GCSE Maths: Answers and commentaries

Higher Tier – Paper 2

A closer look at the live questions from summer 2022

v1.0

Contents

Help prepare your GCSE Maths students with confidence

Every year in GCSE Maths exams, students often misread, misunderstand or misinterpret questions and don't always do what the question is asking them to do.

This booklet has been designed by our curriculum experts for you to use with your students to explore real responses. Inside you'll find best practice approaches, example responses, examiner commentaries and tips on how to access more marks.

Higher Tier – Paper 2

Question 5

5   Solve $5(2x - 1) = 6x + 9$

[3 marks]

$x =$ _____

5   Solve $5(2x - 1) = 6x + 9$

[3 marks]

$$10x - 5 = 6x + 9$$

$$10x = 6x + 14$$

$$4x = 14$$

$$x = \frac{14}{4}$$

$$x = 3.5$$

$x =$ _____ 3.5 _____

Commentary

This is a very well set out solution. It's clearly written and each line shows one step of the process until the value of x is calculated. The chosen answer is then clearly written on the answer line.

3 marks

Question 5, response 2

5   Solve $5(2x - 1) = 6x + 9$

[3 marks]

$$5(2x - 1) = 6x + 9$$
$$10x - 5 = 6x + 9$$
$$10x - 6x = 4x$$
$$5 + 9 = 14$$
$$4x = 14$$
$$x = 0.285714$$

$$5(2x - 1) = 6x + 9$$
$$10x - 5 = 6x + 9$$
$$10x + 6x = 16x$$
$$-5 + 9 = 4$$
$$16x = 4$$
$$x = \frac{16}{4} \frac{4}{16} \to 0.25$$

$x =$ __0.29__

Commentary

This solution is correct until the last line when the division is the wrong way round. If the student had shown the last calculation, then this error might have been avoided.

2 marks (M1,M1,A0)

5   Solve $5(2x - 1) = 6x + 9$

[3 marks]

$$5(2x-1) = 6x+9$$

$$10x - 1 = 6x + 9$$

$$10x = 6x + 10 \quad {}^{+1}$$
$$ {}_{-6x}$$

$$4x = 10 \quad {}_{\div 4}$$

$$x = 2.5$$

$x =$ 2.5

Commentary

This student has made an error when expanding the bracket. However, their method from that point on is correct. The follow through mark can be awarded.

2 marks (M0,M1,A1ft)

Question 5, response 4

5   Solve $5(2x - 1) = 6x + 9$

[3 marks]

$$5(2x - 1) = 6x + 9$$
$$10x - 5 = 6x + 9$$
$$+5 \qquad +5$$
$$10x = 6x + 14$$
$$\div 10 \qquad \div 10$$
$$x = 0.6 + 1.4$$
$$x = 2$$

x = __2__

Commentary

This student has expanded the brackets correctly. Unfortunately, they are then unable to solve the equation. This is a skill which should be practised as it will always be assessed at GCSE.

1 mark (M1,M0,A0)

Question 7

7 Sam types a constant number of words per minute.

He takes 8 minutes to type a report of 416 words.

How long does it take him to type an essay of 1534 words?

Give your answer in minutes and seconds.

[3 marks]

_____

_____

_____

_____

_____

Answer _____ minutes _____ seconds

Question 7, response 1

7   Sam types a constant number of words per minute.

He takes 8 minutes to type a report of 416 words.

How long does it take him to type an essay of 1534 words?

Give your answer in minutes and seconds.

[3 marks]

$$1534 \div 416 = 3.68$$

$$8 \; min = 8 \times 60 = 480 \; seconds$$

$$416 \div 480 = 0.86$$

$$480 \div 416 = 1.153$$

$$1534 \div 1.153 = 1330.44 \; seconds$$

$$1330.44 \div 60 = 22.174$$

Answer _____22_____ minutes _____17_____ seconds

Commentary

This student's first four lines are all useful calculations, each of which could be used to solve the problem. However, the calculation on the fifth line is not useful for solving this problem. This student's first line calculates how many times longer the essay will take than the report. They could have simply multiplied this result by 8 to get the required answer.

1 mark (M1,M0,A0)

7   Sam types a constant number of words per minute.

He takes 8 minutes to type a report of 416 words.

How long does it take him to type an essay of 1534 words?

Give your answer in minutes and seconds.

[3 marks]

$$\begin{array}{c} 8 \quad : \quad 416 \\ 29\cdot5 \,:\, 1534 \end{array} \Big) \times 3.6875$$

8m   416w

m ⊃ wℓ   8 ⊃ 416

480 ⊃ 416 x K

1770

Answer   29   minutes   50   seconds

Commentary

This student has correctly calculated the length of time required for the essay. However, they have incorrectly converted 0.5 minutes into seconds.

2 marks (M1,M1,A0)

Question 7, response 3

7   Sam types a constant number of words per minute.

He takes 8 minutes to type a report of 416 words.

How long does it take him to type an essay of 1534 words?

Give your answer in minutes and seconds.

[3 marks]

$$\frac{416}{8} = 52 \qquad 52 \text{ words/min}$$

$$\frac{1534}{52} = 29.5$$

Answer __29__ minutes __30__ seconds

Commentary

This is a very well set out solution, clearly explaining the significance of the calculation 416 ÷ 8.

3 marks

Question 8

8 A school play takes place each day from Monday to Friday.

Here are the attendances on four of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

For all **five** days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

Answer _____

Question 8, response 1

8   A school play takes place each day from Monday to Friday.

Here are the attendances on four of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

For all **five** days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

72   83   88   97   ~~75~~

~~69~~   83

$9\sqrt{} =$ ~~78~~   84

~~84~~

110   ~~90~~

~~96~~

~~104~~

Answer   110

Commentary

This student has adopted a poor method which appears to be a type of trial and improvement. However, it clearly states the correct answer, and there is no evidence of any incorrect work leading to it. Therefore, this answer can be awarded full marks. This is a risky approach which is not recommended.

