$

$$14.4 \dots 14.4 \dots 14.4 \dots \text{cm}$$

(Total for Question 7 is 3 marks)

3/3

Examiner Comments

Line 1 scores M1 for a correct trig statement

Line 2 scores M1 for isolating PR

Correct answer A1

Student Response B

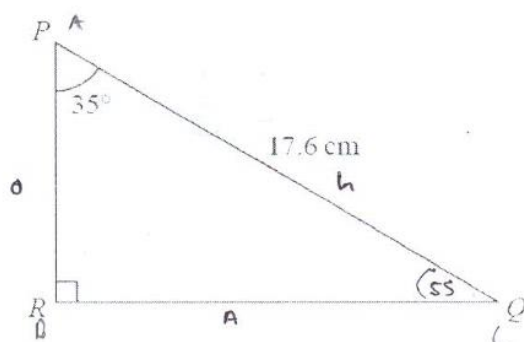


Diagram NOT
accurately drawn

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

Calculate the length of PR .

Give your answer correct to 3 significant figures.

$$\frac{17.6}{\sin 90} = \frac{RQ}{\sin 35}$$

$$RQ = \frac{17 \times \sin 35}{\sin 90}$$

$$= 9.8 \text{ cm}$$

$$a^2 = 309.76 - 96.04$$

$$a = \sqrt{213.72}$$

$$c^2 = a^2 + b^2$$

$$176^2 = a^2 + 9.8^2$$

$$a^2 = 17.6^2 - 9.8^2$$

$$a = 14.6191 \dots 14.6$$

$$= 14.6 \text{ cm (3sf)}$$

(Total for Question 7 is 3 marks)

2/3

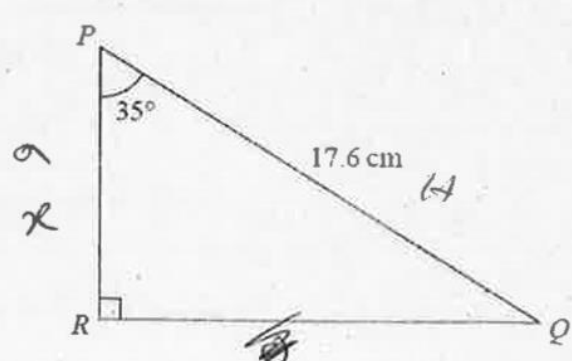
Examiner Comments

A correct Sine Rule statement is given for RQ in Line 1 followed by correct calculation of RQ (albeit with an approximated value for the given 17.6 in line 2) giving 9.8 (correct value is 10.095) so M1 for method for RQ .

RQ is then used in a Pythagoras statement for PR followed by a correct calculation (using the candidate's values) of PR (M1, complete method for PR) arriving at an incorrect answer of 14.6 (A0) because the candidate's use of their incorrect value (9.8) for RQ .

Student Response C

Diagram NOT accurately drawn



Calculate the length of PR.
Give your answer correct to 3 significant figures.

~~tan~~ $\cos 35 = \frac{x}{17.6}$

$x = 14.42$

.....14.42.....cm

(Total for Question 7 is 3 marks)

2/3

Examiner Comments

Line 1 earns M1

Line 2 implicitly earns the second M1

The candidate's answer earns A0 as it is not given to 3 significant figures as required.

Student Response D

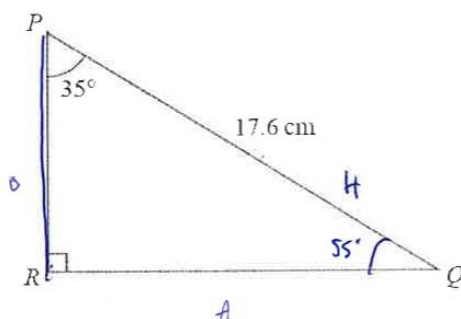


Diagram NOT
accurately drawn

SOHCAHTOA

$$a^2 + b^2 = 309.76$$

Calculate the length of PR.

Give your answer correct to 3 significant figures.

$$\begin{aligned} 35 + 90 &= 125 \\ 180 - 125 &= 55 \end{aligned}$$

$$Q = 55^\circ$$

$$17.2^2 = 309.76$$

$$\begin{aligned} a^2 + b^2 &= c^2 \\ &= 17.6 \end{aligned}$$

.....cm

(Total for Question 7 is 3 marks)

0/3

Examiner Comments

The candidate finds $\angle PQR$ correctly and thinks that using Pythagoras' Theorem will furnish a way forward but the candidate has only one side available to use ($PQ = 17.6$).

In summary, no attempts are made at finding any side so M0 M0 A0, zero marks.

Exemplar Question 8

8. Kwo invests HK\$40 000 for 3 years at 2% per year compound interest.

Work out the value of the investment at the end of 3 years.

(Total for Question 8 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
8	$0.02 \times 40\,000 (=800)$ or $1.02 \times 40\,000 (=40800)$ or 2400 $"40800" \times 0.02 (=816)$ and $"41616" \times 0.02 (=832.32)$ OR 2448.32	42448.32	3	M1 M1 (dep) method to find interest for year 2 and year 3 M2 for $40\,000 \times 1.02^3$ A1

Student Response A

Kwo invests HK\$40 000 for 3 years at 2% per year compound interest.
Work out the value of the investment at the end of 3 years.

$$\begin{aligned}
 2 \div 100 \times 40,000 &= \text{HK\$} 800 \\
 800 \times 3 &= 2400 \\
 40,000 + 2400 &= \text{HK\$} 42400
 \end{aligned}$$

HK\$.....42400.....

(Total for Question 8 is 3 marks)

1/3

Examiner Comments

M1 for 2% of \$40 000.

M0 for incorrect method for find the compound interest for years 2 and 3.

A0 for the answer.

Student Response B

Kwo invests HK\$40 000 for 3 years at 2% per year compound interest.
Work out the value of the investment at the end of 3 years.

$$40000 \times 1.02^3 \simeq 42400$$

HK\$.....42400.....

(Total for Question 8 is 3 marks)

2/3

Examiner Comments

M2 for “ $40\,000 \times 1.02^3$ ”, a special case in the mark scheme but A0.

Student Response C

Kwo invests HK\$40 000 for 3 years at 2% per year compound interest.
Work out the value of the investment at the end of 3 years.

$$\text{1st year} = \frac{2}{100} \times 40000 = 800$$

$$\begin{aligned} \text{1st year} &= 40000 + 800 \\ &= 40800 \end{aligned}$$

$$\text{2nd year} = \frac{2}{100} \times 40800 = 816$$

$$\text{2nd year} = 41616$$

$$\text{3rd year} = \frac{2}{100} \times 41616 = 832.32$$

HK\$ 42448.32

$$\begin{aligned} &\text{42448} \\ &= 42448.32 \end{aligned}$$

(Total for Question 8 is 3 marks)

3/3

Examiner Comments

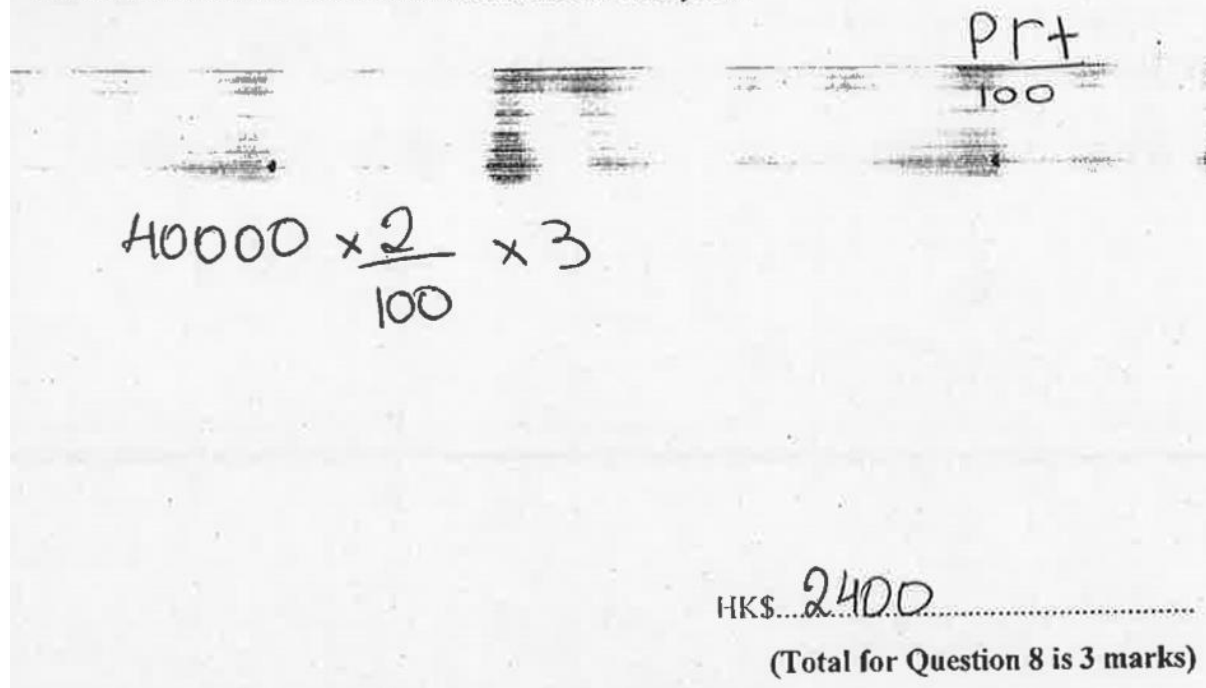
Fully correct answer.

Line 1 earns M1 followed by correct methods in lines 2 to 5 for finding the interest for the 2nd and 3rd years as required in the mark scheme (M1).

A1 for answer.

Student Response D

Kwo invests HK\$40 000 for 3 years at 2% per year compound interest.
Work out the value of the investment at the end of 3 years.



