



Pearson
Edexcel

International GCSE
Mathematics A

Exemplar Material for Paper 2
Higher produced from the
2018 May/June Series
4MA1/02

Paper 2H (Calculator)

Exemplar Question 1

Higher tier Paper 2H Question 2

Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios 2 : 6 : 7

..... yen

(Total for Question 2 is 3 marks)

Mean score: 2.85/3

Examiner Comments – this question is from AO1 - Number

The mean mark for this question was very high but it could have been higher if students had read the question correctly. Far too many did not read the question carefully enough and gave the largest share or the smallest share and not the difference between these.

Mark Scheme

Question	Working	Answer	Mark	Notes
2	$\frac{3450}{2+6+7}$ (=230) or $\frac{2}{2+6+7} \times 3450$ (= 460) or $\frac{7}{2+6+7} \times 3450$ (=1610) or $\frac{7-2}{2+6+7} \left(\frac{1}{3} \right)$		3	M1
	(7 - 2) × "230" or 7 × "230" - 2 × "230" or "1610" - "460" or $\frac{1}{3} \times 3450$			M1
		1150		A1
				Total 3 marks

Examiner Comments

The mark scheme logically builds up from finding one or more shares and then a full method for finding the difference between the largest share and the smallest share.

Any students using a full method but with an arithmetic error would gain 2 marks out of 3 so long as they showed clear working. The students who found either the largest or the smallest share only gained 1 mark.

Student Response A

- 2 Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios 2:6:7

$$7+6+2=15$$

$$3450 \div 15 = 230$$

$$\therefore \text{one share} = 230 \text{ yen}$$

$$\therefore 7 \text{ shares} = 230 \times 7$$
$$= \underline{\underline{1610}}$$

..... 1610 yen

(Total for Question 2 is 3 marks)

Examiner Comments

This student gains the first method mark for finding the value of 1 share (230)

The next Method mark is for a complete method but this is not shown as the student only finds the value of the largest share – we assume the student has not read the question carefully enough. (M1M0A0)

Student Response B

2 Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios 2:6:7

$$2+6+7=15$$
$$3450 \div 15 = 230$$

$$230+230=460$$

460 yen

Examiner Comments

This student gains the first method mark for finding the value of 1 share (230)

The next Method mark is for a complete method but it is not awarded as the student finds only the value of the smallest share. Maybe they didn't read the question carefully enough.

(M1M0A0)

Student Response C

- 2 Work out the difference between the largest share and the smallest share when 3450 yen is divided in the ratios 2:6:7

$$2+6+7=15$$

$$\begin{array}{r} 3450 \\ \hline 15 \end{array} = 230$$

$$230 \times 2 = 462$$

$$230 \times 7 = 1610$$

$$1610 - 462 = 1148$$

1148 yen

(Total for Question 2 is 3 marks)

Examiner Comments

This student gains the first method mark for finding the value of 1 share (230)

They also gain the second method mark for a fully correct method. However they lose the accuracy as an arithmetic error was made when multiplying 230×2 .

This candidate was able to maximise their marks by showing clear working. (M1M1A0)

Exemplar Question 2

Higher tier Paper 2H Question 5

In the diagram below, P and Q are points on a circle with centre O .

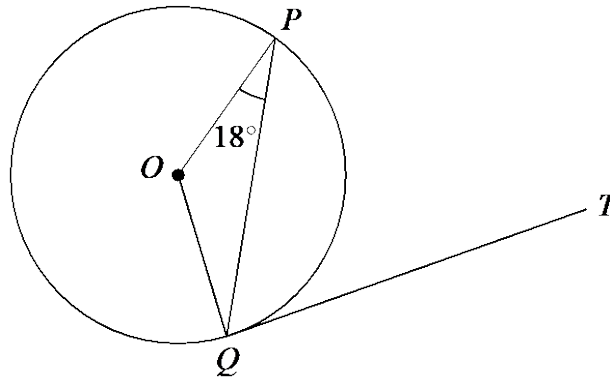


Diagram NOT accurately drawn

QT is a tangent to the circle.
Angle $OPQ = 18^\circ$

Work out the size of angle PQT .
Give a reason for each stage of your working.

..... °

(Total for Question 5 is 3 marks)

Mean score: 2.04/3

Examiner Comments – this question is from AO2, Shape, Space and Measure.

The majority of students were able to correctly find angle PQT , but the problem was with the reason. Students needed to explain their reason using the keywords 'tangent' and 'radius/diameter'

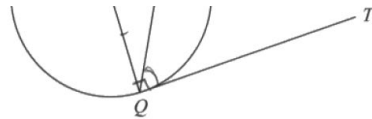
Mark Scheme

Question	Working	Answer	Mark	Notes
5	$\angle OQT = 90^\circ$ and $\angle OQP = 18^\circ$ or $90 - 18$		3	M1 For 90° and 18° correctly identified in the working or on the diagram or for $90 - 18$ or for other fully correct method
		72		A1
	Angle between <u>tangent and radius(or diameter)</u> is 90 degrees			B1 Correct reason for 90° angle [If used <u>alternate segment theorem</u>]
				Total 3 marks

Examiner Comments

In our mark schemes the words that are essential for reasons questions are underlined.

Student Response A



QT is a tangent to the circle.
Angle $OPQ = 18^\circ$

Work out the size of angle PQT .
Give a reason for each stage of your working.

(isosceles)
Angles off radius equal, so $\hat{P}QO = 18^\circ$
Where a tangent meets a radius angle = 90°

$$\text{So } 90 - 18 = 72^\circ$$

72

(Total for Question 5 is 3 marks) **3**

Examiner Comments

This student is awarded M1A1B1 for a fully correct answer and reason.

Student Response B



QT is a tangent to the circle.
Angle $OPQ = 18^\circ$

Work out the size of angle PQT .
Give a reason for each stage of your working.

$\hat{OPQ} = 18^\circ$ (triangles connected to the centre and the ~~sector~~ sector are isosceles triangles)
 $18^\circ - 2 \times 18^\circ = 144^\circ$ (total angle of the triangle = 180°)
 $\hat{PQT} = 144^\circ$ (tangent theorem)

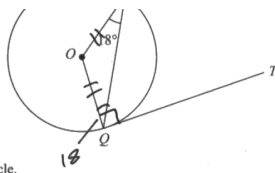
144

(Total for Question 5 is 3 marks) **0**

Examiner Comments

144 was a common incorrect answer and this student shows their reasoning for the answer. It has been mixed up with alternate segment theorem, the mistake being that 144° is at the centre rather than at the circumference. If the student had drawn in the angle at the circumference and realised it was $0.5 \times 144 (=72)$ and this was equal to angle PQT they would have gained M1A1 and the reason mark (B1) if they had written 'alternate segment theorem'. (M0A0B0)

Student Response C



QT is a tangent to the circle.
Angle $OPQ = 18^\circ$

Work out the size of angle PQT .

Give a reason for each stage of your working.

isosceles triangle since two of the sides are radii, making them equal length; equal angles.
 $90 - 18 = 72$
the diameter always meets the tangent that lies on the circumference at 90°

72°

Examiner Comments

This student gains M1A1 for a correct answer. They would also have gained M1 for their work on the diagram if nothing else had existed – working on the diagram for angles is to be encouraged. This student also gains B1 for a correct reason – note that we allow radius or diameter to be used for this reason. (M1A1B1)

Exemplar Question 3

Higher tier Paper 2H Question 11

A solid metal sphere has radius 1.5 cm.
The mass of the sphere is 109.6 grams.

Work out the density of the sphere.
Give your answer correct to 3 significant figures.

..... g / cm³

(Total for Question 11 is 3 marks)

Mean score: 2.32/3

Examiner Comments – This question is from AO2, Shape, Space and Measure.

This was the first time we had tested density on International Mathematics syllabus A and it was met with a pleasing response. We saw many completely correct responses and if not fully correct, students were generally able to benefit from a method mark for finding the volume of the sphere. Some had misconceptions about the formula for density, those using it incorrectly often used density = mass × volume. Unfortunately, a number of students did not get the Volume correct despite a formula sheet, leading to 0 marks despite knowing density formula

Mark Scheme

11	$V = \frac{4}{3} \times \pi \times 1.5^3$ (= 14.1(37)... or $\frac{9}{2}\pi$)		3	M1	Correct expression for volume.
	$D = \frac{109.6}{\frac{4}{3}\pi \times 1.5^3}$ oe			M1	dep
		7.75		A1	7.75 – 7.78
					Total 3 marks

Examiner Comments

One crucial part of this question was to be able to find the volume of the sphere and although the formula is given, some candidates used radius squared rather than radius cubed. Students must copy formula carefully.