3 marks

8   A school play takes place each day from Monday to Friday.

Here are the attendances on four of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

For all **five** days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

$$\frac{72+83+88+97+x}{5} = 90$$

$$\frac{340+x}{5} = 90 \qquad 340+x = 90 \times 5$$

$$= \cancel{48}\,450$$

$$\cancel{68}\,450 - 340 = x$$

$$x = 110$$

Answer _____ 110 _____

Commentary

This student has adopted an algebraic approach. They have let the required value be x, and then formed an equation which they have carefully solved.

3 marks

Question 8, response 3

8   A school play takes place each day from Monday to Friday.

Here are the attendances on four of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

For all **five** days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

$72 + 83 + 88 + 97 = 340$

$340 \div 4 = 85$

$340 + 110 = 450$

$90 \times 5 = 490$

$450 - 340 = 110$

Answer _____ 110

Commentary

This student has started to calculate the average of the first four days, but then abandoned this method. Instead, they have then calculated the total of the first four days and then worked out how many extra are required on Friday.

3 marks

8   A school play takes place each day from Monday to Friday.
     Here are the attendances on (four) of the days.

Monday	Tuesday	Wednesday	Thursday
72	83	88	97

For all **five** days, the mean attendance is 90

Work out the attendance on Friday.

[3 marks]

$$\frac{72+83+88+97}{4} = 85$$

$$90 - 85 = 5$$

$$\frac{total}{amount} = mean$$

Answer _____

Commentary

This student has correctly calculated the average of the first four days, and then worked out how much needs to be added to that average to get the required average. This is the start of a valid method, but this student was unsure of how to proceed.

1 mark (M1,M0,A0)

Question 11

11 A shape is made by joining a right-angled triangle to a rectangle.
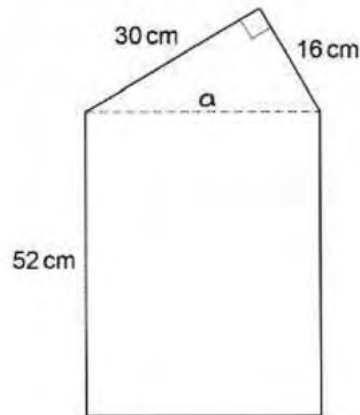
Not drawn accurately

30 cm

16 cm

52 cm
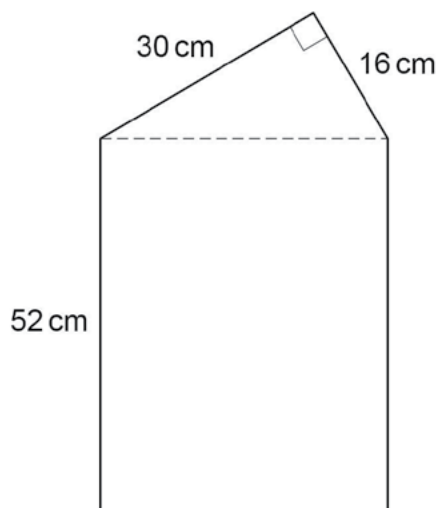
Work out the area of the shape.

[5 marks]

Answer _____ cm^2

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm

Not drawn
accurately

a

52 cm

Work out the area of the shape.

[5 marks]

$$a^2 = (30^2 - 16^2)$$

$$(30^2 - 16^2) = 644 \qquad \sqrt{644} = a$$
$$= 25.38.$$

$$\triangle = \frac{1}{2}(16 \times 25.38) -$$
$$= 203.04$$

$$\square = 52 \times 25.38$$
$$= 1319.76$$

$$1319.76 + 203.04 = 1522.8$$

Answer _____ 1522.80 _____ cm²

Commentary

This student has sensibly labelled the diagram to clarify which side they are referring to. Unfortunately, they have treated the 30 cm side as the hypotenuse of the triangle. However, they correctly use their value of *a* to find the area of the rectangle.

2 marks (M1,M0,M1,M0,A0)

Question 11, response 2

11   A shape is made by joining a right-angled triangle to a rectangle.
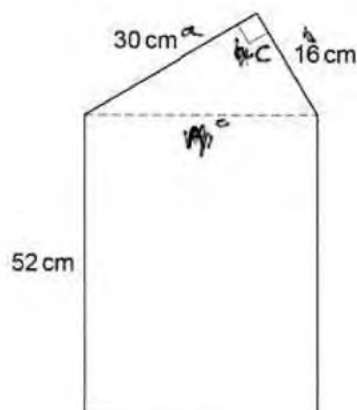
30 cm

16 cm

Not drawn accurately

52 cm

Work out the area of the shape.

[5 marks]

$\frac{1}{2} ab \sin C$

$\frac{1}{2} \times 30 \times 16 \times \sin 90$

$30^2 + 16^2 = c^2$

$900 + 256 = 1156$

$\sqrt{1156} = 34$

$\frac{1}{2} \times 30 \times 16 \times \sin 90 = 214.55 \text{ to } 2 \text{ dp}$

$52 \times 34 = 1768 \text{ cm}^2$

$1768 + 214.55 = 1982.55 \text{ cm}^2$

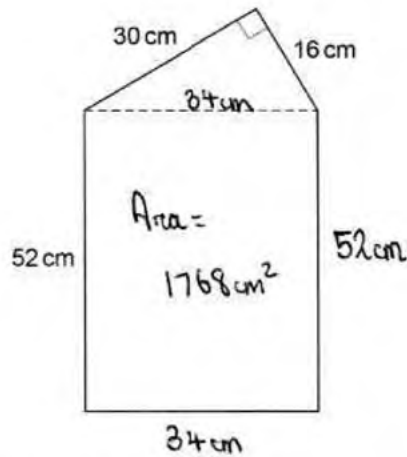Answer 1982.55   cm²

Commentary

This student has correctly calculated the hypotenuse of the triangle. They also correctly calculate the area of the rectangle. Their method for calculating the area of the triangle is correct, although they unnecessarily use the formula ½*ab*sin C. Unfortunately, their calculator must have been in the wrong angle mode as their triangle area is incorrect.

4 marks (M1,M1,M1,M1,A0)

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm   Not drawn accurately

34 um

Ara = 1768 cm²

52 cm   52 cm

34 cm

Work out the area of the shape.