Pr+
100

$$40000 \times \frac{2}{100} \times 3$$

HK\$ 2400

(Total for Question 8 is 3 marks)

1/3

Examiner Comments

This is an attempt at finding the simple interest.

However, line 1 has embedded within it a calculation of 2% of \$40 000 so the first M1 is earned but nothing else.

Exemplar Question 9

9. Solve the simultaneous equations

$$3x + y = 13$$

$$x - 2y = 9$$

Show clear algebraic working.

(Total for Question 9 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
9	$3x + y = 13$ or $6x + 2y = 26$ $- 3x - 6y = 27$ + $x - 2y = 9$ eg. $3x - 2 = 13$ or $15 + y = 13$	5, -2	3	M1 multiplication of one equation with correct operation selected or rearrangement of one equation with substitution into second M1 (dep) correct method to find second variable A1 for both solutions dependent on correct working

Student Response A

9. Solve the simultaneous equations

$$3x + y = 13$$

$$x - 2y = 9$$

$$y = 13 - 3x$$

Show clear algebraic working.

$$x - 2(13 - 3x) = 9$$

$$x - 26 + 6x = 9$$

$$x - 6x = 9 + 26$$

$$x - 6x = 35$$

$$-5x = 35$$

$$x = \frac{35}{-5}$$

$$x = -7$$

$$3(-7) + y = 13$$

$$-21 + y = 13$$

$$y = 13 + 21$$

$$x = -7$$

$$y = 34$$

(Total for Question 9 is 3 marks)

2/3

Examiner Comments

M1 for the operation of removing y correct from the 2nd equation using the 1st equation for y .

M1 for substituting the candidate's value for x ($= -7$) in the 1st equation.

A0 for incorrect answer (error occurred in line 3 in the left hand column).

Student Response B

9. Solve the simultaneous equations

Show clear algebraic working.

Handwritten student work for solving simultaneous equations:

$$\begin{aligned}
 3x + y &= 13 \quad \text{--- (1)} \\
 x - 2y &= 9 \quad \text{--- (2)} \\
 3x - 6y &= 27 \quad \text{--- (3)}
 \end{aligned}$$

Working on the left:

$$\begin{aligned}
 6x + 2y &= 26 \quad \text{--- (4)} \\
 -3x + & \\
 \hline
 (4) + (3) \quad 3x - 6y
 \end{aligned}$$

Working on the right:

$$\begin{aligned}
 3x + y &= 13 \quad \times (2) \quad \text{--- (1)} \\
 x - 2y &= 9 \quad \text{--- (2)} \\
 6x + 2y &= 26 \quad \text{--- (3)}
 \end{aligned}$$

Substitution attempt:

$$\begin{aligned}
 (3) + 2(2) \\
 6x + 2y + 2x - 4y &= 26 + 18 \\
 8x - 2y &= 44 \\
 8x &= 44 + 2y \\
 x &= \frac{44 + 2y}{8}
 \end{aligned}$$

Substitution into equation (1):

$$\begin{aligned}
 3 \times 5.6 + y &= 13 \\
 16.8 + y &= 13 \\
 y &= 13 - 16.8 \\
 y &= -3.8
 \end{aligned}$$

Final answers:

$$\begin{aligned}
 x &= 5.6 \\
 y &= -3.8
 \end{aligned}$$

(Total for Question 9 is 3 marks)

2/3

Examiner Comments

1st M1 in line 4 (left hand column) for trying to eliminate y (although the candidate mistakenly used "13" in place of "9").

2nd M1 for substituting the candidate's value for x (5.6) in the first equation to find y.

A0 for incorrect answer.

Student Response C

9. Solve the simultaneous equations

$$3x + y = 13$$

$$x - 2y = 9$$

Show clear algebraic working.

$$3x + y = 13 \quad \text{--- ①}$$

$$x - 2y = 9 \quad \text{--- ②}$$

$$\textcircled{2} \times 3 \quad 3x - 6y = 27 \quad \text{--- ③}$$

555

$$\textcircled{3} - \textcircled{1}$$

$$3x - 6y - (3x + y) = 27 - 13$$

$$3x - 6y - 3x - y = 14$$

$$-6y - y = 14$$

$$-7y = 14$$

$$\frac{-7y}{-7} = \frac{14}{-7}$$

$$y = -2$$

$$y = -2 \text{ sub to } \textcircled{2}$$

$$3x +$$

$$x - 2(-2) = 9$$

$$x + 4 = 9$$

$$x = 9 - 4$$

$$x = 5$$

$$x = 5$$

$$y = -2$$

(Total for Question 9 is 3 marks)

3/3

Examiner Comments

Correct operation seen to remove x in the left hand column (M1) followed by a substitution of the candidate's y in the 2nd equation (M1) arriving at the correct values (A1).

Student Response D

Show clear algebraic working.

$$\begin{array}{r} \times 2 \\ 3x + y = 13 \\ x - 2y = 9 \end{array}$$

$$\begin{array}{r} 6x + 2y = 26 \\ + \quad + \\ x + 2y = 9 \end{array}$$

$$\begin{array}{r} 6x = 26 \\ \div \\ x = 9 \end{array}$$

$$7x = 35$$

$$x = \frac{35}{7}$$

$$x = 5$$

$$\begin{array}{r} 5 \\ \hline 5 \\ \hline 0 \end{array}$$

$$x = 5$$

$$y = -2$$

(Total for Question 9 is 3 marks)

$$5 - 2y = 9$$

$$-2y = \frac{4}{-2}$$

$$y = -2$$

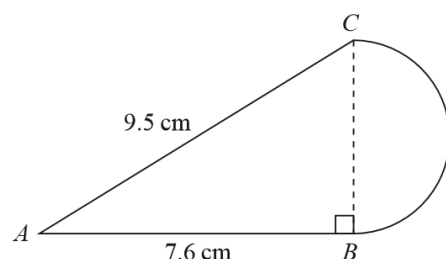
3/3

Examiner Comments

1st M1 as in the mark scheme followed by a substitution of “ $x = 5$ ” in the 2nd equation (M1) to correctly find y (A1).

Exemplar Question 10

10.

Diagram **NOT**
accurately drawn

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC .
Triangle ABC is right-angled at B .

$AB = 7.6$ cm and $AC = 9.5$ cm.

Calculate the area of the shape.

Give your answer correct to 3 significant figures.

(Total for Question 10 is 5 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
10	$\sqrt{9.5^2 - 7.6^2}$ or $\sqrt{90.25 - 57.76}$ or $\sqrt{32.49}$ or $\sqrt{32.5}$ $(BC =) 5.7$ $\frac{1}{2} \times 7.6 \times 5.7$ or 21.6(6) or 21.7 $\frac{1}{2} \times \pi \times \left(\frac{5.7}{2}\right)^2$ or 12.7(587...) or 12.8	34.4	5	M1 A1 M1 dep on first M1 or eg. $ACB = \sin^{-1}\left(\frac{7.6}{9.5}\right) (= 53.1\dots)$ and $\frac{1}{2} \times 9.5 \times 5.7 \times \sin 53.1^\circ$ M1 dep on first M1 A1 for answer rounding to 34.4 $(\pi \rightarrow 34.4187\dots)$ $3.14 \rightarrow 34.4123\dots$

Student Response A

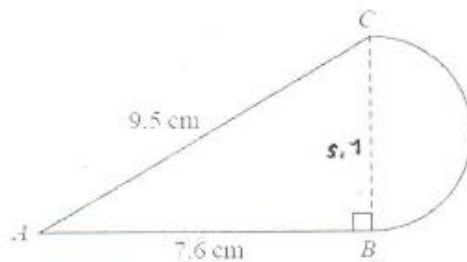


Diagram **NOT**
accurately drawn

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC . Triangle ABC is right-angled at B .

$AB = 7.6$ cm and $AC = 9.5$ cm.

Calculate the area of the shape.

Give your answer correct to 3 significant figures.

$$\begin{aligned}
 & \frac{1}{2} \pi r^2 \\
 & \frac{1}{2} \pi d \\
 & = \frac{1}{2} \times \pi \times 5.7 \\
 & = 8.953539063 \\
 & 8.953539063 + 21.66 \\
 & = 30.61353906 \\
 & 30.6
 \end{aligned}$$

$$\begin{aligned}
 a^2 + b^2 &= c^2 \\
 7.6^2 + b^2 &= 9.5^2 \\
 57.76 + b^2 &= 90.25 \\
 &= 90.25 - 57.76 \\
 b^2 &= \sqrt{32.49} \\
 b &= 5.7
 \end{aligned}$$

$$\begin{aligned}
 & \frac{1}{2} \times l \times b \\
 & \frac{1}{2} \times 7.6 \times 5.7 \\
 & = 21.66
 \end{aligned}$$

.....30.6.....cm²

(Total for Question 10 is 5 marks)

3/5

Examiner Comments

M1 A1 for BC .

Left hand column: incorrect method for half circle area so M0.

Right hand column: correct method for area of $\triangle ABC$ (21.66) M1.

A0 for total area.

Student Response B

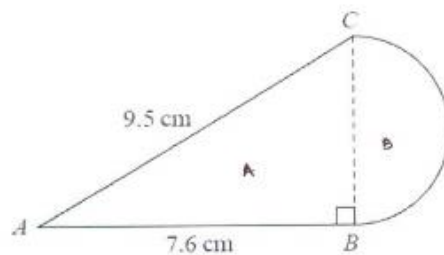


Diagram NOT
accurately drawn

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC . Triangle ABC is right-angled at B .

$AB = 7.6$ cm and $AC = 9.5$ cm.

Calculate the area of the shape.