Student Response A

- 11 A solid metal sphere has radius 1.5 cm.
The mass of the sphere is 109.6 grams.

2 Q11

Work out the density of the sphere.
Give your answer correct to 3 significant figures.

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

$$\text{mass} = 109.6$$

$$\text{volume} = 14.13716694$$

$$\text{volume of sphere} = \frac{4}{3} \pi r^3$$

$$\frac{4}{3} \times \pi \times 1.5^3$$

$$= 14.13716694$$

$$\text{density} = \frac{109.6}{14.13716694}$$

$$= 7.71$$

~~7.71~~ 7.71 g/cm³

Total for Question 11 is 3 marks **2**

Examiner Comments

This student shows a fully correct method and gains M1M1 but they lose the accuracy mark as the accuracy is not within the tolerance given (7.75 – 7.78). They must have put a number into their calculator incorrectly as the calculation they have shown should have given 7.7526...

Writing numbers carefully and checking what they are using in the calculator must be stressed to students, as we see many lost marks due to minor errors such as this. (M1M1A0)

Student Response B

- 11 A solid metal sphere has radius 1.5 cm.
The mass of the sphere is 109.6 grams.

3 Q11

Work out the density of the sphere.
Give your answer correct to 3 significant figures.

$$\begin{aligned} & \cancel{V = \frac{4}{3} \pi r^3} \\ V &= \frac{4}{3} \pi r^3 \\ V &= \frac{4}{3} \times 1.5^3 \times \pi \\ V &= \frac{9}{2} \pi \end{aligned}$$

density:

$$\begin{aligned} d &= \frac{M}{V} \\ &= \frac{109.6}{\frac{9}{2} \pi} \\ &= 7.752614 \\ &= 7.75 \text{ grams/cm}^3 \end{aligned}$$

7.75 g/cm³

(Total for Question 11 is 3 marks) **3**

Examiner Comments

A fully correct answer with an answer in the correct range is shown so M1M1A1 is awarded. Keeping full accuracy in a question where a value is used again in a calculation is to be recommended as students can lose marks if they have rounded too much in the early stages. This student has shown us they have used the exact figure for the second calculation that involves the volume found previously. (M1M1A1)

Exemplar Question 4

Higher tier Paper 2H Question 14abc

- 14 (a) Complete the table of values for $y = x^3 - 2x^2 - 3x + 4$

x	-2	-1	-0.5	0	1	1.5	2	3
y			4.875	4		-1.625		

(2)

- (b) On the grid, draw the graph of $y = x^3 - 2x^2 - 3x + 4$ for values of x from -2 to 3.

(2)

- (c) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation $x^3 - 2x^2 - x + 1 = 0$

Give your solutions correct to 1 decimal place.

Mean score: (a) 1.76/2 (b) 1.49/2 (c) 0.65/4

Examiner Comments – This question is from AO1, Algebra.

This graph question was fairly well approached, with many students gaining full marks for the table of values and the plotting and drawing of the graph. Students tended to struggle a bit more with part (c) as this was a more challenging part. A good number, however, were able to gain marks. Students must realise that when an equation just contains x , we are not looking for y as well so those giving coordinates, lost the final accuracy mark. Some students lost the marks on part (c) as they plotted $y = 2x + 3$ rather than $y = -2x + 3$

Mark Scheme

Question	Working	Answer	Mark	Notes
14 (a)		-6, 4, 0, -2, 4	2	B2 Award B1 for 2, 3 or 4 correct.
(b)		correct curve	2	B2 For correct smooth curve. If B2 not awarded, award B1 for at least 5 points plotted correctly ft from table dep on B1 or B2 in (a) (plots ± 1 sq)
(c)	$x^3 - 2x^2 - 3x + 4 = -2x + 3$		4	M1
	Plot $y = -2x + 3$			M1 Sufficient to cross curve at least once.
	-0.8 or 0.6 or 2.2			A1 Any one correct x value at intersection of graphs (or one or more points given as coordinates) ft dep on second M1 (Award even if curve in (a) is incorrect)
		-0.8 0.6 2.2		A1 Accept -0.9 to -0.7 Accept 0.4 to 0.7 Accept 2.1 to 2.4 (not coordinates) ft (± 1 square) dep on second M1 must be 3 values
				SC B2 for all correct solutions from graph of $y = x^3 - 2x^2 - x + 1$
				Total 8 marks

Examiner Comments

It must be noted that follow through of plotting points is allowed for part (b).

Advice to students would be that if they cannot plot a point they have calculated in their table, then they have almost certainly made a mistake and should revisit the table.

Student exemplar A

14 (a) Complete the table of values for $y = x^3 - 2x^2 - 3x + 4$

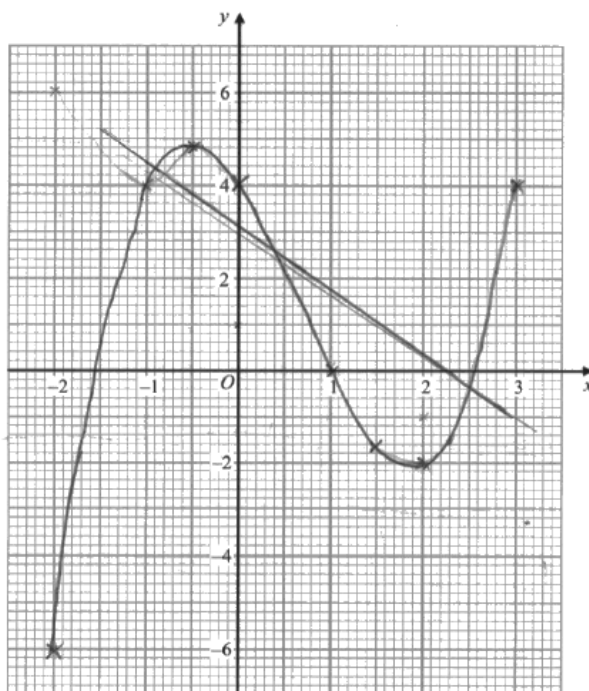
2 Q14a

x	-2	-1	-0.5	0	1	1.5	2	3
y	-6	4	4.875	4	0	-1.625	-2	4

(2)

(b) On the grid, draw the graph of $y = x^3 - 2x^2 - 3x + 4$ for values of x from -2 to 3

2 Q14b



(2)

0 Q14c

(c) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation $x^3 - 2x^2 - x + 1 = 0$. Give your solutions correct to 1 decimal place.

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

$$-x + 1$$

$$-3x + 4$$

$$2.2, 0.5, +, -0.7$$

Examiner Comments:

(a) B2 for a correct table.

(b) B2 for a correct smooth curve.

(c) M0 as we see no correct rearrangement of the equation. M0 the equation drawn is incorrect.

No more marks can be awarded as the method is incorrect.

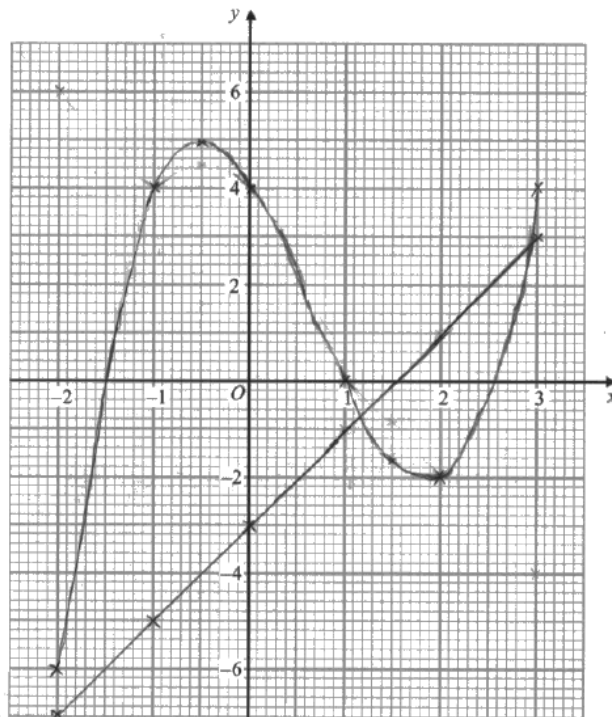
Student exemplar B

x	-2	-1	-0.5	0	1	1.5	2	3
y	6	8 4	4.875	4	0	-1.625	-2	4

(2)

(b) On the grid, draw the graph of $y = x^3 - 2x^2 - 3x + 4$ for values of x from -2 to 3

2 Q14



(2)

(c) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation $x^3 - 2x^2 - x + 1 = 0$. Give your solutions correct to 1 decimal place.

$$x^3 - 2x^2 - x + 1 = 2x - 3$$

$$x = 1.1 \quad y = 0.8$$

$$x = 2.9 \quad y = 2.8$$

$$x = 1.1, x = 2.9$$
~~$$(1.1, 0.8) (2.9, 2.8)$$~~

(4)

(Total for Question 14 is 8 marks)

4

Examiner Comments:

(a) B2 for a correct table.