[5 marks]

30² = 900

16² = 256

√(900 + 256) = 34 cm

Ara of rectangle = 52 × 34 = 1768 cm²

Area of triangle = $\frac{34 \times 16}{2}$ = 272 cm²

2040 cm²

Answer _____ 2040 _____ cm²

Commentary

This student's work is very clearly set out. They correctly calculated the hypotenuse of the triangle and then the area of the rectangle. However, their method for the area of the triangle is incorrect as they calculate ½ × 34 × 16 instead of ½ × 30 × 16.

3 marks (M1,M1,M1,M0,A0)

Question 11, response 4

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm

Not drawn accurately

34 cm

52 cm
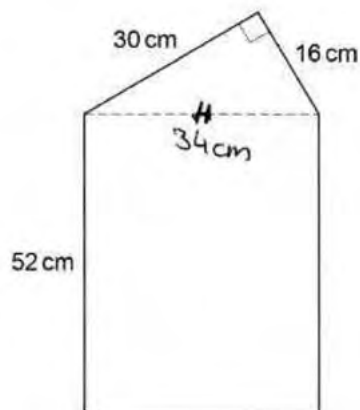
Work out the area of the shape.

[5 marks]

$$30^2 + 16^2 = x^2$$
$$900 + 256 = x^2$$
$$1,156 = x^2$$
$$\sqrt{1,156} = x$$
$$34 = x$$

triangle $= \frac{1}{2} \times 30 \times 16 = 31 \text{cm}^2$

rectangle $= 52 \times 34 = 1,768 \text{cm}^2$

$$1,768 + 31 = 1,799 \text{cm}^2$$

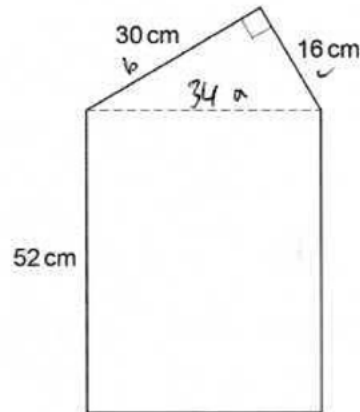Answer   1,799   cm^2

Commentary

This student has shown their fully correct method very clearly. The error ($\frac{1}{2} \times 30 \times 16 = 31$) is easy for the examiner to find and so just the A mark is lost.

4 marks (M1,M1,M1,M1,A0)

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm
16 cm

Not drawn
accurately

34 a

52 cm

Work out the area of the shape.

[5 marks]

$$a^2 = b^2 + C^2$$

$$900 + 256 = 1156$$

$$\sqrt{1156} = 34$$

$$52 \times 34 = 1768 \, cm^2$$

Answer _____ cm²

Commentary

This student seems unsure of how to complete the question. However, instead of leaving the response space empty, they have calculated as much as possible. Their methods for finding the length of the hypotenuse and then the area of the rectangle are completely correct.

3 marks (M1,M1,M1,M0,A0)

Question 11, response 6

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   Hyp

16 cm   Adj

Not drawn
accurately

52 cm
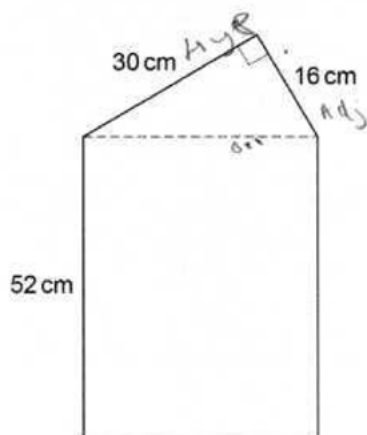
Work out the area of the shape.

[5 marks]

Area of triangle = B x H ÷ 2
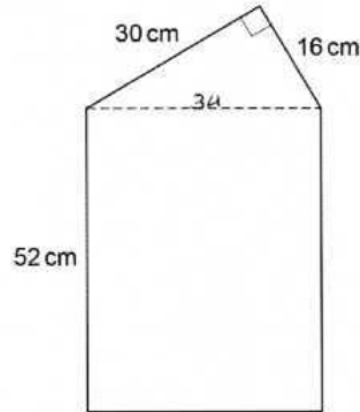   30 x 16 ÷ 2 = 240

Answer _____ cm²

Commentary

This student mislabels the sides of the triangle, but their calculation for its area is correct.

1 mark (M0,M0,M0,M1,A0)

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm   Not drawn accurately

34

52 cm

Work out the area of the shape.

[5 marks]

$16^2 + 30^2 = x^2 = 1156$ $\sqrt{1156} = 34$

$52 \times 34 =$ area of the rectangle $=$ ~~168~~ 1168

$30 \times 16 = 480/2 =$ area of triangle $= 480$

$1168 + 480 = 1648$

Answer ___1648___ cm²

Commentary
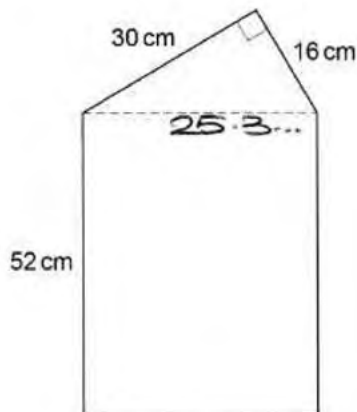
This student's method is a little unclear but completely correct.

There are two arithmetical errors: 52 × 34 = 1168 and 480 ÷ 2 = 480.

4 marks (M1,M1,M1,M1,A0)

Question 11, response 8

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm

Not drawn accurately

25.3...

52 cm

Work out the area of the shape.

[5 marks]

puthooprus = a²+b² = c²

30² - 16² = 644   √644 = 25.37715508

52 × 25.3.. = 1319.612064

1319.6 (1dp)

Answer ___1319.6___ cm²

Commentary

This student has clearly used Pythagoras' theorem, but has unfortunately treated the 30 cm side as the hypotenuse. They then use the width of the rectangle to find its area, but neglect to include the area of the triangle.