Give your answer correct to 3 significant figures.

$$\begin{aligned}
 \text{Area of } A: AC^2 &= AB^2 + BC^2 \\
 9.5^2 &= 7.6^2 + BC^2 \\
 9.5^2 - 7.6^2 &= BC^2 \\
 32.49 \text{ cm} &= BC^2 \\
 BC &= \sqrt{32.49 \text{ cm}} \\
 &= 5.7 \text{ cm}
 \end{aligned}$$

$$\begin{aligned}
 \text{Area of } A &= \frac{1}{2} \times 7.6 \text{ cm} \times 5.7 \text{ cm} \\
 &= 21.66 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{Area of } B &= \frac{\pi r^2}{2} \\
 &= \frac{\pi \times (5.7 \div 2)^2}{2} \\
 &= \frac{\pi \times 2.85^2}{2} \\
 &= 12.75879316 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 \text{Total area} &= 21.66 \text{ cm}^2 + 12.75879316 \text{ cm}^2 \\
 &= 34.41879316 \text{ cm}^2 \\
 &= 34.4 \text{ cm}^2 //
 \end{aligned}$$

$$\dots\dots\dots 34.4 \dots\dots\dots \text{cm}^2$$

(Total for Question 10 is 5 marks)

5/5

Examiner Comments

M1 A1 for BC .

M1 for correct method for area of $\triangle ABC$ ("Area of A " = 21.66)

M1 for correct method for half circle area ("Area of B " = 12.7587...)

A1 for correct area correct to 3 significant figures.

Student Response C

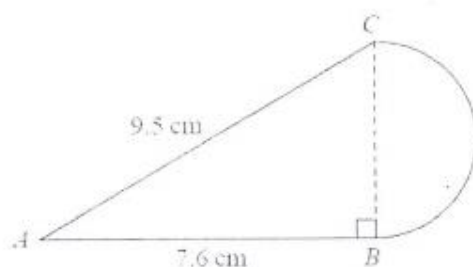


Diagram **NOT**
accurately drawn

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC . Triangle ABC is right-angled at B .

$AB = 7.6$ cm and $AC = 9.5$ cm.

Calculate the area of the shape.

Give your answer correct to 3 significant figures.

$$\begin{aligned}
 &\cancel{AC^2 = AB^2 + BC^2} \\
 &\cancel{9.5^2 = 7.6^2 + BC^2} \\
 &\cancel{9.5 - 7.6 = BC^2} \\
 &\cancel{BC^2 = 1.9} \\
 &\cancel{BC = \sqrt{1.9}} \\
 &\cancel{BC = 1}
 \end{aligned}$$

$$\begin{aligned}
 c^2 &= a^2 + b^2 \\
 9.5^2 &= 7.6^2 + B^2 \\
 90.25 &= 57.76 + B^2 \\
 90.25 - 57.76 &= B^2 \\
 B &= \sqrt{32.49} \\
 B &= \underline{\underline{5.7}}
 \end{aligned}$$

$$\begin{aligned}
 \text{Area of } \Delta & \\
 \frac{1}{2} \times b \times h & \\
 \frac{1}{2} \times 7.6 \times 5.7 & \\
 &= \underline{\underline{21.66 \text{ cm}^2}}
 \end{aligned}$$

$$\begin{aligned}
 \text{Area of } \text{D} &= \frac{\pi r^2}{2} \\
 &= \frac{\pi \times 2.85^2}{2} \\
 &= 12.8 \text{ cm}^2 \\
 &= 34.46^2 \text{ cm}^2
 \end{aligned}$$

$$\begin{aligned}
 21.66 + 12.8 & \\
 &= \underline{\underline{34.46 \text{ cm}^2}} \quad (\text{Total for Question 10 is 5 marks})
 \end{aligned}$$

4/5

Examiner Comments

M1 A1 for BC .

M1 for correct method for area of $\triangle ABC$ ("Area of Δ " = 21.66).

M1 for correct method for half circle area ("Area of" = 12.8).

A0 for total area not given to 3 significant figures ("34.46").

Student Response D

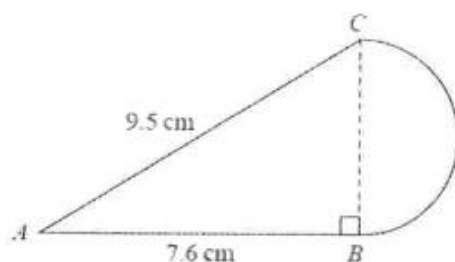


Diagram NOT
accurately drawn

The diagram shows a shape made from triangle ABC and a semicircle with diameter BC .
Triangle ABC is right-angled at B .

$AB = 7.6$ cm and $AC = 9.5$ cm.

Calculate the area of the shape.

Give your answer correct to 3 significant figures.

$$\begin{aligned} BC^2 &= 9.5^2 - 7.6^2 \\ &= 90.25 - 57.76 \\ &= 32.69 \end{aligned}$$

$$\begin{aligned} BC &= \sqrt{32.69} \\ &= 5.7175... \quad (\rightarrow^{\text{STO}} A) \end{aligned}$$

~~5.7175...~~

$$\begin{aligned} \text{Area of triangle } ABC &= 7.6 \times 5.7175... \\ &\quad \times \frac{1}{2} \\ &= 21.7265... \quad (\rightarrow^{\text{STO}} B) \end{aligned}$$

$$\begin{aligned} \text{Area of semicircle} &= \frac{1}{2} \pi d \\ &= \frac{1}{2} \times \pi \times 5.7175... \\ &= 8.98105... \quad (\rightarrow^{\text{STO}} C) \end{aligned}$$

$$\begin{aligned} \text{Area of shape} &= 21.7265... + 8.98105... \\ &= 30.7076... \\ &\approx 30.7 \end{aligned}$$

30.7

.....cm²

(Total for Question 10 is 5 marks)

3/5

Examiner Comments

M1 A1 for BC .

M1 for correct method for area of $\triangle ABC$ (= "21.7265...")

M0 for incorrect area of a semicircle.

A0 for incorrect area.

Higher Paper 1

Exemplar Question 1

1. a , b , c and d are 4 integers written in order of size, starting with the smallest integer.

The mean of a , b , c and d is 15

The sum of a , b and c is 39

- (a) Find the value of d

(2)

Given also that the range of a , b , c and d is 10

- (b) work out the median of a , b , c and d .

(2)

(Total for Question 1 is 4 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
1	a $4 \times 15 (=60)$ or $\frac{a+b+c+d}{4} = 15$ or $4 \times 15 - 39$	21	2	M1
	b $d - a = 10$ or $a = 11$ or $a = "21" - 10$ or $b + c = 39 - 11 = 28$			A1 M1 ft from (a) (can be implied by 11, b , c , 21 OR a , b , c , d with $b + c = 28$) A1 cao

Student Response A

1. a, b, c and d are 4 integers written in order of size, starting with the smallest integer.

The mean of a, b, c and d is 15

The sum of a, b and c is 39

- (a) Find the value of d .

$$\begin{aligned}\frac{a+b+c+d}{4} &= 15 \\ a+b+c+d &= 60 \\ d &= 60 - 39 \\ &= 21\end{aligned}$$

$$d = \underline{\hspace{2cm} 21 \hspace{2cm}} \quad (2)$$

Given also that the range of a, b, c and d is 10,

- (b) work out the median of a, b, c and d .

$$21 - a = 10$$

$$a = 11$$

$$11, b, c, 21$$

$$\text{median} = \frac{b+c}{2}$$

$$\frac{28}{2} = 14$$

$$\underline{\hspace{2cm} 14 \hspace{2cm}} \quad (2)$$

(Total for Question 1 is 4 marks)

4/4

Examiner Comments

(a) Line 1 earns the M1 followed by A1 for $d = 21$.

(b) Either of the first 2 lines on the left earns the M1 followed by A1 for 14.

Student Response B

1. a , b , c and d are 4 integers written in order of size, starting with the smallest integer.

The mean of a , b , c and d is 15

The sum of a , b and c is 39

- (a) Find the value of d .

$$a+b+c+d = 60$$

$$a+b+c = 39$$

$$60 - 39 = d$$

$$= 21$$

$$d = \underline{\hspace{2cm} 21 \hspace{2cm}} \quad (2)$$

Given also that the range of a , b , c and d is 10,

- (b) work out the median of a , b , c and d .

$$a = 11$$

$$d = 21$$

$$\text{median} = 16$$

$$\underline{\hspace{2cm} 16 \hspace{2cm}} \quad (2)$$

(Total for Question 1 is 4 marks)

3/4

Examiner Comments

(a) Line 1 earns M1 and then A1 for $d = 21$.

(b) " $a = 11$ " earns M1 but the stated value of the median is wrong (A0).

Student Response C

1. a, b, c and d are 4 integers written in order of size, starting with the smallest integer.

The mean of a, b, c and d is 15

The sum of a, b and c is 39

$$a+b+c+d=60$$

$$a+b+c=39$$

$$d=21$$

- (a) Find the value of d .

$$d = \underline{21} \quad (2)$$

Given also that the range of a, b, c and d is 10,

- (b) work out the median of a, b, c and d .

$$d - a = 10$$

$$10, b, c, 21$$

$$b+c=29$$

$$\underline{24.5} \quad (2)$$

(Total for Question 1 is 4 marks)

3/4

Examiner Comments

(a) Line 1 earns M1 and then A1 for $d = 21$.

(b) " $d - a = 10$ " earns M1 but the median value is wrong so A0.

Student Response D

1. a , b , c and d are 4 integers written in order of size, starting with the smallest integer.

The mean of a , b , c and d is 15

The sum of a , b and c is 39

- (a) Find the value of d .

$$a, b, c, d = 39$$

$$15 \times 4 = 60 \quad \therefore 60 \div 4 = 15$$

$$d = 15 \quad (2)$$

Given also that the range of a , b , c and d is 10,

- (b) work out the median of a , b , c and d .

..... (2)

(Total for Question 1 is 4 marks)

1/4

Examiner Comments

(a) “ $15 \times 4 = 60$ ” earns M1 followed by A0 for “ $d = 15$ ”.

(b) No attempt.