(b) B2 for a correct smooth curve.

(c) This student is the one who has some knowledge of what to do here but unfortunately the equation is incorrect.

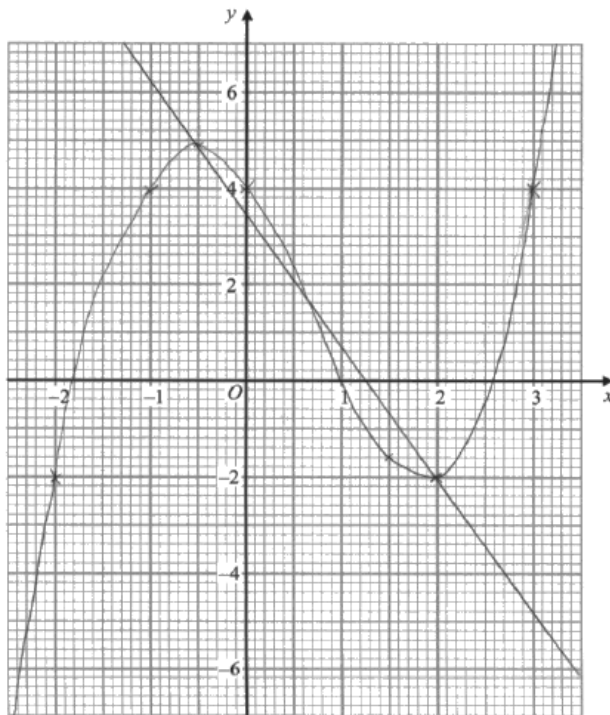
(M0M0A0A0)

Student exemplar C

x	-2	-1	-0.5	0	1	1.5	2	3
y	-2	4	4.875	4	0	-1.625	-2	4

$(-2)^3 - (2 \times 4) = (-8) - (8) = -16$
 $(-1)^3 - (2 \times 4) = (-1) - (8) = -9$
 $(-0.5)^3 - (2 \times 4) = (-0.125) - (8) = -8.125$
 $(0)^3 - (2 \times 4) = 0 - (8) = -8$
 $(1)^3 - (2 \times 4) = 1 - (8) = -7$
 $(1.5)^3 - (2 \times 4) = 3.375 - (8) = -4.625$
 $(2)^3 - (2 \times 4) = 8 - (8) = 0$
 $(3)^3 - (2 \times 4) = 27 - (8) = 19$

(b) On the grid, draw the graph of $y = x^3 - 2x^2 - 3x + 4$ for values of x from -2 to 3



(2)

(c) By drawing a suitable straight line on the grid, find estimates for the solutions of the equation $x^3 - 2x^2 - x + 1 = 0$. Give your solutions correct to 1 decimal place.

$x^3 - 2x^2 - x + 1 = 0$
 $(0.5, 4.9)$ maximum point
 $(2, -2)$ minimum point
 $2.6 \quad -1.8$
 ~~$(0.5, 4.9)$~~

Examiner Comments:

(a) B1 for 4 entries correct

(b) B1 for a curve that is fit their table – ie this is not the correct curve, but a fit mark is available.

(c) This student draws a line through the maximum and minimum point which gains no marks. (M0M0A0A0)

1 Q

Exemplar Question 5

Higher tier Paper 2H Question 15

$$e = 8.31 \text{ correct to 2 decimal places}$$

$$f = 0.65 \text{ correct to 2 decimal places}$$

Work out the lower bound for the value of $e - f$

Show your working clearly.

Mean score: 1.25/2

Examiner Comments - this question is from AO1, Number.

A few students did not recognise this as an upper and lower bounds type question so merely used the numbers given for $e - f$. A common misunderstanding was to think that the lower bound for the sum would be found by taking the lower bound of 0.65 from the lower bound of 8.31. Even if students did this they were able to pick up a method mark for using the lower bound of 8.31. The accuracy mark here depended on seeing correct working, as requested, because the correct answer could come from incorrect working.

Mark Scheme

15	8.305-0.655		2	M1	For either bound correct (used or seen). Accept 0.6549
		7.65		A1	dep on correct method shown
					Total 2 marks

Examiner Comments

Note that M1 was awarded for either bound correct – used or seen – and many students were able to benefit from this even if they did not use the correct bounds for both figures.

Student exemplar A

15 $e = 8.31$ correct to 2 decimal places
 $f = 0.65$ correct to 2 decimal places

1 Q15

Work out the lower bound for the value of $e - f$
 Show your working clearly.

$$8.305 - 0.665 = 7.64$$

Examiner Comments:
 M1 for a correct bound (8.305)
 A0 as the incorrect answer has been given.
 The student has used the incorrect value of 0.665 rather than 0.655

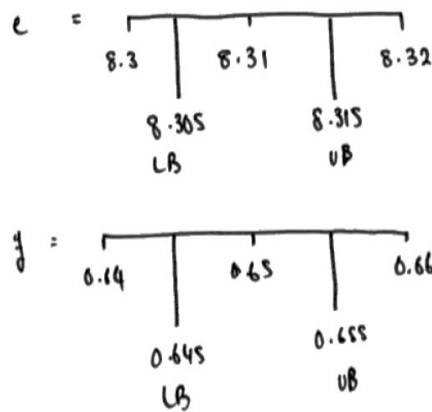
$$7.64$$

Student exemplar B

$$LB = e - f$$

$$8.305 - 0.645$$

$$= 7.66$$



$$7.66$$

Examiner Comments:
 M1 for a correct bound (8.305 or 0.655)
 A0 as the student has used the Lower bound minus the Lower bound – this is a common misconception and one that students need practice avoiding

Student exemplar C

lower e :

$$e = 8.305$$

upper f :

$$f = 0.655$$

lower $e - f$:

$$e - f = 8.305 - 0.655$$

$$= 7.65$$

$$7.65$$

Examiner Comments:
 M1A1 for a completely correct answer. NB: working had to be shown as it was possible to get a correct answer from an incorrect method – ‘Show your working clearly’ was stated and students must always adhere to this statement to enable them to benefit from all marks.

Exemplar Question 6

Higher tier Paper 2H Question 17ab

$$y = x^3 - 2x^2 - 15x + 5$$

(a) Find $\frac{dy}{dx}$

$$\frac{dy}{dx} = \dots\dots\dots (2)$$

C is the curve with equation $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of x for which C has a negative gradient.

Mean score: (a) 1.64/2 (b) 1.49/4

Examiner Comments – this question is from AO1, Algebra

(a) Most students who knew about differentiation were comfortable differentiating the equation and often gained 2 marks or at least 1 mark. A few clearly did not understand what was involved.

(b) This part of the question was more challenging, but a fair few had a go and some were able to find the solutions for x but many failed to write their answers correctly using inequalities. Finding the critical values for x gained 3 marks out of 4 which was very reasonable for this stage in the paper.

Mark Scheme

Question	Working	Answer	Mark	Notes
17 (a)		$3x^2 - 4x - 15$	2	B2 Award B1 for any 2 or 3 of the 4 terms differentiated correctly.
(b)	$3x^2 - 4x - 15 < 0$ (or = 0)		4	M1 ft from (a) ie "their (a)" = 0 (or < 0)
	$(3x + 5)(x - 3) < 0$ or $\frac{-(-4) \pm \sqrt{(-4)^2 - 4 \times 3 \times (-15)}}{2 \times 3}$			M1 ft from "their (a)" (=0) for 3 term quadratic, for correct factorisation or correct use of quadratic formula to find the two critical values, allow 1 sign error. [-(-4) could be 4 and (-4) ² could be 4 ²](condone missing brackets)
	$-\frac{5}{3}, 3$			M1 Both critical values correct Accept -1.66... rounded or truncated to 3SF.
		$-\frac{5}{3} < x < 3$		A1oe Inequality signs needed Allow $x > -\frac{5}{3}, x < 3$
				Total 6 marks

Examiner Comments

Students were able to pick up B1 if they differentiated 2 of the 4 terms correctly – some students do some sort of ‘simplifying’ after they have differentiated by merging terms (incorrectly) and these would also be worthy of B1

For part (b) candidates can benefit from a M1 follow through mark for their answer to (a) = 0

In these sort of questions, factorisation is often possible, but we still see a lot of students using the quadratic formula to solve their equations.