2 marks (M1,M0,M1,M0,A0)

11   A shape is made by joining a right-angled triangle to a rectangle.

30 cm   16 cm

Not drawn
accurately

6·34

52 cm

52

34
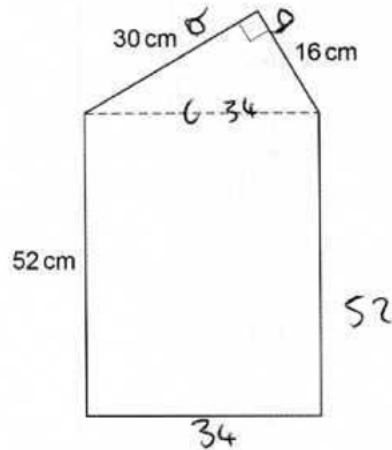
Work out the area of the shape.

[5 marks]

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

$30^2 + 16^2 = c^2$

$1156 = c^2$

$\sqrt{1156} = c^2$

$c^2 = 34$

30cm ✱ 16cm = 46cm

46 ÷ 2 = 23cm²

$52 + 34 + 52 + 34 = 172cm² + 23cm = 195cm²$

Answer _____ 195 _____ cm²

Commentary

This student has correctly calculated the perimeter of the rectangle.

They have also calculated ½ × (30+16). Neither of these are valid calculations in this question.

However, their method includes a correct calculation for the rectangle width, so they can be awarded the method marks for this.

2 marks (M1,M1,M0,M0,A0)

Question 13(a)

13 Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.
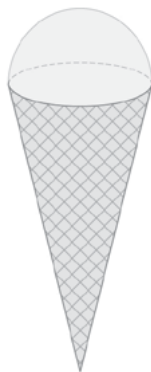
The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone $= \dfrac{1}{3}\pi r^2 h$
r is the radius
h is the perpendicular height

Volume of a hemisphere $= \dfrac{2}{3}\pi r^3$
r is the radius

13 (a) Work out the total volume of the cornet.

[4 marks]

Answer _____ cm^3

13   Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$	Volume of a hemisphere = $\frac{2}{3}\pi r^3$
r is the radius	r is the radius
h is the perpendicular height	

13   (a)   Work out the total volume of the cornet.

[4 marks]

$$70572.7\dot{3}$$
$$28952.9174$$
$$99525.65527$$

Answer 99525.65527 cm³

Commentary

This student has not shown their method, but their answer is within the acceptable range.

4 marks

Question 13(a), response 2

13 Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$

r is the radius

h is the perpendicular height

Volume of a hemisphere = $\frac{2}{3}\pi r^3$

r is the radius

13 (a) Work out the total volume of the cornet.

[4 marks]

$$\frac{1}{3} + \pi - 24^2 + 117 \quad \text{cone}$$

$$\frac{1}{3} + \pi + 24^2 - 117 = 485.183$$

$$\frac{2}{3} + \pi + 24^3 = 9216\pi$$

$$\frac{1}{3} + \pi + 24^2 + 117 = 220.187$$

Answer 9935.185 cm³

Commentary

This student's response is difficult to read. They have written + signs instead of × signs.

However, one of their calculated areas, 9216π, is correct, so the first two marks can be awarded.

2 marks (M1,A1,M0,A0)

13   Outside a cafe there is a large plastic ice cream cornet.
      The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$	Volume of a hemisphere = $\frac{2}{3}\pi r^3$
r is the radius	r is the radius
h is the perpendicular height	

13 (a)   Work out the total volume of the cornet.

[4 marks]

$\frac{1}{3}\pi 24^2 \, 117$

volume of cone
↓
$\frac{1}{3} \times \pi \times 24^2 \times 117 = 22416\pi$

$22416\pi \div 9216\pi$

$= 4.1632947$

volume of hemisphere

$\frac{2}{3} \times \pi \times 24^3 = 9216\pi$

Answer   4.10   cm³

Commentary

This student has correctly calculated the volume of each part of the cornet.

Unfortunately, they have then divided their volumes rather than adding them.

2 marks (M1,A1,M0,A0)

Question 13(a), response 4

13 Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$	Volume of a hemisphere = $\frac{2}{3}\pi r^3$
r is the radius	r is the radius
h is the perpendicular height	

13 (a) Work out the total volume of the cornet.

[4 marks]

$$\frac{1}{3} \times \pi \times 24^2 \times 117 = 22467\pi = 70572.74$$

$$\frac{2}{3} \times \pi \times 24^3 = 9216\pi = 28952.92$$

$$22467\pi + 9216\pi = 31683\pi$$

Answer ___31683 π___ cm³

Commentary

This student correctly calculated the hemisphere volume. Their calculation for the cone volume is correct but their answer is incorrect. However, they then show the two volumes being added, so the second method can be awarded.

3 marks (M1,A1,M1,A0)

13 Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$	Volume of a hemisphere = $\frac{2}{3}\pi r^3$
r is the radius	r is the radius
h is the perpendicular height	

13 (a) Work out the total volume of the cornet.

[4 marks]

$$\frac{2}{3} \times \pi \times 24^3 = 9216\pi$$

$$\frac{1}{3} \times \pi \times 24^2 \times 117 = 22464\pi$$

$$9216\pi + 22464\pi =$$
$$31680$$

$$31680\pi = 99525.652$$

Answer 99525.6552 cm³

Commentary

This response is well set out but includes a small error on the fourth line — the π symbol has been omitted. However, the student recovers and calculates the correct answer.

4 marks

Question 13(a), response 6

13   Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$
r is the radius
h is the perpendicular height

Volume of a hemisphere = $\frac{2}{3}\pi r^3$
r is the radius

13 (a)   Work out the total volume of the cornet.

[4 marks]
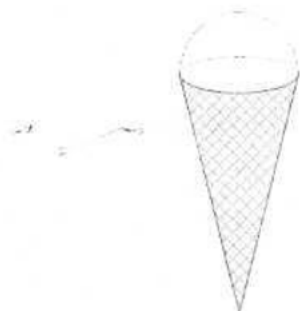
$$cone = \frac{1}{3}\pi \, \overset{24}{\cancel{585}}{}^2 \, 117$$

$$= 70572.73737$$

$$70500$$

$$hemisphere = \frac{2}{3}\pi \, 24^3$$

$$= 28952.9179$$

$$30000$$

$\}$ +

Answer   99525.65526   cm³

Commentary

This student unnecessarily rounds each of their volumes.

However, the correct answer is shown, so the rounding can be ignored.