Exemplar Question 2

2. Expand and simplify $(x + 5)(x - 3)(x + 3)$

(Total for Question 2 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
2	<p>e.g. $(x^2 + 5x - 3x - 15)(x + 3)$ or $(x^2 + 2x - 15)(x + 3)$ or $(x - 5)(x^2 + 3x - 3x - 9)$ or $(x - 5)(x^2 - 9)$</p> <p>E.g. $x^3 + 3x^2 + 2x^2 + 6x - 15x - 45$ or $x^3 + 5x^2 - 9x - 45$</p>	$x^3 + 5x^2 - 9x - 45$	3	<p>M1 expansion of any two of the three brackets – at least 3 correct terms</p> <p>M1 (dep) ft for at least 3 correct terms in second expansion</p> <p>A1</p>

Student Response A

2. Expand and simplify $(x + 5)(x - 3)(x + 3)$

$$(x + 5)(x^2 - 9)$$

$$x^3 - 9x + 5x^2 - 45$$

$$x^3 + 5x^2 - 9x - 45$$

(Total for Question 2 is 3 marks)

3/3

Examiner Comments

Line 1 collects M1 for a correct expansion of two brackets.

Line 2 and answer line collect M1 (correct 2nd expansion) A1.

Student Response B

2. Expand and simplify $(x + 5)(x - 3)(x + 3)$

$$= (x+5)(x^2 + 3x - 3x - 9)$$

$$= (x+5)(x^2 - 9)$$

$$= x^3 - 9x + 5x^2 - 45$$

$$x^3 - 9x + 5x^2 - 45$$

(Total for Question 2 is 3 marks)

3/3

Examiner Comments

Line 1 collects M1 for a correct expansion of two brackets.

Line 2 collects M1 for 2nd expansion and A1 (note that the answer line has an error and since the answer in line 2 is correct, we ignore subsequent working and thus the answer line.)

Student Response C

2. Expand and simplify $(x + 5)(x - 3)(x + 3)$

$$\begin{aligned} & (x+5)(x-3)(x+3) \\ & (x+5)(x+9)^2 \end{aligned}$$

.....
(Total for Question 2 is 3 marks)

0/3

Examiner Comments

Line 1 has an incorrect expansion of $(x - 3)(x + 3) (= (x - 9)^2)$ so M0.

There is no attempt at a second expansion so M0 A0.

Student Response D

2. Expand and simplify $(x + 5)(x - 3)(x + 3)$

$$= (x^2 + 2x - 15)(x + 3) =$$

$$x^3 + 2x^2 - 15x + 3x^2 + 6x - 45 = x^3 + 5x^2 - 11x - 45$$

$$x^3 + 5x^2 - 11x - 45$$

(Total for Question 2 is 3 marks)

2/3

Examiner Comments

Line 1 collects M1 for a correct expansion of $(x + 5)(x - 3)$.

Line 2 collects M1 for 3 correct terms in the 2nd expansion but A0 for answer.

Exemplar Question 3

3. Line L_1 has equation $y = 3x + 5$

Line L_2 has equation $6y + 2x = 1$

Show that L_1 is perpendicular to L_2

(Total for Question 3 is 2 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
3	$y = \frac{1-2x}{6}$ or $m = -\frac{1}{3}$ oe	shown	2	M1 A1 for conclusion from correct gradients

Student Response A

3. Line L_1 has equation $y = 3x + 5$
Line L_2 has equation $6y + 2x = 1$

Show that L_1 is perpendicular to L_2

$$6y + 2x = 1$$

$$6y = -2x + 1$$

$$y = \frac{-2x}{6} + \frac{1}{6}$$

$\frac{-2}{6}$ is the negative reciprocal of 3 \therefore L_1 & L_2 are perpendicular

(Total for Question 3 is 2 marks)

2/2

Examiner Comments

M1 for $-\frac{x}{3} + \frac{1}{6} = y$ followed by A1 for a correct conclusion.

Student Response B

3. Line L_1 has equation $y = 3x + 5$
 Line L_2 has equation $6y + 2x = 1$

Show that L_1 is perpendicular to L_2

$$L_1 \rightarrow y = 3x + 5$$

$$L_2 \rightarrow 6y + 2x = 1$$

$$m \text{ of } L_1 \Rightarrow 3$$

$$m \text{ of } L_2 \Rightarrow -\frac{1}{3}$$

$$3 \times -\frac{1}{3} = -1 //$$

$$\text{product of gradients} = -1$$

$$y = 3x + 5$$

$$6y + 2x = 1$$

$$\frac{6y}{6} = \frac{-2x+1}{6}$$

$$y = -\frac{1}{3}x + \frac{1}{6}$$

(Total for Question 3 is 2 marks)

2/2

Examiner Comments

M1 for $-\frac{x}{3} + \frac{1}{6} = y$ followed by A1 for a correct conclusion.

Student Response C

3. Line L_1 has equation $y = 3x + 5$
Line L_2 has equation $6y + 2x = 1$

Show that L_1 is perpendicular to L_2

$$L_1: y = 3x + 5$$

$$m_1 = 3$$

$$L_2: 6y + 2x = 1$$

$$6y = 1 - 2x$$

$$y = \frac{1}{6} - \frac{1}{3}x$$

$$m_2 = -\frac{1}{3}$$

$$m_1 \times m_2$$

$$3 \times -\frac{1}{3} = -1$$

$\therefore L_1$ is perpendicular to L_2

(Total for Question 3 is 2 marks)

2/2

Examiner Comments

M1 for $\frac{1}{6} - \frac{x}{3} = y$ followed by A1 for a correct conclusion.

Student Response D

3. Line L_1 has equation $y = 3x + 5$
 Line L_2 has equation $6y + 2x = 1$

Show that L_1 is perpendicular to L_2

$$L_1 \quad y = 3x + 5$$

$$L_2 \quad 6y = -2x + 1$$

$$y = -\frac{2}{6}x + \frac{1}{6}$$

$$y = -\frac{1}{3}x + \frac{1}{6}$$

$$3x = -\frac{1}{3}x$$

$$\therefore -\frac{1}{3}x \text{ is per}$$

\therefore Line L_1 is perpendicular to L_2
 (Total for Question 3 is 2 marks)

0/2

Examiner Comments

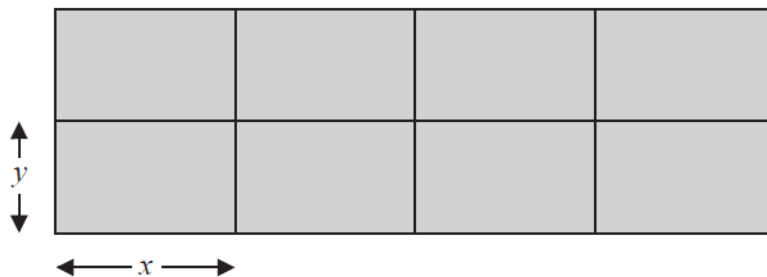
M0 for $-\frac{x}{3} + 1 = y$ and therefore A0.

Exemplar Question 4

4. A farmer has 180 metres of fencing.

With the 180 metres of fencing, he makes an enclosure divided into eight equal, rectangular pens.

The fencing is used for the perimeter of each pen.



The length of each pen is x metres and the width of each pen is y metres.

- (a) (i) Show that $y = 18 - 1.2x$.

The total area of the enclosure is $A \text{ m}^2$.

- (ii) Show that $A = 144x - 9.6x^2$.

(3)

- (b) Find $\frac{dA}{dx}$.

(2)

- (c) Find the maximum value of A .

(3)

(Total for Question 4 is 8 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
4	(a)(i) $12x + 10y = 180$		1	B1 Accept $12x = 180 - 10y$ or $10y = 180 - 12x$
	(ii) $(A =) 4x \times 2y$			M1 $4x \times 2y$ or $8xy$ oe
	$(A =) 4x \times 2(18 - 1.2x)$	Proceed to $A = 144x - 9.6x^2$	2	A1 $4x \times 2(18 - 1.2x)$ or $8x(18 - 1.2x)$ or $4x(36 - 2.4x)$ AND proceeding correctly to $A = 144x - 9.6x^2$
	(b)	$(dA/dx =)$ $144 - 19.2x$	2	B2 B1 for 144, B1 for $-19.2x$ Do not isw
	(c) $"144 - 19.2x" = 0$ $x = 7.5$ ($y = 9$) $(A =) 144 \times "7.5"$ $- 9.6 \times "7.5^2"$ or $(A =) 8 \times "7.5" \times "9"$	540	3	M1 ft Must be a 2 part linear expression M1 dep A1

Student Response A

(a) (i) Show that $y = 18 - 1.2x$.

$$\begin{aligned} 180 &= 10y + 12x \\ 10y &= 180 - 12x \\ y &= \frac{180 - 12x}{10} = 18 - 1.2x \end{aligned}$$

The total area of the enclosure is $A \text{ m}^2$.

(ii) Show that $A = 144x - 9.6x^2$.

$$\begin{aligned} \text{Area of 1 pen} &= xy \\ &= x(18 - 1.2x) \\ &= 18x - 1.2x^2 \end{aligned}$$

$$\begin{aligned} \therefore \text{Area of enclosure} &= 8(18x - 1.2x^2) \\ A &= 144x - 9.6x^2 \end{aligned}$$

(3)

(b) Find $\frac{dA}{dx}$. $\frac{dA}{dx} = 144 - 19.2x$



$$\frac{144 - 19.2x}{\dots\dots\dots}$$

(2)

(c) Find the maximum value of A .

$$\begin{aligned} 144 - 19.2x &= 0 \\ 144 &= 19.2x \\ x &= \frac{144}{19.2} \\ x &= 7.5 \end{aligned}$$

$$\begin{aligned} \therefore A &= 144x - 9.6x^2 \\ &= (144 \times 7.5) - (9.6)(7.5)^2 \\ &= 1080 - 540 \\ &= 540 \text{ m}^2 \end{aligned}$$

$$A = \frac{540 \text{ m}^2}{\dots\dots\dots}$$

(3)

(Total for Question 4 is 8 marks)

8/8

Examiner Comments

(a)(i) Correctly shown B1.