Student exemplar A

17

$$y = x^3 - 2x^2 - 15x + 5$$

(a) Find $\frac{dy}{dx}$

2 Q17:

$$3x^2 - 4x - 15$$

$$\frac{dy}{dx} = \frac{3x^2 - 4x - 15}{(2)}$$

C is the curve with equation $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of x for which C has a negative gradient.

3 Q17:

$$3x^2 - 4x - 15 = 0$$

$$(3x + 5)(x - 3) = 0$$

$$\begin{array}{ccc} \downarrow & & \downarrow \\ x = -\frac{5}{3} & & x = 3 \end{array}$$

$$-\frac{5}{3} \text{ to } 3$$

Examiner Comments

This student has gained full marks in part (a) by differentiating all terms correctly. In part (b) the student has found both critical values but put nothing on the answer suggesting that they don't know what to do with their answers. M1M1M1A0 is awarded.

Student exemplar B

(a) Find $\frac{dy}{dx} = 3x^2 - 4x - 15$

2 Q17a

$$\frac{dy}{dx} = 3x^2 - 4x - 15$$

(2)

C is the curve with equation $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of x for which C has a negative gradient.

3 Q17b

$$\frac{dy}{dx} < 0$$

$$3x^2 - 4x - 15 < 0$$

$$(3x + 5)(x - 3) < 0$$

$$\text{the } -\frac{5}{3} \leq x \leq 3$$

Examiner Comments

This student has gained full marks in part (a) by differentiating all terms correctly. Part (b) is done fairly well, the student finding the critical values correctly but then writing the inequalities incorrectly with 'equals to' included with the figures. M1M1M1A0 is awarded.

Student exemplar C

dx

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

$$3x^2 - 4x - 15$$

$$\frac{dy}{dx} = \frac{3x^2 - 4x - 15}{(2)}$$

C is the curve with equation $y = x^3 - 2x^2 - 15x + 5$

(b) Work out the range of values of x for which C has a negative gradient.

0 Q17:

1✓

2✓

3✓

4✓

$$3x - 4x - 15$$

$$\frac{1, 2, 3, 4}{(4)}$$

Examiner Comments

This student has gained full marks in part (a) by differentiating all terms correctly. In part (b) the student thinks they need to find individual values for which their equation has a negative gradient – no marks are awarded. M0M0M0A0

Exemplar Question 7

Higher tier Paper 2H Question 18

A triangle has sides of length 8 cm, 10 cm and 14 cm.

Work out the size of the largest angle of the triangle.

Give your answer correct to 1 decimal place.

Mean score: 1.22/3

Examiner Comments: This question is from AO2, Shape, Space and Measure and tests that student can use the cosine rule and that they can decide which the largest angle of a triangle is when you know the sizes of the 3 sides.

If candidates knew the cosine rule they made a good attempt at this question, but many showed they had no idea how to find which of the angles was the biggest. Some worked out the two smaller angles and subtracted the sum of these from 180° which was a perfectly acceptable method, although a bit long-winded. We saw a good number of fairly accurate diagrams where students had measured the angle, but the insistence on the angle to 1 decimal place usually meant no marks were awarded. It must be stressed to students that when a question says ‘Work out...’ a calculation is required. Some students used a fairly accurate diagram to see which angle looked the biggest and then they knew which one to calculate.

Mark Scheme

Question	Working	Answer	Mark	Notes
18	$14^2 = 10^2 + 8^2 - 2 \times 10 \times 8 \times \cos A$ or $\cos A = \frac{10^2 + 8^2 - 14^2}{2 \times 10 \times 8}$ oe		3	M1 Correct substitution in cosine rule for any angle or for 44.4... or 34.047....(the other 2 angles to 1dp or better)
				M1 $\cos^{-1}\left(\frac{10^2 + 8^2 - 14^2}{2 \times 10 \times 8}\right)$ oe ie \cos^{-1} of the correct angle or a fully correct method to find the largest angle eg $180 - \cos^{-1}\left(\frac{196 + 100 - 64}{280}\right) - \cos^{-1}\left(\frac{196 + 64 - 100}{224}\right)$ oe
		101.5		A1 101.5 to 101.6
				Total 3 marks

Examiner Comments

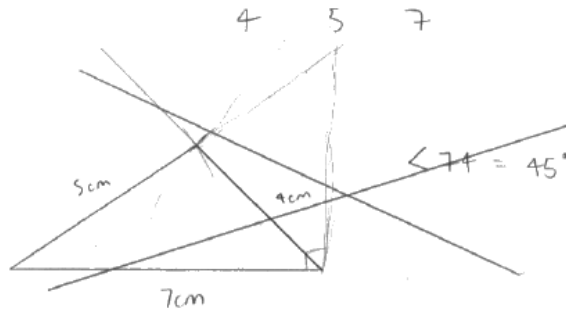
No marks were available for a scale diagram unless an answer from 101.5 – 101.6 was given. Students who didn’t know how to tell which angle was the biggest could be awarded M1 for the calculation of any angle.

Student exemplar A

18 A triangle has sides of length 8 cm, 10 cm and 14 cm.

0 Q18

Work out the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.



$$4 + 5 + 7 = 16$$

$$180 \div 16 = 11.25$$

$$4 \times 11.25 = 45$$

$$5 \times 11.25 = 56.25$$

$$7 \times 11.25 = 78.75$$

$$= 78.8^\circ$$

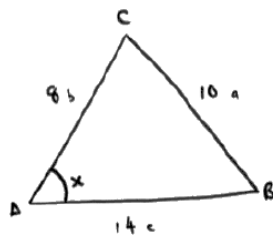
$$78.8^\circ$$

Examiner Comments:

This response is one which shows the student did not know how to tackle the question. They have used a ratio method using the lengths of the sides and thinking that the angles are in the same ratio as the sides. M0M0A0 is awarded.

Student exemplar B

Work out the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.



$$\text{Cosine rule} = \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$\cos A = \frac{8^2 + 14^2 - 10^2}{2 \times 8 \times 14}$$

$$= 0.7142857143$$

$$\sin^{-1}(0.7142857143)$$

$$= 45.6$$

$$45.6^\circ$$

Examiner Comments:

This student gains M1 for a correct substitution into the cosine rule. They do not gain any more marks as they do not show a method to find the largest angle, but in any case they start with $\cos A$ and then use \sin^{-1} getting a bit mixed up.

Student exemplar C

18 A triangle has sides of length 8 cm, 10 cm and 14 cm.

3 Q18

Work out the size of the largest angle of the triangle.
Give your answer correct to 1 decimal place.

$$\begin{aligned}8^2 &= 10^2 + 14^2 - 2 \times 10 \times 14 \times \cos A \\64 &= 100 + 196 - 280 \cos A \\(100 + 196) - 64 &= 280 \cos A \\A &= 34.048 \\10^2 &= 8^2 + 14^2 - 2 \times 8 \times 14 \times \cos A \\100 &= 64 + 196 - 224 \cos A \\(64 + 196) - 100 &= 224 \cos A \\160 &= 224 \cos A \\A &= 44.415 \\180 - 44.415 - 34.048 &= 101.537\end{aligned}$$

101.5°

(Total for Question 18 is 3 marks) **3**

Examiner Comments

This response shows how some students worked out all 3 angles and then decided which one they should choose as their answer. This is rather an inefficient way of working out the correct answer. (M1M1A1)

Exemplar Question 8

Higher tier Paper 2H Question 19

The diagram shows a triangular prism.

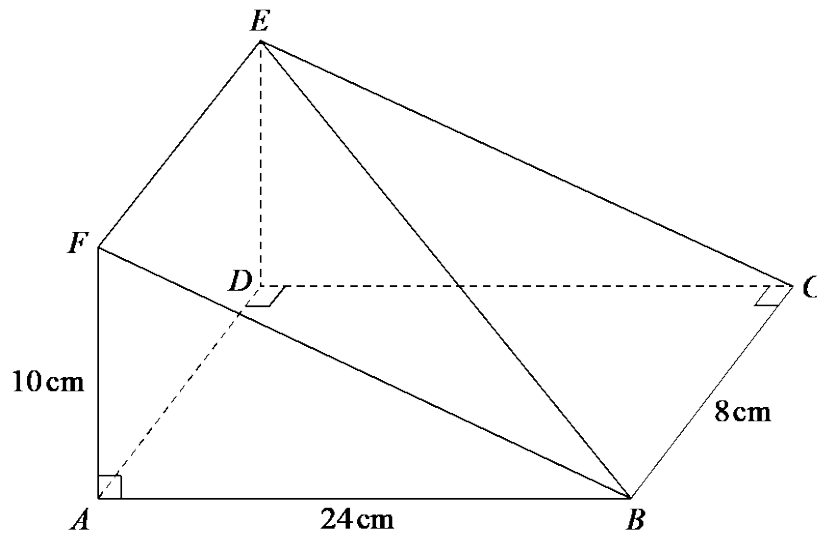


Diagram **NOT**
accurately drawn

$AF = 10\text{ cm}$, $AB = 24\text{ cm}$ and $BC = 8\text{ cm}$.
Angle $FAB = \text{angle } ADC = \text{angle } BCD = 90^\circ$

Work out the size of the angle between the line BE and the plane $ABCD$.
Give your answer correct to 1 decimal place.