4 marks

13   Outside a cafe there is a large plastic ice cream cornet.

        The cornet is a hemisphere on top of a cone.

The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone = $\frac{1}{3}\pi r^2 h$

r is the radius

h is the perpendicular height

Volume of a hemisphere = $\frac{2}{3}\pi r^3$

r is the radius

13 (a)   Work out the total volume of the cornet.

                                                        [4 marks]
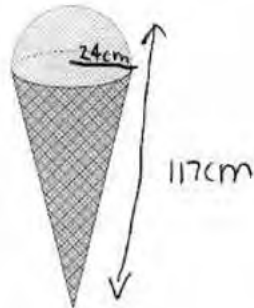
$$\text{Volume of Cone} = \frac{1}{3}\pi r^2 h$$

$$\frac{1}{3}\pi 24^2 \, 117\text{cm} \qquad \text{hemisphere} = \frac{2}{3}\pi r^3$$

$$24^2 = 576$$

$$\frac{1}{3}\pi 576 \times 117\text{cm} \qquad = \frac{2}{3}\pi \times 70572.73^3$$

$$= 22464\pi \qquad\qquad = \frac{2}{3}\pi \times 3.51477$$

$$= 70572.73737 \qquad = 7.361317074$$

$$\qquad\qquad\qquad = \pi \, 86\text{err}^3$$

$$= 70572\text{cm}^3 \qquad = 7.36$$

$$\qquad 70572 + 7.36 = 70579.36\text{cm}^3$$

Answer   ~~7.36~~ 70579   cm³

Commentary

This student has correctly calculated the volume of the cone. However, they then use this volume as the radius when calculating the hemisphere volume.

2 marks (M1,A1,M0,A0)

Question 13(b)

13 (b) The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

Answer _____

13 (b) The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$$\frac{40.8407045}{16.75\ 516082}$$

Answer ~~57,59586532~~ 1225.309091

Commentary

This response is unclear as no method is shown. However, this student is lucky as one of the numbers (40.8407045) is recognised as the volume of the smaller cone. From this we can infer that the linear ratio of 12 must have been calculated. The student should have made this more obvious to be certain of the mark they gain.

1 mark (M1,M0,A0)

Question 13(b), response 2

13 (b) The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$$2 \xrightarrow{\times 12} 24$$

$$9.75 \xleftarrow{\div 12} 117$$

$$\frac{1}{3} \times \pi \times 2^2 \times 9.75$$

$$= 13\pi$$

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

$$= \frac{16}{3}\pi$$

$$13\pi$$

$$= \frac{55}{3}\pi$$

$$= 57.595\,86532 \quad \text{Answer} \quad 1728$$

Commentary

This student has calculated the linear ratio of 12. They have then used this to calculate the volumes of the small cone, small hemisphere, and hence the small cornet. Presumably they have then used this to correctly calculate the volume ratio. They have shown these calculations clearly but, just in case of an error, they should have also shown the final division.

3 marks

13 (b)   The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$$\frac{2}{3} \times \pi \times 2^3 = 16.75516082$$

$$\frac{1}{3} \times \pi \times 2 \times h \qquad 9216\pi \div 16.75516082$$

$$= 1728 \text{ times greater}$$

Answer   *1728*

Commentary

This student has calculated the volume of the small hemisphere and then divided this into the volume of the big hemisphere.

3 marks

Question 13(b), response 4

13 (b) The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$$\frac{1}{3} \times \pi \times 2^2 \times 117 = 156\pi = 490.1$$

$$\frac{2}{3} \times \pi \times 2^3 = 16.8$$

$$16.8 + 490.1 = 506.9$$

$$99525.6 \div 506.9 = 196.3$$

Answer   196.3

Commentary

This student has attempted to calculate the volume of the small cornet. However, they have not reduced the height of the cone.

0 marks

13 **(b)** The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$24 \div 2 = 12$

Plastic is 12 × bigger than the actual cornet

Answer _____ 12 _____

Commentary

This student has only calculated the linear ratio. They should have cubed this number to get the volume ratio.

1 mark (M1,M0,A0)

Question 13(b), response 6

13 (b) The actual cornets that the cafe sells are **similar** to the plastic one.

For the actual cornets, the cone and the hemisphere each have radius 2 cm

How many times greater is the volume of the plastic cornet than an actual cornet?

[3 marks]

$24 \div 2 = 12$

$\times 12$

$LSF^2 = ASF$

$LSF^3 = VSF$

$12^3 = 1728$

$V = 57.59586532 \times 1728 = 31680\pi = 99525..$

Answer _____ 1728

Commentary

This student has used the quick method of cubing the linear ratio to find the volume ratio. They have then checked their answer to see if it works.

3 marks

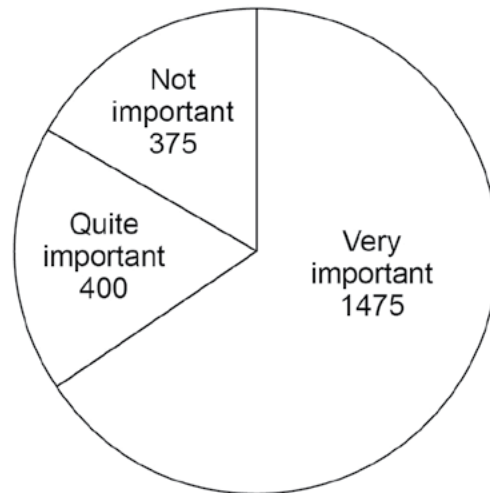**14** A survey was held in a football stadium.

A sample of the crowd was asked about the importance of a family area.

The pie chart represents the answers.

14 (a) The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

Answer _____

Question 14(a), response 1

14 (a) The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

$$1475 + 400 + 375 = 2250$$

$$\frac{1475}{2250} \quad \overset{\times 13}{\frown} \quad \frac{19175}{29250}$$

$$\underset{\times 13}{\smile}$$

Answer _____ 19175 _____

Commentary

This student has calculated the total number of people in the sample. They've then found an equivalent fraction to that represented by 'Very important' in the pie chart, clearly explaining their method.