(a)(ii) Correct substitution for y (M1), followed by correct algebra (A1).

(b) 144 (B1) with “ $- 19.2x$ ” collecting the 2nd B1.

(c) Derivative set to zero (M1). “ $x = 7.5$ ” substituted in A (M1(Dep)). Correct area found (A1).

Student Response B

(a) (i) Show that $y = 18 - 1.2x$.

$$10y + 12x = 180$$

$$10y = 180 - 12x$$

$$y = \frac{180 - 12x}{10} \quad \therefore y = 18 - 1.2x$$

The total area of the enclosure is $A \text{ m}^2$.

(ii) Show that $A = 144x - 9.6x^2$.

$$A = x \times (18 - 1.2x) = 18x - 1.2x^2$$

$$8 \times (18x - 1.2x^2) = 144x - 9.6x^2 \quad //$$

(3)

(b) Find $\frac{dA}{dx}$.

$$\frac{dA}{dx} = 144 - 2 \times 9.6x$$

$$= -19.2x + 144 \quad //$$

(2)

(c) Find the maximum value of A .

$$10y + 12x = 180$$

$$\therefore 180 =$$

$$\therefore 2y = 8.18 \times 2 = 16.36$$

$$4x = 4 \times 8.18 = 32.72$$

$$180 \div 10 + 12 = 8.18$$

$$\therefore A = 16.36 \times 32.72 = 355.3$$

$$A = \dots \dots \dots 355.3 \quad //$$

(3)

(Total for Question 4 is 8 marks)

5/8

Examiner Comments

(a)(i) B1

(a) (ii) The candidate's "A" on line 1 earns nothing yet, but the M1 is collected on the next line by the multiplication by 8 followed by a correct conclusion (A1).

(b) Correct derivative obtained from given expression for A (B1 B1).

(c) Part (b) is not solved for x and so the candidate is unable to find the maximum area thus M0 (for not setting "(b)" = 0) thus M0 A0.

Student Response C

(a) (i) Show that $y = 18 - 1.2x$.

$$\begin{aligned}
 180 &= 12x + 10y \\
 10y &= 180 - 12x \\
 y &= \frac{180}{10} - \frac{12x}{10} \quad \therefore y = 18 - 1.2x
 \end{aligned}$$

The total area of the enclosure is $A \text{ m}^2$.

(ii) Show that $A = 144x - 9.6x^2$.

$$\begin{aligned}
 \text{Since } y &= 18 - 1.2x \quad \therefore A = 2y \times 4x \\
 \text{substitute } y &= 18 - 1.2x \quad A = 2(18 - 1.2x) \times 4x \\
 &A = 4x(36 - 2.4x) \\
 &A = 144x - 9.6x^2 \quad (3)
 \end{aligned}$$

(b) Find $\frac{dA}{dx}$.

$$\begin{aligned}
 \frac{dA}{dx} &= 144 - 19.2x \\
 &\quad \quad \quad \underline{144 - 19.2x} \quad (2)
 \end{aligned}$$

(c) Find the maximum value of A .

$$\begin{aligned}
 0 &= 144 - 19.2x \\
 -144 &= -19.2x \\
 \frac{-144}{-19.2} &= \frac{-19.2x}{-19.2} \\
 x &= 7.5 \\
 (144 \times 7.5) + (-9.6 \times 7.5)^2 & \quad A = 6264 \text{ m}^2 \\
 1080 + (72)^2 & \quad (3) \\
 1080 + 5184 &= 6264 \text{ m}^2
 \end{aligned}$$

(Total for Question 4 is 8 marks)

6/8

Examiner Comments

(a)(i) Correctly shown B1.

(a)(ii) Correct substitution for y (M1), followed by correct algebra (A1).

(b) 144 (B1) with “- 19.2x” collecting the 2nd B1.

(c) Derivative set to zero (M1). But the candidate's value for x is incorrectly substituted into the given expression for A (M0 A0).

Student Response D

- (a) (i) Show that
- $y = 18 - 1.2x$
- .

$$10y + 12x = 180$$

$$\frac{10y}{10} = \frac{180}{10} - \frac{12x}{10}$$

$$y = 18 - 1.2x$$

The total area of the enclosure is $A \text{ m}^2$.

- (ii) Show that
- $A = 144x - 9.6x^2$
- .

$$2 \times (18 - 1.2x)^2 + 4x^2$$

$$(36 - 2.4x)^2$$

$$1296 - 5.76x^2$$

$$2 \times (18 - 1.2x)^2 + 4x^2$$

$$2 \times (324 - 72x + 2.88x^2) + 4x^2$$

$$648 - 144x + 5.76x^2 + 4x^2$$

$$648 - 144x + 9.76x^2$$

$$A = 144x - 9.6x^2$$

- (b) Find
- $\frac{dA}{dx}$
- .

$$144 - 19.2x$$

$$144 - 19.2x$$

- (c) Find the maximum value of
- A
- .

$$215$$

$$A = 215$$

(Total for Question 4 is 8 marks)

3/8

Examiner Comments

(a)(i) Correctly shown B1.

(a) (ii) Incorrect substitution of y in A (M0 A0).

(b) 144 (B1) with “- 19.2x” collecting the 2nd B1.

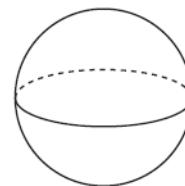
(c) No differentiating attempt nor one for finding the stationary point thus M0 M0 A0.

Exemplar Question 5

5. A sphere has a surface area of $81\pi \text{ cm}^2$.

Work out the volume of the sphere.

Give your answer correct to 3 significant figures.



(Total for Question 5 is 4 marks)

Mark Scheme

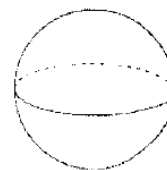
Question	Working	Answer	Mark	Notes
5	$4\pi r^2 = 81\pi$ or $4r^2 = 81$ $r = \sqrt{\frac{81\pi}{4\pi}} (= 4.5)$ $\frac{4}{3} \times \pi \times "4.5"{}^3$	382	4	M1 M2 for $r = 4.5$ M1 $r = \sqrt{\frac{81\pi}{4\pi}}$ oe (may be seen in two stages) M1 ft for " r " dep on first M1 A1 For 381 - 382

Student Response A

5. A sphere has a surface area of $81\pi \text{ cm}^2$.

Work out the volume of the sphere.

Give your answer correct to 3 significant figures.



$$\frac{4}{3} \times \pi \times \cancel{4.5}^{\cancel{4.5}^3}$$

$$= \underline{\underline{382}}$$

$$\frac{\cancel{4\pi} r^2}{\cancel{4\pi}} = \frac{81\pi}{\cancel{4\pi}}$$

$$r^2 = \frac{81}{4}$$

$$r = \underline{\underline{4.5}}$$

$$\dots \underline{\underline{382}} \dots \text{ cm}^3$$

(Total for Question 5 is 4 marks)

4/4

Examiner Comments

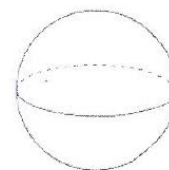
In the right hand column, the candidate collects M1 on line 1 followed M1 for $r (= 4.5)$ on the next line. $r = 4.5$ is substituted into the spherical volume formula (M1 (Dep)) in the left hand column with the correct answer obtained (A1).

Student Response B

5. A sphere has a surface area of $81\pi \text{ cm}^2$.

Work out the volume of the sphere.

Give your answer correct to 3 significant figures.



$$A = 4\pi r^2 = 81\pi$$

$$4r^2 = 81$$

$$r^2 = \frac{81}{4}$$

$$r = \sqrt{\frac{81}{4}}$$

$$r = \frac{9}{2}$$

$$V = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \pi \times \frac{9}{2}$$

$$= 6\pi$$

$$= 18.84955592$$

$$18.8 \text{ (3sf)}$$

$$\underline{\quad 18.8 \quad} \text{ cm}^3$$

(Total for Question 5 is 4 marks)

2/4

Examiner Comments

M1 collected on the 1st line on the left, followed M1 for isolating r .

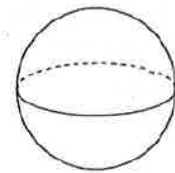
The candidate fails to cube r in the expression for the spherical volume (M0 (Dep)) and so A0.

Student Response C

5. A sphere has a surface area of $81\pi \text{ cm}^2$.

Work out the volume of the sphere.

Give your answer correct to 3 significant figures.



$$\begin{aligned}
 4\pi r^2 &= \text{Surface Area} \\
 \sqrt{81 \div 4\pi} &= 2.54\dots = r \\
 2.54^3 \times \frac{4\pi}{3} &= 68.55\dots \\
 \frac{4}{3}\pi r^3 &= \text{Volume}
 \end{aligned}$$

$$\begin{array}{r}
 68.5 \\
 \hline
 \dots\dots\dots \text{cm}^3
 \end{array}$$

(Total for Question 5 is 4 marks)

0/4

Examiner Comments

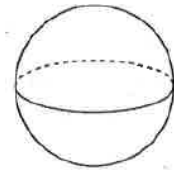
We do not see the candidate equating $4\pi r^2$ to 81π - the π in 81 is missing in the next line therefore M0 and M0. The 3rd M1 falls because the first one has not been obtained with the result that the candidates scores zero marks.

Student Response D

5. A sphere has a surface area of $81\pi \text{ cm}^2$.

Work out the volume of the sphere.