Mean score: 1.67/3

Examiner Comments: This question is from AO2, Shape, Space and Measure and tests that student can use work with 3D shapes. Some students find it very hard to visualise the triangles they need so these questions are challenging.

We did see a pleasing number of correct answers, but we saw a wide range of incorrect responses, where, in many cases the student found the incorrect angle. Students who made an attempt but did not find the correct angle often gained a method mark for BE or BD found.

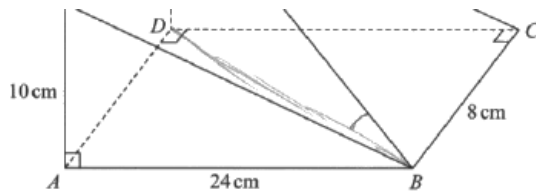
Mark Scheme

19	$BE^2 = 10^2 + 24^2 + 8^2$ $(= 100 + 576 + 64 = 740)$ $(BE = 2\sqrt{185} = 27.202 \dots)$	$BD^2 = 8^2 + 24^2$ $(= 64 + 576 = 640)$ $(BD = 8\sqrt{10} = 25.298 \dots)$	3	M1	Complete method to find BE or BE^2 or BD or BD^2
	$\sin DBE = \frac{10}{\sqrt{740}}$ $(= 0.3676 \dots)$	$\tan DBE = \frac{10}{\sqrt{640}}$ $(= 0.3952 \dots)$ or $\cos DBE = \frac{\sqrt{640}}{\sqrt{740}}$ $(= 0.9428 \dots)$		M1	Allow use of sine or cosine rule $\sin DBE = \frac{10 \sin 90}{\sqrt{740}}$ or $\cos DBE = \frac{640 + 740 - 10^2}{2 \times \sqrt{640} \times \sqrt{740}}$ $(= 0.9299 \dots)$
			21.6	A1	21.5 - 21.6
					Total 3 marks

Examiner Comments

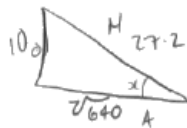
The first mark was for a complete method to find BE , BE^2 , BD or BD^2 . This enabled students who were finding the incorrect angle to often pick up a mark for starting to work in 3D. The second M1 was for a completely correct method for the sin, cos or tan of the correct angle. We allowed a small range of values for the award of the accuracy mark, so it is essential that students use the most accurate previous figure (certainly not using a figure that is very rounded) that they can to prevent accuracy errors in the final answer.

Student exemplar A



$AF = 10\text{ cm}$, $AB = 24\text{ cm}$ and $BC = 8\text{ cm}$.
 Angle $FAB = \text{angle } ADC = \text{angle } BCD = 90^\circ$

Work out the size of the angle between the line BE and the plane $ABCD$.
 Give your answer correct to 1 decimal place.



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

$$24^2 + 8^2 = c^2$$

$$c = 25.29$$

$$c = \sqrt{640}$$

SOH CAH TOA

$$\tan^{-1} = \frac{10}{\sqrt{640}}$$

$$= 23.9645\dots$$

$$= 23.964\dots$$

$$= 24.0$$

18

$$\text{Angle } DEB = 66.0$$

$$\text{Angle } DB = 28.24.0$$

$$24.0^\circ$$

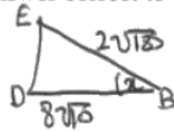
(Total for Question 19 is 3 marks) **2**

Examiner Comments

This student gains M1M1 for a completely correct method (apart from the \tan^{-1} rather than \tan which we condoned). Unfortunately the angle given as the answer is incorrect so the student gets A0 (M1M1A0)

Student exemplar B

Give your answer correct to 1 decimal place.



length $DB =$

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 24^2 + 8^2 &= c^2 \\ 576 + 64 &= c^2 \\ 640 &= c^2 \\ c &= 8\sqrt{10} \end{aligned}$$

length $EB =$

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 8^2 + 26^2 &= c^2 \\ 676 + 64 &= c^2 \\ c^2 &= 740 \\ c &= 2\sqrt{185} \end{aligned}$$

$$\begin{aligned} \sin y &= \frac{\text{adj}}{\text{hyp}} \\ \sin y &= \frac{8\sqrt{10}}{2\sqrt{185}} \end{aligned}$$

$$\begin{aligned} y &= \sin^{-1}\left(\frac{8\sqrt{10}}{2\sqrt{185}}\right) \\ y &= 68.43127054 \end{aligned}$$

$$\begin{aligned} \text{length } FB &= \\ a^2 + b^2 &= c^2 \\ 10^2 + 24^2 &= c^2 \\ 100 + 576 &= c^2 \\ 676 &= c^2 \\ c &= 26 \\ FB &= 26 \end{aligned}$$

$$\begin{aligned} DB^2 &= 8^2 + 24^2 \\ DB &= 8\sqrt{10} \\ \tan x &= \frac{\text{adj}}{\text{opp}} \\ \tan x &= \frac{8\sqrt{10}}{10} \\ x &= \tan^{-1}\left(\frac{8\sqrt{10}}{10}\right) \\ x &= 68.43 \end{aligned}$$

$$y = 68.4$$

$$68.4$$

(Total for Question 10 is 3 marks)

1

Examiner Comments

This student is awarded M1 for a correct method to find length DB or for a correct method to find the length of EB . No more marks are awarded as the method shows the wrong angle M1M0A0

Student exemplar C

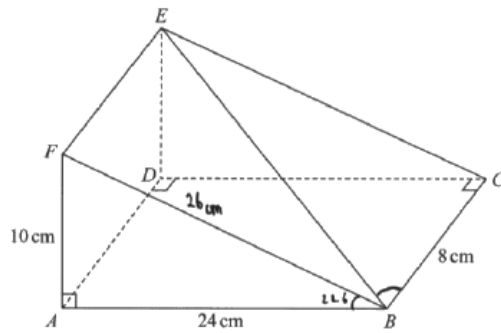


Diagram NOT
accurately drawn

$AF = 10$ cm, $AB = 24$ cm and $BC = 8$ cm.
Angle $FAB =$ angle $ADC =$ angle $BCD = 90^\circ$

Work out the size of the angle between the line BE and the plane $ABCD$. $3^{\circ} 6' 47''$
Give your answer correct to 1 decimal place.

$$\begin{aligned} a^2 + b^2 &= c^2 \\ 10^2 + 24^2 &= c^2 \\ c^2 &= 676 \\ c &= 26 \\ \therefore \text{length } FB &= 26 \end{aligned}$$

$$\begin{aligned} \text{angle } FB &= \tan^{-1} \left(\frac{10}{24} \right) \\ &= 0.416\dots \\ \tan^{-1}(0.416\dots) &= 22.6^\circ \end{aligned}$$

68.3°

(Total for Question 19 is 3 marks) 0

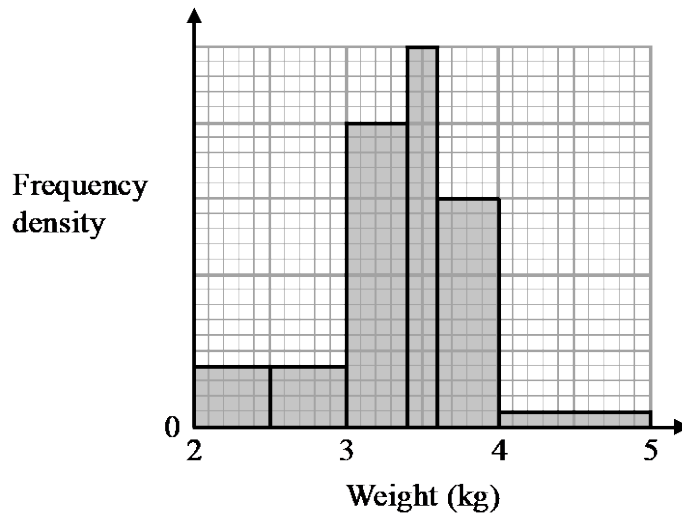
Examiner Comments

This student is not awarded any marks as they have found FB which does not help to find the required angle. They continue by working out angle FBA which is incorrect. M0M0A0

Exemplar Question 9

Higher tier Paper 2H Question 20

The histogram shows information about the birth weights of some babies.