3 marks

14 (a)   The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

$1475 + 375 + 400 = 2250$

$29250 - 2250 = 27000$

Answer _____

Commentary

This student seems unsure of how to tackle this question. However, they have calculated the total number of people in the survey, and so scored the first mark.

1 mark (M1,M0,A0)

Question 14(a), response 3

14 (a) The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

$375 + 400 + 1475 = 2250$

$\dfrac{1500}{2000} = 0.75$

$30000 \times 0.75 = 22500$

Answer ___22500___

Commentary

This student has misunderstood the 'estimate' instruction. In a statistical context, we use data to make predictions. However, the numbers used should be as accurate as possible. As they have calculated the sample total before approximating the numbers, they can be awarded the first mark.

1 mark (M1,M0,A0)

14 (a) The total number of people in the crowd was 29 250

Estimate how many people in the crowd think that a family area is **very important**.

Assume that the sample is representative of the crowd.

[3 marks]

$$375 +$$
$$400 +$$
$$1475 \quad = 2250 \qquad \frac{1475}{2250} \times 100 = 65.5\%$$

$$29250 \times 0.655 = 19158$$

Answer _____ 19,158 _____

Commentary

This student has used a completely correct method. However, they have used their rounded decimal (0.655) instead of the ANS key on their calculator, which has led to a loss of accuracy in the final answer.

2 marks (M1,M1,A0)

Question 16(b)

16   Amol owns a sandwich shop.

The shop is open from Monday to Saturday.

In June, Amol sold 3000 sandwiches.

16 (a)   Amol wants to work out the mean number of sandwiches he sold per day in June.

His method is $3000 \div 30 = 100$

Make **one** criticism of Amol's method.

[1 mark]

_____

_____

16 (b)   Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

Answer £ _____

16 (b) Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

$$M \qquad C \qquad V$$
$$9 \ : \ 4 \ : \ 7$$
$$2.39 \qquad 1.89 \qquad ?$$
$$+ \qquad\qquad +$$

$$= £6660$$

$$330 \times 2.39 = 788.7 \qquad 9 + 4 + 7 = 20$$
$$330 \times 1.89 = 623.7 \qquad 6660 \div 20 = 330$$
$$788.7 + 623.7 = 1412.84$$
$$1412.4 \div 330 = 4.28$$

Answer £   4.28

Commentary

This student adds the sandwich shares but then divides this into the total money received rather than the total number of sandwiches. This student would need to restart their response in order to score any marks.

0 marks

Question 16(b), response 2

16 (b) Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

1350   600   1050

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

$9 + 4 + 7 = 20$

~~$6660 \div 7/20 = 2331$~~

~~$3000 \div 10 = 150$~~

~~$150 \times 7 = 1050$~~

~~$\dfrac{2331}{1050} = 2.22$~~

$9 + 4 + 7 = 20$

$3000 \div 10 = 150$

$150 \times 7 = 1050$

$(1350 \times 2.39) + (600 \times 1.89)$

$= 4360.5$

$6660 - 4360.5 = 2299.5$

$2299.5 \div 1050 = 2.19$

Answer £   ~~2.22~~   2.19

Commentary

This is a very well set out correct response. If an arithmetic error had been made, an examiner would have been able to award the 3 method marks. The incorrect attempt has been clearly crossed out so that the examiner can see which attempt the student would like to be marked.

4 marks

16 (b) Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

Handwritten working:

£2.39 £1.89 ?

m   c   v
9 : 4 : 7

£1350 : £600 : £1050

1350 ÷ 2.39 = 564.85 35565

1.89 ÷ 4 = 0.4725

0.4725 × 7 = 3.3075

1.858

6660 = 300

3000 ÷ 20 = 150

150 × 7 = £1050
150 × 9 = £1350
150 × 4 = £600

Answer £ _____

Commentary

This student seems unsure of how to tackle this problem question. Their attempt can be awarded the first mark as they correctly divide the total number of sandwiches by the total number of shares in the ratio. Unfortunately, they have divided the number of meat sandwiches by £2.39 instead of multiplying.

1 mark (M1,M0,M0,A0)

Question 16(b), response 4

16 (b) Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

$$m : c : v$$
$$9 : 4 : 7 = 20$$

$$£6660 \div 3000$$
$$= 2.22$$

$$2.39 \times 9$$
$$= £21.51$$

$$£1.89 \times 4$$
$$= £7.56$$

$$\frac{2.39 + 1.89 + x}{3} = 2.22$$

$$£29.07 + 7.56 \times 2.38$$

$$4.28 + x = 6.66$$
$$x = £2.38$$

$$£45.73 \times 150$$

$$1134 + 3226.50$$
$$= 4360.50$$
$$6660 - 4360.5$$
$$= 2299.5 \div 7 \div 150$$
$$\boxed{= £2.19}$$

$$3000 \div 20 = 150$$
$$2.39 \times 150 = £358.5 \times 9 = £3226.5$$
$$1.89 \times 150 \times 4 = £1134$$

Answer £ **2.19**

Commentary

This student is initially unsure of how to tackle this problem. They include some irrelevant calculations on the right-hand side but their final, correct, answer clearly comes from a correct method.

4 marks

16 (b)   Amol received £6660 from selling the 3000 sandwiches in June.

The numbers of sandwiches sold were in the ratio

meat : cheese : vegan = 9 : 4 : 7

The price of a meat sandwich is £2.39

The price of a cheese sandwich is £1.89

Work out the price of a vegan sandwich.

[4 marks]

$$9 \times 2.39 = 21.51 \qquad 9+4+7= 20$$
$$4 \times 1.89 = 7.56 \qquad 6660 \div 20 = 333$$
$$150 \times 21.51 = \qquad 3000$$
$$3226.5 \quad += 4360.5$$
$$150 \times 7.56 = 1134 \qquad 6660 - 4360.5 =$$
$$2299.5$$
$$6660 \div 20 = 333 \qquad 2299.5 \div 7 =$$
$$2299.5 \div 333 = 6.9054 \div 6660$$
$$0.345270 \times 7 = 2.416 \; 891$$

Answer £   £2.42

Commentary

This student has correctly calculated the amount of money spent on meat and cheese sandwiches. However, they then appear to get themselves confused on how to proceed further. Their chosen answer comes from an incorrect method. This student benefits from the marking instruction which allows for the first two method marks to be awarded regardless of the number of attempts.