Give your answer correct to 3 significant figures.



$$\frac{4}{3} \pi r^2$$

$$4\pi r^2 = 81\pi$$

$$4r^2 = 81$$

$$r^2 = 20.25$$

$$r = 4.5$$

$$\frac{4}{3} \times \pi \times 4.5^2$$

$$\underline{\underline{84.8}} \text{ cm}^3$$

(Total for Question 5 is 4 marks)

2/4

Examiner Comments

The 2nd line earns the 1st M1 with the correct evaluation of r to 4.5 collecting the 2nd M1. However, the candidate then squares 4.5 in the volume expression thus losing the 3rd M mark and thus the A mark.

Exemplar Question 6

- 6 Prove algebraically that
 $(2n + 1)^2 - (2n + 1)$ is an even number
 for all positive integer values of n

(Total for Question 6 is 3 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
6	$(4n^2 + 2n + 2n + 1)$ $- (2n + 1)$ $= 4n^2 + 4n + 1 - 2n - 1$ $= 4n^2 + 2n$ $= 2n(2n + 1)$	Proof	3	<p>M1 for 3 out of 4 terms correct in the expansion of $(2n + 1)^2$ or $(2n + 1)\{(2n + 1) - 1\}$</p> <p>A1 for $4n^2 + 2n$ or equivalent expression in factorised form</p> <p>C1 for convincing statement using $2n(2n + 1)$ or $2(2n^2 + n)$ or $4n^2 + 2n$ to prove the result</p>

Student Response A

6. Prove algebraically that

$$(2n + 1)^2 - (2n + 1) \text{ is an even number}$$

for all positive integer values of n .

$$\begin{aligned}
 & \cancel{(2+1)^2 - (2+1) = 6} \\
 & \cancel{(4+1)^2 - (4+1) = 20} \\
 & (2n+1)(2n+1)^2 - (2n+1) \neq 0 \\
 & 4n^2 + 4n + 1 - 2n - 1 \neq 0 \\
 & 4n^2 + 2n \neq 0 \\
 & 2n(2n+1) = 0 \\
 & \begin{array}{cc} \uparrow & \uparrow \\ \text{even} & \times \text{ odd} \end{array} = \text{even}
 \end{aligned}$$

3/3

Examiner Comments

2nd line earns M1 for correct expansion of $(2n + 1)^2$

A1 for $4n^2 + 2n$

C1 for a convincing statement in the last line of the answer.

Student Response B

6. Prove algebraically that

$(2n+1)^2 - (2n+1)$ is an even number

for all positive integer values of n .

$$(4n^2 + 2n + 2n + 1) - 2n + 1$$

$$4n^2 + 4n + 1 - 2n + 1$$

$$4n^2 - 2n + 2$$

$$2(2n^2 - 1)$$

Anything times by an even number is even. and
thus $2 \times n$ must be even so $2n \times$ anything is
even!

1/3

Examiner Comments

M1 for correct expansion of $(2n+1)^2$ but this is followed by a sign mistake and incorrect algebra (A0) thus C0 (a correct answer/conclusion cannot be obtained from incorrect working).

Student Response C

6. Prove algebraically that

$$(2n + 1)^2 - (2n + 1) \text{ is an even number}$$

for all positive integer values of n .

$$(2n+1)^2 = 4n^2 + 4n + 1$$

$4n^2 + 4n + 1$
 $\swarrow \quad \searrow \quad \downarrow$
 $4n^2 \quad 4n \quad 1$
 even, because even times anything = even
 odd
 $2n + 1$
 odd

$$4n^2 + 4n + 1 \text{ is odd}$$

$2n+1$
 \uparrow even \uparrow odd
 because even
 time anything
 = even

$2n+1$ is odd

$$4n^2 + 4n + 1 - 2n + 1 = \text{odd} - \text{odd} = \text{even}$$

1/3

Examiner Comments

M1 for correct expansion of $(2n + 1)^2$ and then states that this will be odd whilst $(2n + 1)$ will be also be odd for the allowed values of n .

However, the penultimate line is algebraically incorrect and since we do not see $4n^2 + 2n$, A0, and so C0 (again, a correct answer/conclusion cannot be obtained from incorrect working)..

Student Response D

6. Prove algebraically that

$$(2n + 1)^2 - (2n + 1) \text{ is an even number}$$

for all positive integer values of n .

$$(2n+1)(2n+1) - (2n+1)$$

$$4n^2 + 4n + 1 - 2n - 1 = 0$$

$$4n^2 - 2n = 0$$

$$(2n-1) = 0 \text{ or } n = 0$$

$$n = \frac{1}{2}$$

1/3

Examiner Comments

M1 for correct expansion of $(2n + 1)^2$ but then the candidate makes a sign error and arrives at $4n^2 - 2n$ (A0 and so C0).

Student Response E

6. Prove algebraically that

$$(2n+1)^2 - (2n+1) \text{ is an even number}$$

for all positive integer values of n .

$$\begin{aligned} & (2n+1)^2 - (2n+1) \\ & 4n^2 + 4n + 1 - 2n - 1 \\ & = 4n^2 + 2n \\ & = 2(2n^2 + n) \end{aligned}$$

∴ for all values of n + (ve) integer
the value of n is an even number
since n is multiplied by 2 which
is an even number so it
given n is a whole number
multiplied by 2

∴ for all values of n + (ve) integer
the value of n is an even since
it is multiplied by an even number and
also it is squared n^2

$$n^2 + \frac{1}{2}n$$

$$n^2 + \frac{1}{2}n + \left(\frac{1}{4}\right)^2 - \left(\frac{1}{4}\right)^2$$

$$4\left(n + \frac{1}{4}\right)^2 - \frac{1}{2}$$

$$4\left(n + \frac{1}{4}\right)^2 - \frac{1}{2}$$

2/3

Examiner Comments

M1 for correctly expanding $(2n+1)^2$.

A1 for $4n^2 + 2n$.

C0 for an unconvincing statement

Student Response F

6. Prove algebraically that

$$(2n + 1)^2 - (2n + 1) \text{ is an even number}$$

for all positive integer values of n .

$$(2n+1) \times (2n+1) - (2n+1) = \text{even}$$

$$(4n^2 + 4n + 1) - (2n + 1) = \text{odd} - \text{odd} = \text{even}$$

3/3

Examiner Comments

M1 for correctly expanding $(2n + 1)^2$.

The question does not explicitly ask for an expansion of the expression and the candidate's observation and conclusion are correct therefore A1 C1 even though his answer deviates from the mark scheme.

Student Response G

6. Prove algebraically that

$$(2n + 1)^2 - (2n + 1) \text{ is an even number}$$

for all positive integer values of n .

$$(2n + 1)(2n + 1) - (2n + 1)$$

$$4n^2 + 2n + 2n + 1 - (2n + 1)$$

$$4n^2 + 2n$$

Any number times 4 is even as 4 is an even number and if you square any even number you get an even number.

Any number times two is even as two is an even number

2/3

Examiner Comments

M1 for correctly expanding $(2n + 1)^2$.

A1 for $4n^2 + 2n$.

The candidate does not complete his argument – he states that $4n^2$ and $2n$ are each even numbers but fails to say what happens when they are added together (C0)

Exemplar Question 7

7. $ABCD$ is a parallelogram.

$$\vec{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad \vec{AC} = \begin{pmatrix} 9 \\ 4 \end{pmatrix}$$

Find the magnitude of \vec{BC}

(Total for Question 7 is 3 marks)

Mark Scheme

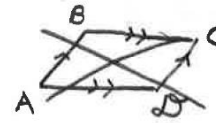
Question	Working	Answer	Mark	Notes
7	$\vec{BC} = \vec{BA} + \vec{AC}$ or $\begin{pmatrix} -2 \\ -3 \end{pmatrix} + \begin{pmatrix} 9 \\ 4 \end{pmatrix}$ or $\begin{pmatrix} 7 \\ 1 \end{pmatrix}$ $\sqrt{7^2 + 1^2}$	$\sqrt{50}$ oe	3	M1 M1 dep A1 accept 7.07(06...)

Student Response A

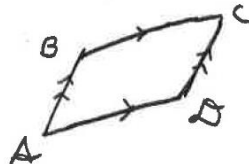
7. $ABCD$ is a parallelogram.
 $ABCD$ is tilted

$$\vec{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$$\vec{AC} = \begin{pmatrix} 9 \\ 4 \end{pmatrix}$$



Find the magnitude of \vec{BC}



$$\vec{BC} = \begin{pmatrix} -2 + 9 \\ -3 + 4 \end{pmatrix}$$

$$\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

$$= \sqrt{1^2 + 7^2}$$

$$= \sqrt{50}$$

7.07

(Total for Question 7 is 3 marks)

3/3

Examiner Comments

M1 for correct method for \vec{BC} .

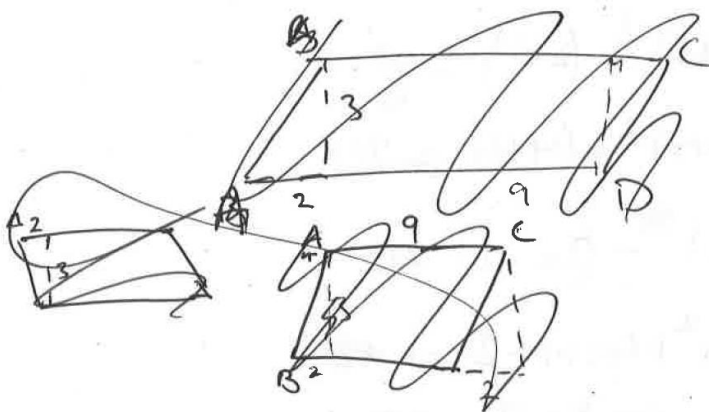
The penultimate line on the left earns the candidate M1(Dep) for the method for the magnitude for \vec{BC} , followed by A1 for the correct answer.