6 of these babies had a birth weight less than 2.5 kg or greater than 4 kg.

Work out the number of babies who had a birth weight between 2.5 kg and 4 kg.

Mean score: 1.26/3

Examiner Comments: This question is from AO3, Statistics. The essence of histograms is to realise the area of the bars is proportional to the frequency, whether by working out the frequency density or by working out an area equivalence, e.g. 5 small squares represent 1 baby.

Students had varying degrees of success with this question, a few apparently misunderstood the question and allocated the 6 students to the first bar, and did not split between first and last, leading to 0 marks. Students often have more success with histograms when they have to start from scratch and draw the complete diagram.

Mark Scheme

Question	Working	Answer	Mark	Notes
20	eg $4 \times 5 + 1 \times 10 = 30$ small squares for 6 babies or $30 \div 6$ or 5 small squares represent 1 baby or height of first bar $= \frac{4}{0.5} (= 8)$ or height of last bar $= \frac{2}{1} (= 2)$ or 1 small square vertically = FD of 2 or 1cm vertically = FD of 10 oe		3	M1 Start working with area being proportional to frequency or show the height of the first or last bar or show a correct scale on the frequency density scale, with no inconsistent values. eg could be awarded by seeing total of little squares $\div 5$ oe
	eg $(4 \times 5 + 20 \times 4 + 25 \times 2 + 15 \times 4) \div 5$ or $4 + 40 \times 0.4 + 50 \times 0.2 + 30 \times 0.4$ or $4 + 16 + 10 + 12$ oe			M1 Fully correct method, allow one error in products but must be the sum of 4 parts
		42		A1
				Total 3 marks

Examiner Comments

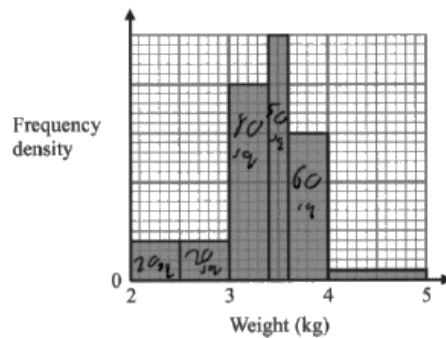
The first method mark can be gained for any method that shows a clear understanding that the student is working with area e.g. by showing 30 small squares = 6 babies or for a correct frequency density of 1 small square vertically = 2 or 1 cm vertically = a frequency density of 10.

For the 2nd method mark, a correct method needed to be seen with one error in products being allowed.

Student exemplar A

20 The histogram shows information about the birth weights of some babies.

2 Q20



6 of these babies had a birth weight less than 2.5 kg or greater than 4 kg.

Work out the number of babies who had a birth weight between 2.5 kg and 4 kg.

$$x = \frac{6}{1.5}$$

$$6 \text{ babies} = 30 \text{ squares}$$

$$0.2 \text{ babies} = 1 \text{ sq}$$

$$\begin{aligned} \text{Between 2.5 kg and 4 kg,} \quad & 20 + 80 + 50 + 30 \text{ squares} \\ & = 180 \text{ squares} \end{aligned}$$

$$\begin{aligned} 180 \text{ babies} &= 180 \times 0.2 \\ &= 36 \end{aligned}$$

36 babies

(Total for Question 20 is 3 marks) **2**

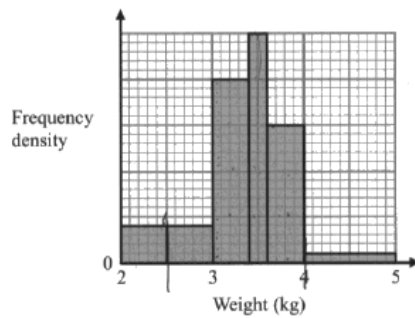
Examiner Comments

This response is awarded M1 for starting to work with area being proportional to frequency – shown in this case by 6 babies = 30 squares. The next M1 is also awarded for a fully correct method to find the number of babies who had a weight between 2.5 kg and 4 kg with just one error – the error being the “30” at the end of the 20+80+50+30 which should have in fact been 60 – but this is the only mistake. A0 as the incorrect answer is given. (M1M1A0)

Student exemplar B

20 The histogram shows information about the birth weights of some babies.

3 Q20



6 of these babies had a birth weight less than 2.5 kg or greater than 4 kg.

Work out the number of babies who had a birth weight between 2.5 kg and 4 kg.

$$4 \times 5 = 20 + 10 = 30$$

$$30 \div 6 = 5 \text{ squares} = 1 \text{ baby}$$

$$20 + 80 + 100 + 60 = 260$$

$$260 \div 5 = 52 \text{ babies}$$

42

(Total for Question 20 is 3 marks) **3**

Examiner Comments

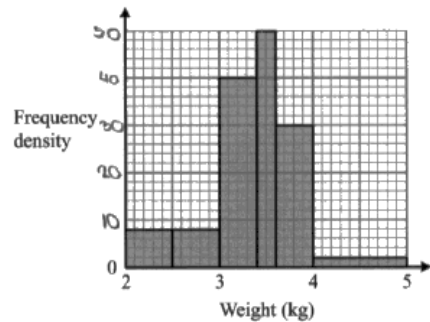
This response is awarded M1 for starting to work with area being proportional to frequency – shown in this case by 5 squares = 1 baby. This is followed by a completely correct method and answer so the student is awarded M1A1 for this.

(M1M1A1)

Student exemplar C

20 The histogram shows information about the birth weights of some babies.

3 Q20



6 of these babies had a birth weight less than 2.5 kg or greater than 4 kg.

Work out the number of babies who had a birth weight between 2.5 kg and 4 kg.

$$\begin{aligned}(0.5 \times 4x) + (1 \times x) &= 6 \\ 2x + x &= 6 \\ 3x &= 6 \\ x &= 2\end{aligned}$$

$$\begin{aligned}(0.5 \times 8) + (0.4 \times 40) + (0.2 \times 50) + \\ (0.4 \times 30) &= 42\end{aligned}$$

(Total for Question 20 is 3 marks) **3**

Examiner Comments

This response is awarded M1 for starting to work with area being proportional to frequency – shown in this case by $x = 2$ or the correct frequency density scale. The student then continues with a correct method and gives the correct answer, so gains M1A1. (M1M1A1)

Exemplar Question 10

Higher tier Paper 2H Question 21abc

- (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$
Show your working clearly.

.....
(2)

- (b) Express $\frac{2}{\sqrt{3}-1}$ in the form $p + \sqrt{q}$

where p and q are integers.
Show your working clearly.

.....
(2)

- (c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x + a)^2 + b$
Show your working clearly.

.....
(2)

(Total for Question 21 is 6 marks)

Mean score: (a) 1.01/2 (b) 0.82/2 (c) 0.71/2

Examiner Comments

These questions examine AO1, Number and Algebra

Part (a) is testing that students know how to simplify surds and must show their working – as their calculators will do all the work for them. Part (b) is testing rationalising the denominator and again, the calculator could do this, so all working must be shown. Part (c) would be more difficult to do on the calculator.

Mark Scheme

Question	Working	Answer	Mark	Notes
21 (a)	$\sqrt{9 \times 5}$ and $\sqrt{4 \times 5}$		2	M1 or for $45 = 3 \times 3 \times 5$ and $20 = 2 \times 2 \times 5$
		$5\sqrt{5}$ shown		A1 dep on M1 cao with sight of $3\sqrt{5} + 2\sqrt{5}$ but we must see where these come from
(b)	$\frac{2}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$ or $\frac{2(\sqrt{3}+1)}{3-1}$ or $\frac{2\sqrt{3}+2}{2}$		2	M1 Rationalise denominator - award for seeing multiplication by $\frac{\sqrt{3}+1}{\sqrt{3}+1}$ or $\frac{-\sqrt{3}-1}{-\sqrt{3}-1}$
oe		$1+\sqrt{3}$		A1 dep on M1
(c)	$(x+3\sqrt{2})^2 - (3\sqrt{2})^2 - 1$		2	M1 or $(x+3\sqrt{2})^2 - 18 - 1$ or for $a = 3\sqrt{2}$ or $b = -19$
		$(x+3\sqrt{2})^2 - 19$		A1
				Total 6 marks

Examiner Comments

As can be seen on the mark schemes for parts (a) and (b), the answer is dependent on a correct method being seen, so students had to show working to gain any marks. For part (c) we allowed a correct answer for full marks (M1A1) or part of the completed square form correct for M1

Student exemplar A

- 21 (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$ 0 Q21c
 Show your working clearly.

$$\begin{aligned} \sqrt{45} + \sqrt{20} &= 3\sqrt{5} + 2\sqrt{5} \\ &= 5\sqrt{5} \end{aligned}$$

- (b) Express $\frac{2}{\sqrt{3}-1}$ in the form $p + \sqrt{q}$ (2) 2 Q21c
 where p and q are integers.
 Show your working clearly.