2 marks (M1,M1,M0,A0)

Question 19

19   *A*, *B*, *C*, *D* and *E* are points on a straight line.
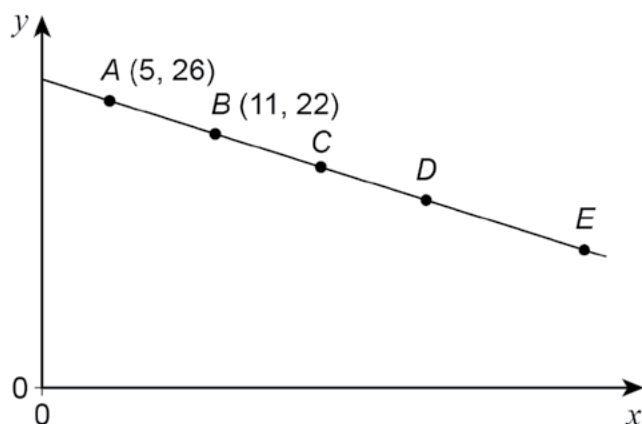
Not drawn accurately

A, *B*, *C* and *D* are equally spaced.

AD : *DE* = 2 : 1

Work out the coordinates of *E*.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

Answer (_____ , _____)

19   A, B, C, D and E are points on a straight line.

Not drawn
accurately

A, B, C and D are equally spaced.

AD : DE = 2 : 1

Work out the coordinates of E.

[3 marks]

11 - 5 = 6

22 - 26 = -4

CD = 17, 18

AD = 17 - 5 18 - 26   D = 23, 14
        12 , -8   23 - 5 = 18

AD = 6, -4   14 - 26 = -12
  2

           AD = 18, -12

D 23, 14 + 9, -6   DE = 9, -6

32, 8

Answer (__32__ , __8__)

Commentary

This student has first calculated the differences between the x-coordinates and the y-coordinates. They have then gradually worked their way along the line until they reached E.

3 marks

Question 19, response 2

19   A, B, C, D and E are points on a straight line.

Not drawn
accurately

A, B, C and D are equally spaced.

$AD : DE = 2 : 1$

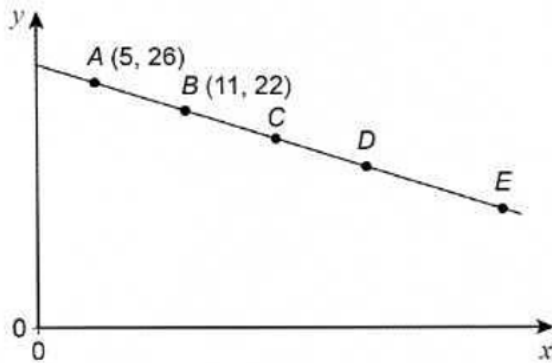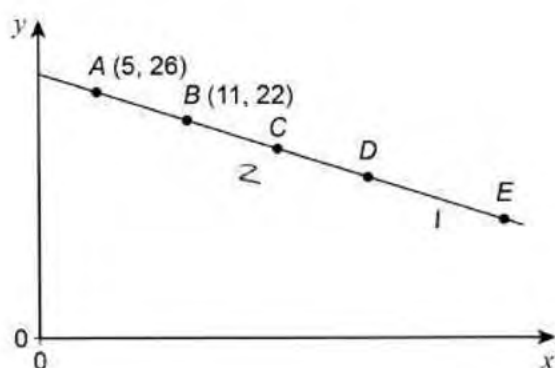Work out the coordinates of E.

[3 marks]

$$\frac{23-5}{2} = 9$$

$(9, 6)$ (16 , 18)

$$\frac{23-14}{2} = 6$$

$5 + 6 = 11$

$11 + 6 = 17$ $E = (28,$

$C = D = (17, 18)$

$D = (23, 14)$

$23 + 5 + 11 + 17 = 56$

$$\frac{56}{2} = 28$$

Answer (___9___ , ___6___)

Commentary

This student has correctly calculated the differences between the x-coordinates and the y-coordinates, but has given the differences as their answer rather than the coordinates. However, they have also found the correct coordinates of points C and D, one of which is sufficient to score the first mark.

1 mark

19 A, B, C, D and E are points on a straight line.
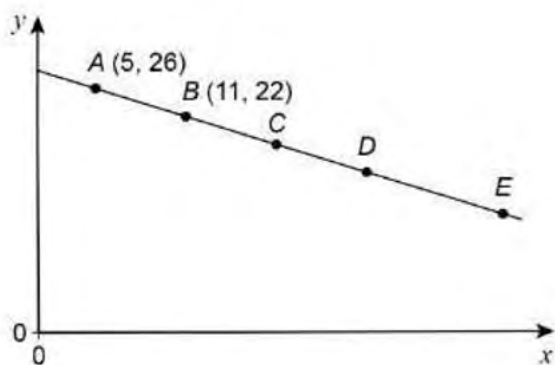
Not drawn
accurately

A, B, C and D are equally spaced.

AD : DE = 2 : 1

Work out the coordinates of E.

[3 marks]

17, 18   23, 14

9, 6

Answer (14 , 8)

Commentary

This student has correctly calculated the y-coordinate of E, but made a mistake when calculating the x-coordinate.

2 marks

Question 20

20   A company makes and sells boxes of washing powder.

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

         increase the price to £5.88

         or

         reduce the mass of powder in the box by x%

Work out the value of x to 2 decimal places.

[4 marks]

$x =$ _____

20 A company makes and sells boxes of washing powder.

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

    increase the price to £5.88

    or

    reduce the mass of powder in the box by x%

Work out the value of x to 2 decimal places.

[4 marks]

$$560 = 100\% \div 100 = 5.60$$
$$588 = ?\% \overset{105}{} \div 100 = 5.88$$
$$588 - 560 = 28$$

$$10\% = 56 \div 100 = 0.56$$
$$5\% = 28 \div 100 = 0.28$$

$x =$ 0.28

Commentary

This student has identified that £5.88 is 105% of £5.60. Unfortunately, they are unsure of how to proceed from this point.