Student Response B

7. $ABCD$ is a parallelogram.

$$\vec{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad \vec{AC} = \begin{pmatrix} 9 \\ 4 \end{pmatrix}$$

Find the magnitude of \vec{BC}



$$\begin{pmatrix} 2 \\ 3 \end{pmatrix} + \begin{pmatrix} 9 \\ 4 \end{pmatrix} = \begin{pmatrix} 11 \\ 7 \end{pmatrix}$$

$$\sqrt{11^2 + 7^2} \approx \sqrt{170}$$

$$\sqrt{170} \approx 13.04$$

(Total for Question 7 is 3 marks)

0/3

Examiner Comments

Incorrect attempt at \vec{BC} . (the candidates mistakenly tries $\vec{AB} + \vec{AC}$) thus M0.
 Since the 1st M mark is lost, the 2nd M mark is not available thus the candidate's statement of " $\sqrt{11^2 + 7^2}$ " earns nothing.

Student Response C

7. $ABCD$ is a parallelogram.

$$\vec{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad \vec{AC} = \begin{pmatrix} 9 \\ 4 \end{pmatrix}$$

Find the magnitude of \vec{BC}



$$\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

$$\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

(Total for Question 7 is 3 marks)

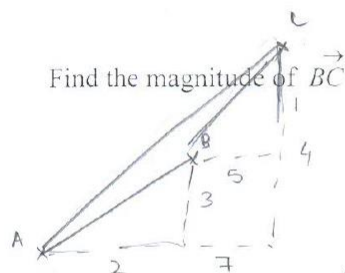
1/3

Examiner Comments

The candidate correctly states, with no working, that $\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$. (M1) but does nothing else thus scoring M0 A0.

Student Response D

7. $ABCD$ is a parallelogram.



Find the magnitude of \vec{BC}

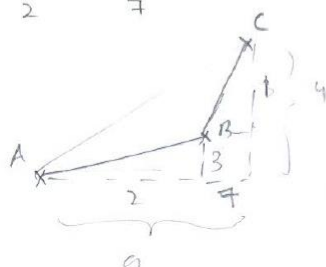
$$\vec{AB} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$$\vec{AC} = \begin{pmatrix} 9 \\ 4 \end{pmatrix}$$

$$\begin{aligned} BC^2 &= AC^2 - AB^2 \\ &= \begin{pmatrix} 9 \\ 4 \end{pmatrix}^2 - \begin{pmatrix} 2 \\ 3 \end{pmatrix}^2 \\ &= \begin{pmatrix} 49 \\ 16 \end{pmatrix} - \begin{pmatrix} 4 \\ 9 \end{pmatrix} \\ &= \begin{pmatrix} 45 \\ 7 \end{pmatrix} \end{aligned}$$

BC

$$7^2 + 1^2 = 50$$



$$\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

$$7^2 + 1^2 =$$

$$= 49 + 1$$

$$= 50$$

$$|\vec{BC}| = \sqrt{50}$$

(Total for Question 7 is 3 marks)

1/3

Examiner Comments

The candidate correctly finds that $\vec{BC} = \begin{pmatrix} 7 \\ 1 \end{pmatrix}$. (M1) and proceeds to calculate $7^2 + 1^2 = 50$ but fails to take the square root and so does not have a complete method for the magnitude of \vec{BC} (M0) and so A0.

Exemplar Question 8

- 8 (a) Write $2x^2 - 8x + 9$ in the form $a(x + b)^2 + c$

(3)

- (b) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 - 8x + 9 = 0$ does not intersect the x -axis.

(1)

(Total for Question 8 is 4 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
8 (a)	$2(x^2 - 4x) + 9$ or $2(x^2 - 4x + \frac{9}{2})$			M1
	$2((x - 2)^2 - 2^2) + 9$ or $2((x - 2)^2 - 2^2 + \frac{9}{2})$			M1
(b)		$2(x - 2)^2 + 1$	3	A1
		explanation	1	B1 E.g. Because minimum is at (2, 1)

Student Response A

8. (a) Write $2x^2 - 8x + 9$ in the form $a(x + b)^2 + c$

$$\begin{aligned}
 &2x^2 - 8x + 9 \\
 &2 \left[x^2 - 4x + \frac{9}{2} \right] \\
 &2 \left[(x-2)^2 - 4 + \frac{9}{2} \right] \\
 &2 \left[(x-2)^2 + \frac{1}{2} \right] \\
 &2(x-2)^2 + 1
 \end{aligned}$$

~~corr~~ $2(x-2)^2 + 1$
 (3)

- (b) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 - 8x + 9 = 0$ does not intersect the x -axis.

$$\begin{aligned}
 &(x-2)^2 \neq -\frac{1}{2} \quad \text{when } y=0 \quad \text{therefore} \\
 &y = 2x^2 - 8x + 9 \quad \text{does not intersect the } x \text{ axis.} \\
 &2(x-2)^2 + 1 = 0 \\
 &2(x-2)^2 = -1 \\
 &(x-2)^2 = -\frac{1}{2} \\
 &\text{No real roots}
 \end{aligned}$$

(1)

(Total for Question 8 is 4 marks)

4/4

Examiner Comments

- (a) Line 2 earns the 1st M1 with Line 3 earning the 2nd M1 followed by A1 for the correct answer.
- (b) The candidate rearranges the answer to (a) to the form $(x-2)^2 = -\frac{1}{2}$ and realises that this statement means that there are no real values of x satisfying this and hence the conclusion (B1).

Student Response B

8. (a) Write $2x^2 - 8x + 9$ in the form $a(x + b)^2 + c$

$$2x^2 - 8x + 9$$

$$2x^2 - 4x + x + 9$$

$$x \neq 2$$

$$2(x^2 - 4x + \frac{9}{2})$$

$$2[x^2 - 4x + 2^2 - 2^2 + \frac{9}{2}]$$

$$2[(x-2)^2 - 4 + \frac{9}{2}]$$

$$2[(x-2)^2 + \frac{1}{2}]$$

$$2(x-2)^2 + 1$$

$$\therefore a=2, b=2, c=1$$

$$2(x-2)^2 + 1$$

(3)

- (b) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 - 8x + 9 = 0$ does not intersect the x -axis.

It does not meet since it cannot be so i.e. when $y=0$
 $b^2 - 4ac < 0$

$\sqrt{-1}$ cannot be solved, so it does not intersect the x -axis.

$$y = 0 \quad (x-2)^2 = -1 \quad b^2 - 4ac$$

$$x \text{ and } y = 0$$

$$(-8)^2 - 4 \times 2 \times 9$$

$$= -8$$

(1)

(Total for Question 8 is 4 marks)

4/4

Examiner Comments

(a) Line 2 earns M1 with line 4 earning the 2nd M1 followed by a correct expression (A1).

(b) The candidate collects the B1 after correctly evaluating $b^2 - 4ac = -8$ thus realising that $y = 0$ does not intersect the x -axis.

Student Response C

8. (a) Write $2x^2 - 8x + 9$ in the form $a(x + b)^2 + c$ $a = 2$

$$\begin{aligned}
 2x^2 - 8x + 9 & \Rightarrow 2(x - 2)^2 + 1 \quad \# \quad b = -2 \\
 & = 2(\cancel{x+2})^2 + 1 = 2(x-2)^2 + 1 \quad c = 1 \\
 & = 2(\cancel{x^2 + 4x + 4}) + 1 = 2(x^2 - 4x + 4) + 1 \\
 & = 2(\cancel{x^2 + 4x + 4}) + 1 = 2x^2 - 8x + 8 + 1 \\
 & = 2x^2 - 8x + 9
 \end{aligned}$$

$$2(x-2)^2 + 1$$

(3)

- (b) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 - 8x + 9 = 0$ does not intersect the x -axis.

$$\begin{aligned}
 b^2 - 4ac & = \# (-2)^2 - (4 \times 2 \times 1) \\
 & = 4 - 8 = -4 \therefore b^2 - 4ac < 0 \text{ so does not intersect.}
 \end{aligned}$$

(1)

(Total for Question 8 is 4 marks)

3/4

Examiner Comments

- (a) The candidate correctly states the answer and expands it to show that it can be written as $2x^2 - 8x + 9$ (M1 M1 A1) and so has answered the demand of the question.
- (b) The candidate correctly evaluates $b^2 - 4ac = -8$ and remarks on the negative value but so not elaborate sufficiently on its significance. (B0)

Student Response D

8. (a) Write $2x^2 - 8x + 9$ in the form $a(x + b)^2 + c$

$$\begin{array}{l}
 2x^2 - 8x + 9 \\
 \hline
 2x^2 - 4x - 4x + 8 + 1 \\
 \hline
 2x(x - 2) - 4(x - 2) + 1 \\
 \hline
 (x - 2)(2x - 4) + 1 \\
 \hline
 2(x - 2)^2 + 1
 \end{array}$$

where $a = 2$
 $b = -2$
 $c = 1$

$2(x - 2)^2 + 1$
 (3)

- (b) Hence, or otherwise, explain why the graph of the curve with equation $y = 2x^2 - 8x + 9 = 0$ does not intersect the x-axis. $y = 0$

$y = 2x^2 - 8x + 9$
 when $y = 0$
 $0 = 2x^2 - 8x + 9$ crossing point in the x axis.

(1)

(Total for Question 8 is 4 marks)

3/4

Examiner Comments

- (a) The candidate manipulates $2x^2 - 8x + 8$ into the form $(x - 2)(2x - 4)$ (M1) which is $2(x - 2)^2$ (M1) and then remembers that 1 needs to be added to recover the 9 in the original expression (A1).
 (b) The candidate writes nothing of substance and essentially rewrites the question and so fails to earn the B mark.

Exemplar Question 9

- 9 The 4th term of an arithmetic series is 17.
The 10th term of the same arithmetic series is 35.

Find the sum of the first 50 terms of this arithmetic series.