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

$$= \frac{2\sqrt{3}+2}{3-1}$$

$$= \frac{2\sqrt{3}+2}{2}$$

$$= 1 + \sqrt{3}$$

(2)

- (c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x+a)^2 + b$ 2 Q21c
 Show your working clearly.

$$x^2 + 6\sqrt{2}x - 1$$

$$= (x + 3\sqrt{2})^2 - 18 - 1$$

$$= (x + 3\sqrt{2})^2 - 19$$

$$(x + 3\sqrt{2})^2 - 19$$

(2)

4

Examiner Comments

In part (a) the student has simply written down what the calculator gives for root 45 and root 20 and so gains no marks. (M0A0)

In part (b) the student has clearly shown the multiplication of numerator and denominator by root 3 plus 1 and given a correct answer. (M1A1)

In part (c) the student gives the correct answer. (M1A1)

Student exemplar B

- 21 (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$
Show your working clearly.

2 Q21a

$$\begin{aligned} & \sqrt{9 \times 5} + \sqrt{4 \times 5} \\ &= 3\sqrt{5} + 2\sqrt{5} \\ 3+2=5 \text{ so } &= 5\sqrt{5} \end{aligned}$$

- (b) Express $\frac{2}{\sqrt{3}-1}$ in the form $p + \sqrt{q}$
where p and q are integers.
Show your working clearly.

(2)
0 Q21b

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

$$\frac{1 + \sqrt{3}}{(2)}$$

- (c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x + a)^2 + b$
Show your working clearly.

1 Q21c

$$\begin{aligned} & (x + 3\sqrt{2})^2 - 6 - 1 \\ & (x + 3\sqrt{2})^2 - 7 \end{aligned}$$

$$\frac{(x + 3\sqrt{2})^2 - 7}{(2)}$$

(Total for Question 21 is 6 marks) **3**

Examiner Comments

In part (a) the student has clearly shown how root 45 is the same as root of 9×5 and root 20 is root 4×5 and so gains M1. The answer is also correct so the A1 is awarded. (M1A1)

Part (b) shows multiplication of numerator and denominator by root 3 and while the student gives the correct answer, this does not come from correct working. No marks are awarded. (M0A0)

In part (c) the student gives the value of a correctly as $3\sqrt{2}$ but gives the incorrect value for b . (M1A0)

Student exemplar C

- 21 (a) Show that $\sqrt{45} + \sqrt{20} = 5\sqrt{5}$
Show your working clearly.

~~$$4\sqrt{5} + 4\sqrt{5}$$~~
~~$$3\sqrt{5} + 2\sqrt{5}$$~~

$$\sqrt{45} + \sqrt{20}$$

$$\rightarrow 3\sqrt{5} + 2\sqrt{5} = 5\sqrt{5}$$

0 Q21a

- (b) Express $\frac{2}{\sqrt{3}-1}$ in the form $p + \sqrt{q}$
where p and q are integers.
Show your working clearly.

$$\frac{2}{\sqrt{3}-1} \rightarrow \frac{2+(-1)}{1} + \sqrt{3}$$

(2)
0 Q21b

- (c) Express $x^2 + 6\sqrt{2}x - 1$ in the form $(x+a)^2 + b$
Show your working clearly.

$$x^2 + 6\sqrt{2}x - 1 = 0$$
~~$$6\sqrt{2}x - 1 = 0 - x^2$$~~

$$\frac{1+\sqrt{3}}{(2)}$$

0 Q21c

(2)

(Total for Question 21 is 6 marks) **0**

Examiner Comments

No marks are awarded in part (a) as the calculator writes root 45 and root 20 as 3 root 5 and 2 root 5 as would be given on the calculator. (M0A0)

No marks are awarded in part (b) as the student does not show a correct method to rationalise the denominator. Although we see a correct answer it gains M0A0 as no correct working is shown. (M0A0)

For part (c) no marks are awarded as the student makes no progress. (M0A0)

Exemplar Question 11

Higher tier Paper 2H Question 22

22

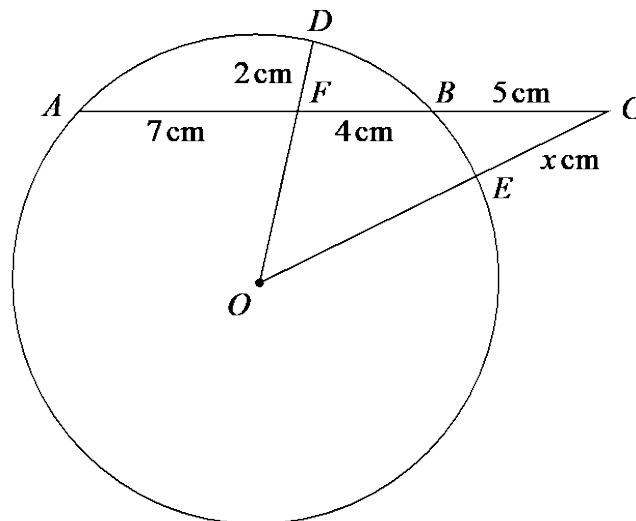


Diagram **NOT**
accurately drawn

A , D , B and E are points on a circle, centre O .
 $AFBC$, OEC and OFD are straight lines.

$AF = 7$ cm, $FB = 4$ cm, $BC = 5$ cm, $FD = 2$ cm and $CE = x$ cm.

Work out the value of x .
Show your working clearly.

Mean score 0.42/6

Examiner Comments

This question was set at the highest level and is part of AO2, Shape, Space and Measure.

It was testing the intersecting chord theorem in a problem situation. A common misconception for some students was to treat the centre of the circle as if it was a point on the circumference, giving radius = 16 cm which was incorrect. There were a good number of blank responses and then those that tried all sorts of different approaches such as trigonometry, Pythagoras or just adding lengths together. Students who were not targeting

Mark Scheme

Incorrect working giving the radius as 16 cm gains M0A0				
Question	Working	Answer	Mark	Notes
22	$7 \times 4 = 2(2r - 2)$ or $7 \times 4 = 2(d - 2)$		6	M1 Or a correct equation in r eg $5.5^2 - 1.5^2 = 4r - 4$
	$r = 8$ or $d = 16$			A1
	$5 \times (5 + 4 + 7) = x \times (2 \times "8" + x)$			M1 Accept $5 \times 16 = x(2r + x)$
	$x^2 + 16x - 80 (= 0)$			A1
	$(x - 4)(x + 20) (= 0)$ $\frac{-16 \pm \sqrt{16^2 - 4 \times 1 \times (-80)}}{2 \times 1}$ or $\frac{-16 \pm \sqrt{576}}{2}$			M1 Correct factors or evidence of correct use of quadratic formula.
		4		A1 dep on first 2 method marks
				Total 6 marks

Examiner Comments

There are 6 marks to be awarded here and few students made good progress. A few were able to gain M1A1 for a correct radius (or diameter) but then failed to continue correctly; however those who had a good knowledge of intersecting chord theorems and drew a line from the centre to the circumference were often able to get full marks. However, the number of students gaining marks was low as shown by the mean of 0.42 marks out of 6

Student exemplar A

22

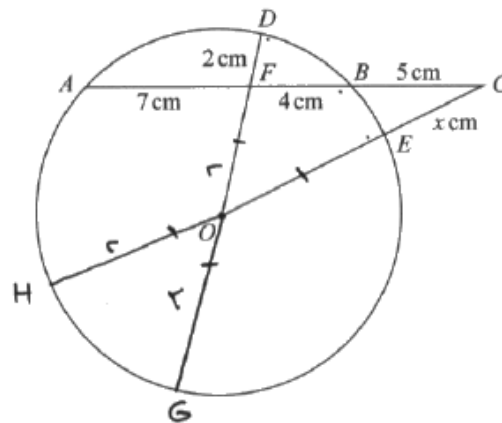


Diagram NOT accurately drawn

6 Q22

A, D, B and E are points on a circle, centre O .
 $AFBC, OEC$ and OFD are straight lines.

$AF = 7\text{ cm}, FB = 4\text{ cm}, BC = 5\text{ cm}, FD = 2\text{ cm}$ and $CE = x\text{ cm}$.

Work out the value of x .
 Show your working clearly.

$$AF \cdot BF = DF \cdot GF \quad GF = 2r - 2$$

$$7 \times 4 = 2 \times GF$$

$$14 = GF$$

$$2r - 2 = GF$$

$$2r - 2 = 14$$

$$2r = 16$$

$$r = 8$$

$$AC \cdot BC = HC \cdot EC$$

$$16 \times 5 = (2r + x) \cdot x$$

$$16 \times 5 = (16 + x) \cdot x$$

$$80 = x^2 + 16x$$

$$0 = x^2 + 16x - 80$$

$$0 = x^2 + 20x - 4x - 80$$

$$0 = x(x + 20) - 4(x + 20)$$

$$(x - 4)(x + 20) = 0$$

$$x = 4 \text{ or } -20$$

$$HC = 16 + x$$

$$16 + (-20) < 0$$

$$\therefore x = 4$$

$$x = 4$$

Total for Question 22 is 6 marks **6**

Examiner Comments

This response shows clear correct working throughout and is awarded full marks. The student shows us they clearly know about intersecting chord theorem and has correctly extended line DFO to the circumference, and shown they are using the correct theorem throughout. (M1A1M1A1M1A1)

Student exemplar B

2

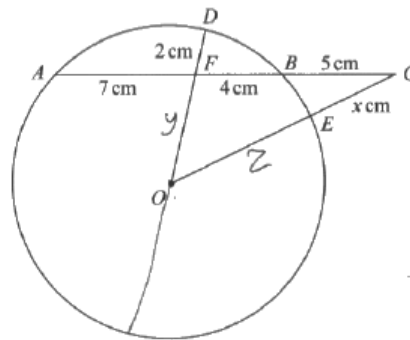


Diagram NOT
accurately drawn

0 Q22

A, D, B and E are points on a circle, centre O .
 $AFBC, OEC$ and OFD are straight lines.

$AF = 7\text{ cm}, FB = 4\text{ cm}, BC = 5\text{ cm}, FD = 2\text{ cm}$ and $CE = x\text{ cm}$.

Work out the value of x .
Show your working clearly.

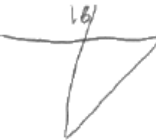
let $FO = y$

$$5 \times 11 = x \times 2$$

$$55 = x \times 2$$

$$\begin{aligned} \text{Diameter} &= 2 \times (2 + y) \\ &= 4 + 2y \end{aligned}$$

$$5 \times 11 = x \times (2 + y)$$



$$x = 3 \text{ cm}$$

(Total for Question 22 is 6 marks) **0**

Examiner Comments

This response shows incorrect working and gains no marks. The student has incorrectly stated that $OE = 2$ and used this in their working. No progress on finding the radius or diameter has been made. (M0A0M0A0M0A0)

Student exemplar C

22

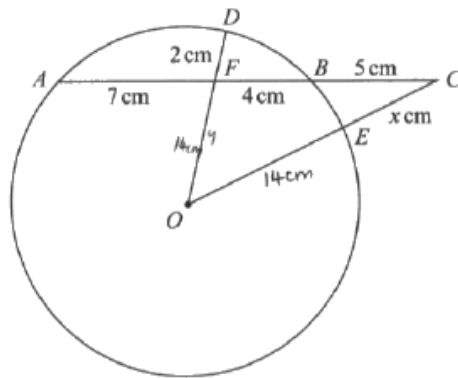


Diagram NOT accurately drawn

0 Q22

A, D, B and E are points on a circle, centre O .
 $AFBC, OEC$ and OFD are straight lines.

$AF = 7$ cm, $FB = 4$ cm, $BC = 5$ cm, $FD = 2$ cm and $CE = x$ cm.

Work out the value of x .
 Show your working clearly.

$$\cancel{7 \times 9} = \cancel{2 \times y}$$

$$\frac{7 \times 9}{2} = y$$

$$y =$$

$$7 \times 4 = 2 \times y$$

$$\frac{7 \times 4}{2} = y$$

$$y = 14$$

$$FC \times BC = OC \times EC$$

$$9 \times 5 = \cancel{14} \times x$$

$$45 = x(14 + x)$$

$$45 = 14x + x^2$$

$$x^2 + 14x - 45 = 0$$

$$\cancel{x} \quad x = -7 + \sqrt{94}$$

$$x = -7 + \sqrt{94}$$

(Total for Question 22 is 6 marks) 0

Examiner Comments

This response shows incorrect working and gains no marks. The student's first statement shows they have not remembered the intersecting chord theorem correctly. It was one of many students who tried spurious attempts but gained no marks. (M0A0M0A0M0A0)

Exemplar Question 12

Higher tier Paper 2H Question 23

- 23 The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

Find the sum of the first 30 terms of this series.

.....
(Total for Question 23 is 5 marks)

Mean score: 1.1/5

Examiner Comments

The problem with this question on arithmetic series was that no actual sum of 48 terms or 36 terms was given and the question therefore became algebraic in its solution. However, students could, and often did, pick up marks for correctly substituting in the correct expression for the sum of 48 or 36 terms or an arithmetic sequence; it was pleasing to see so many students doing this. It was also worrying how many students copied the sum of the series incorrectly from the formula page.

Mark Scheme

23	$\frac{48}{2}(2a+(48-1)d)$ or $\frac{36}{2}(2a+(36-1)d)$ oe		5	M1	For a correct expression for the first 48 terms or the first 36 terms
	$\frac{48}{2}(2a+(48-1)d)=4 \times \frac{36}{2}(2a+(36-1)d)$ oe			M1	For a correct equation.
	$96a + 1392d = 0$ oe eg $4a + 58d = 0$, $2a + 29d = 0$ or $a = -14.5d$ etc			M1	
	$\frac{30}{2}(2a+(30-1)d)$			M1	Indep Allow substitution of any 'found' values of a and d
		0		A1	
					Total 5 marks

Examiner Comments

A pleasing number of students picked up the first method mark for the correct substitution into the formula for 48 or 36 terms. Fewer were able to write a correct equation with a common mistake being to multiply the wrong formula by 4 – however there were a number of correct equations and few gaining any more marks as they did not seem to realise what to do next. Those who were able to find a in terms of d or similar, often completed the solution and gave a correct answer.

Student exemplar A

- 23 The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

2 Q23

Find the sum of the first 30 terms of this series.

$$\frac{48}{2} (2a + (n-1)d) = 4 \left(\frac{36}{2} (2a + (n-1)d) \right)$$

~~$$24(2a + (n-1)d) = 72(2a + (n-1)d)$$~~

~~$$72 - 24 \cdot 48$$~~

$$24(2a + 47d) = 72(2a + 35d)$$

$$48a + 1128d = 144a + 2520d$$

$$\frac{144}{48} = 3$$

$$S_{48} = 4(S_{36})$$

$$a = 3$$

$$48 - 36 = 12$$

$$36 \text{ to } 48 = 3 \times 1 \text{ to } 48$$

Examiner Comments

This student gains M1 for a correct substitution into the formula for the sum of either 48 terms or 36 terms. The next M1 is awarded for a correct equation. No more marks are awarded as the student shows some incorrect working and gets a value for a.

(M1M1M0M0A0)

Student exemplar B

- 23 The sum of the first 48 terms of an arithmetic series is 4 times the sum of the first 36 terms of the same series.

3 Q2:

Find the sum of the first 30 terms of this series.

$$S_n = \frac{n}{2} [2a + (n-1)d]$$

$$S_{48} = \frac{48}{2} [2a + (48-1)d] = 4 \left(\frac{36}{2} [2a + (36-1)d] \right)$$

$$24 [2a + 47d] = 4 (18 [2a + 35d])$$

$$48a + 1128d = 4 (36a + 630d)$$

$$48a + 1128d = 144a + 2520d$$

$$-96a = 1392d$$

$$1392d + 96a = 0$$

(Total for Question 23 is 5 marks) **3**

Examiner Comments

This student gains M1 for a correct substitution into the formula for the sum of either 48 terms or 36 terms. The next M1 is awarded for a correct equation. The student gains another M1 for a correct simplified equation. No more marks are awarded as the student does not show the formula for the sum of 30 terms.

(M1M1M1M0A0)

Student exemplar C

Find the sum of the first 30 terms of this series.

$$\begin{aligned} & \frac{48}{2} [2a + (48-1)d] \\ & = 24 [2a + 47d] \\ & = 48a + 1128d \\ & \frac{36}{2} [2a + (36-1)d] \\ & = 18 [2a + 35d] \\ & = 36a + 630d \end{aligned}$$

(Total for Question 23 is 5 marks) **1**

Examiner Comments

This response gains M1 for a correct substitution into the formula for either 48 terms or for 36 terms. No equation is formed and no more correct working is given so no more marks (M1M0M0M0A0)