(Total for Question 9 is 5 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
9	$a + 3d = 17$ or $a + 9d = 35$ or $35 - 17 = 6d$ $d = 3$ $a = 8$ $\frac{50}{2}(2 \times '8' + (50 - 1) \times '3')$ oe	4075	5	M1 M1 for $17 = 4p + q$ and $35 = 10p + q$ A1 $p = 3$ and $q = 5$ A1 ft from $d = 3$ $u_1 = 8$ and $u_{50} = 155$ M1 $\frac{1}{2} \times 50(8 + 155)$ A1

Student Response A

9. The 4th term of an arithmetic series is 17.
The 10th term of the same arithmetic series is 35.

Find the sum of the first 50 terms of this arithmetic series.

$$17 = a + 3d \quad \text{--- ②}$$

$$35 = a + 9d \quad \text{--- ①}$$

$$\text{①} - \text{②}$$

$$a + 9d = 35$$

$$a + 3d = 17$$

$$6d = 18$$

$$d = 3$$

$$17 = a + 3 \times 3$$

$$17 = a + 9$$

$$a = 17 - 9 \quad a = 8$$

$$S_n = \frac{50}{2} (2 \times 8 + (50 - 1)3)$$

$$S_n = 25(16 + 147) \\ = 4075$$

(Total for Question 9 is 5 marks)

5/5

Examiner Comments

The left hand column begins with two correct equations in a and d (M1) followed by the correct evaluation of a and d (A1, A1).

The two values of a and d are then substituted in a correct expression for S_{50} (M1) followed by a correct evaluation of S_{50} to 4075 (A1).

Student Response B

9. The 4th term of an arithmetic series is 17.
The 10th term of the same arithmetic series is 35.

Find the sum of the first 50 terms of this arithmetic series.

$$\begin{aligned}
 &4 = \quad \quad \quad n=4 \quad = 17 \\
 &\quad \quad \quad n=10 \quad = 35 \quad \quad 35 - 17 = 18 \div 6 = 3 \\
 &a = 5, \quad d = 3, \quad n = 50 \quad \quad \quad 3, 6, 9, \quad d = 3 \\
 &S = \frac{n}{2} \times [2a + (n-1)d] \quad \quad \quad 3 \times 4 = 12 \\
 &S = \frac{50}{2} \times [2 \times 5 + (50-1) \times 3] \quad \quad \quad 17 - 12 = 5 \\
 &\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \therefore a = 5 \\
 &S = 25 \times [10 + 147] \\
 &S = 3925 //
 \end{aligned}$$

(Total for Question 9 is 5 marks)

3/5

Examiner Comments

A correct method and evaluation of the difference (d) between terms to 3 (M1, A1) but the answer is spoilt by an incorrect method for a (A0).

The candidate correctly substitutes his values for a and d into the expression S_{50} (M1) arriving at an incorrect answer because of the use of an incorrect value for a (A0).

Student Response C

9. The 4th term of an arithmetic series is 17.
The 10th term of the same arithmetic series is 35.

Find the sum of the first 50 terms of this arithmetic series.

$$u_4 = 17 \quad u_{10} = 35$$

$$u_n = a + (n-1)d = 17$$

$$a + 3d = 17 \quad \text{--- (1)} \quad a + 9d = 35 \quad \text{--- (2)}$$

$$a + 9d - a + 3d = 35 - 17$$

$$12d = 18$$

$$d = 1.5$$

$$a = 17 - 3 \times 1.5$$

$$a = 12.5$$

$$\begin{aligned} S_{50} &= \frac{50}{2} [2a + (n-1)d] \\ &= \frac{50}{2} [2 \times 12.5 + (50-1)1.5] \\ &= 25 (25 + 73.5) \\ &= \underline{\underline{2462.5}} \end{aligned}$$

(Total for Question 9 is 5 marks)

2/5

Examiner Comments

A correct equation involving the 4th term is given (M1) but followed by a correct one for the 10th term but subsequent incorrect algebra results in incorrect values for a and d (A0, A0). The incorrect values for a and d are substituted correctly into the expression for S_{50} (M1) resulting in an incorrect sum (A0).

Student Response D

9. The 4th term of an arithmetic series is 17.
The 10th term of the same arithmetic series is 35.

Find the sum of the first 50 terms of this arithmetic series.

$$35 - 17 = 18$$

$$18 \div 6 = 3$$

$$3^{rd} = 14$$

$$2^{nd} = 11$$

$$1^{st} = 8$$

$$S_{50} = \frac{50}{2} [16 + (50-1)3]$$

$$= 25 (16 + 147)$$

$$= 25 (163)$$

$$= \underline{\underline{4075}}$$

(Total for Question 9 is 5 marks)

5/5

Examiner Comments

In the left hand column, the candidate evaluates the difference between successive terms of the sequence to be $d = 3$ (M1 A1) and then uses this manually to work back correctly to the first term ($a = 8$) (A1). These two values are then correctly substituted into S_{50} (M1) to calculate the correct answer (A1).

Exemplar Question 10

10. Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

Show your working clearly.

(Total for Question 10 is 4 marks)

Mark Scheme

Question	Working	Answer	Mark	Notes
10	$\frac{(\sqrt{12}-1)(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$ $\frac{2\sqrt{12}-2+\sqrt{12}\sqrt{3}-\sqrt{3}}{4-3}$ $\sqrt{12}=2\sqrt{3}$	shown	4	<p>M1 method to rationalise</p> <p>M1 correct expansion of brackets</p> <p>B1 may be seen before expansion</p> <p>A1 answer from fully correct working with all steps seen</p>

Student Response A

10. Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

Show your working clearly.

$$\begin{aligned}
 \frac{\sqrt{12}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} &= \frac{2\sqrt{12} + \sqrt{36} - 2 - \sqrt{3}}{4-3} \\
 &= \frac{2\sqrt{12 \times 4} + \sqrt{36} - 2 - \sqrt{3}}{1} \\
 &= \frac{2\sqrt{48} + \sqrt{36} - 2 - \sqrt{3}}{1} \\
 &= \frac{4 + 4\sqrt{3} + 6 - 2 - \sqrt{3}}{1} \\
 &= 4 + 3\sqrt{3}
 \end{aligned}$$

(Total for Question 10 is 4 marks)

4/4

Examiner Comments

Line 1 (left) earns M1 for rationalising and M1 (right) for a correct expansion of brackets.
 Lines 2 and 3 see the candidate correctly handling the $\sqrt{12}$ terms (B1) resulting in a correct conclusion (A1).

Student Response B

10. Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

Show your working clearly.

Handwritten student work showing the rationalization of the denominator:

$$\frac{\sqrt{12}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} = \frac{(\sqrt{12}-1)(2+\sqrt{3})}{(2-\sqrt{3})(2+\sqrt{3})}$$

$$\frac{(\sqrt{12}-1)(2+\sqrt{3})}{4-3} = (\sqrt{12}-1)(2+\sqrt{3})$$

$$= 2\sqrt{12} + \sqrt{36} - 2 - \sqrt{3}$$

$$= 2 \times 2\sqrt{3} + 6 - 2 - \sqrt{3}$$

$$= 4\sqrt{3} + 4 - 2 - \sqrt{3}$$

$$= 4 + 3\sqrt{3}$$

(Total for Question 10 is 4 marks)

4/4

Examiner Comments

A messy answer that is correct.

Starting on the left, the candidate realises that the denominator equals 1 when multiplied by $(2+\sqrt{3})$ and then proceeds on the right to correctly expand $(\sqrt{12}-1)(2+\sqrt{3})$ so earning the 1st M1 for rationalising and continues in the next 4 lines to correctly expand the brackets earning the 2nd M1. The candidate then manipulates the $\sqrt{12}$ terms into "6" and $4\sqrt{3}$ (B1) arriving at the correct conclusion (A1) earning full marks.

Student Response C

10. Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$ $\frac{2\sqrt{3}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}}$

Show your working clearly.

$$\frac{\sqrt{12}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}}$$

$$\begin{aligned} 4\sqrt{3} - 2 - \sqrt{3} + 2\sqrt{9} \\ 4\sqrt{3} - 2 - \sqrt{3} + 2 \times 3 \\ 4 - 3\sqrt{3} // \end{aligned}$$

$$\frac{(\sqrt{12}-1)(2+\sqrt{3})}{4-3} = \frac{2\sqrt{12} - 2 + \cancel{2\sqrt{3}} - \sqrt{3} + \sqrt{36}}{4-3}$$

$$\begin{aligned} \cancel{2\sqrt{4} \times \sqrt{3}} - 2 + 2\sqrt{3} - \sqrt{3} \\ = 4\sqrt{3} + 2\sqrt{3} - \sqrt{3} - 2 \end{aligned}$$

$$\Rightarrow 5\sqrt{3} - 2$$

$$\begin{aligned} \cancel{2\sqrt{12}} \\ 4\sqrt{3} - 2 + 2\sqrt{3} - \sqrt{3} + 6 \\ -4+ \end{aligned}$$

(Total for Question 10 is 4 marks)

3/4

Examiner Comments

The 1st M1 is earned on the first line on the right. The denominator is correctly expanded two lines down on the left and a correct attempt is made to expand the numerator (M1, 2nd line on the right) including manipulating the $\sqrt{12}$ term so that it can be combined with the $-\sqrt{3}$ term (B1). Alas, the candidate makes a sign slip in his conclusion (B0 – we cannot be sure whether this was a miswrite or an algebraic error) thus earning 3 of 4 marks.

Student Response D

10. Show that $\frac{\sqrt{12}-1}{2-\sqrt{3}}$ can be written as $4+3\sqrt{3}$

Show your working clearly.

$$\begin{aligned} & \frac{\sqrt{12}-1}{2-\sqrt{3}} \times \frac{2+\sqrt{3}}{2+\sqrt{3}} \\ &= \frac{4+3\sqrt{3}}{4-3} \\ &= 4+3\sqrt{3} \end{aligned}$$

(Total for Question 10 is 4 marks)

1/4

Examiner Comments

A correct statement of rationalisation is made on line 1 (M1). However, the candidate writes down $4+3\sqrt{3}$ on the next line without showing any intermediate working as required explicitly by the question so M0 B0 A0, earning a total of 1 mark only.