1 mark (M1,M0,M0,A0) because 105% is equivalent to 1.05

Question 20, response 2

20   A company makes and sells boxes of washing powder.

Washing powder
1.68 kg
£5.60

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

increase the price to £5.88

or

reduce the mass of powder in the box by $x\%$

Work out the value of x to 2 decimal places.

[4 marks]

$5.88 \times \frac{35}{42} = £3.5 \, per \, kg \qquad \frac{35}{42}$

$3.5 \qquad\qquad 3.5 \times 1.68 = 5.88$

$£5.88 \; per \; 1.68 \, kg \qquad \overline{5.88} \, 5.6$

$£5.60 \qquad 5.88 \qquad 1.596 + N \times \frac{350}{319} =$

% $|$ 100% $\nearrow^{105}$ 5%

$\times 1.05$

$x =$ _____ 5 _____

Commentary

This is a very disorganised response. They have correctly calculated the scale factor of 1.05 and have also correctly calculated the required cost per kilogram. Unfortunately, they are unsure of how to make any further progress.

1 mark (M1,M0,M0,A0)

20   A company makes and sells boxes of washing powder.

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

increase the price to £5.88

or

reduce the mass of powder in the box by x%

Work out the value of x to 2 decimal places.

[4 marks]

$5.88 \div 1.68 = 3.5$ £3.50 kg

$5.60 \div 1.68 = 3.\dot{3}$

$5.60 \div 1.6 = 3.5$ $0.\dot{0}4\dot{7}6\dot{0}$

$\left.\dfrac{1.68}{1.60}\right\} -0.08$ or $\sim 4.\dot{7}61904\dot{9}$ %

$x =$ 4.76

Commentary

This student has correctly calculated the value of x, but is unable to explain their logic. However, there is no evidence that the correct answer has come from incorrect work, so full marks can be awarded.

4 marks

Question 20, response 4

20   A company makes and sells boxes of washing powder.

Washing
powder
1.68 kg
£5.60

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

increase the price to £5.88

or

reduce the mass of powder in the box by x%

Work out the value of x to 2 decimal places.

[4 marks]

$5.88 - 5.6 = 0.28$ difference
5% increase

3.50 per kg $= 5.88 l$
$5.6 \div 3.5 = 1.6$ 1.68 1.6

$1.68 \times 0.95 = 1.596$

0.952380952 $?$
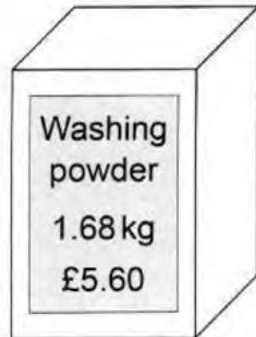
0.047619048 %

$x =$ 5

Commentary

This student correctly calculates the required percentage reduction (written as a decimal). However, they then ignore this and opt for the percentage on the second line. Fortunately, they benefit from the marking instruction which allows for the first three marks to be awarded regardless of the chosen method or answer.

3 marks (M1,M1,M1,A0)

20 A company makes and sells boxes of washing powder.

Washing powder
1.68 kg
£5.60

The company wants to increase the amount of money it receives **per kg** of powder.

To get the required increase it can

increase the price to £5.88

or

reduce the mass of powder in the box by x%

Work out the value of x to 2 decimal places.

[4 marks]

£5.88 ÷ 1.68 = £3.50 ← per kg when changing the price.

£5.60 ÷ 1.68 = £3.35

£3.35 × 1.05

1.68 × 1.05 = 1.784 kg

5.60 ÷ 1.784

price
mass 2kg

$\frac{5.60}{3.50}$ = 1.6 kg

£5.60 ÷ 1.6 kg = £3.50

$\frac{1.6}{1.68}$ = 0.95

0.95 × 100 = 95

100 − 95 = 5%

$x =$ ___5.00___

Commentary

This student's method is completely correct. Unfortunately, they have rounded the result of the calculation 1.6 ÷ 1.68 and then used the rounded value (0.95) in their remaining calculations. They should have left the result of 0.95 in their calculator, and then used the ANS key instead of retyping 0.95.

3 marks (M1,M1,M1,A0)

Question 24

24 A straight line

is perpendicular to the straight line through (2, 8) and (6, 15)

and

passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks]

$x =$ _____

24   A straight line

      is perpendicular to the straight line through (2, 8) and (6, 15)

      and

      passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks]

$y = mx + c$

$$\frac{7}{4} = 1.75$$

$x =$ 3

Commentary

This student has correctly calculated the gradient of the line through (2, 8) and (6, 15), but doesn't know how to make any further progress. This is a good example that marks can be awarded even if a student does not know how to complete the question.

1 mark (M1, M0, M0, A0)

Question 24, response 2

24   A straight line

  is perpendicular to the straight line through (2, 8) and (6, 15)

  and

  passes through (0, 9) and $(x, 17)$

Work out the value of x.

[4 marks]

$$\text{gradient of straight line} = \frac{15-8}{6-2} = 1.75 = 7/4$$

$$\text{perpendicular gradient} = -\frac{4}{7}$$

$$\frac{17-9}{x-0} = -\frac{4}{7}$$

$$17-9 = -\frac{4}{7}(x-0)$$

$$8 = -\frac{4}{7}(x)$$

$$\frac{8}{(-4/7)} = x$$

$$x = -14$$

$$\frac{17-9}{-14-0} = \frac{8}{-14} = -\frac{4}{7}$$

$x = $ -14

Commentary

This is a very good response. The method is clearly set out, and then the final answer is checked by substituting back into the gradient formula.

4 marks

24   A straight line

      is perpendicular to the straight line through (2, 8) and (6, 15)

      and

      passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks]

$$\frac{\Delta y}{\Delta x} \qquad \frac{15-8}{6-2} = \frac{7}{4}$$

$$8 = \frac{7}{4} \times 2 + c \qquad\qquad y = \frac{7}{4}x + 4.5$$

$$8 = 3.5 + c$$

$$4.5 = c \qquad\qquad\qquad \text{negative reciprocal}$$

$$\text{of } \frac{7}{4} = -\frac{4}{7} = m \text{ of line}$$

$$y = -\frac{4}{7}x + c \qquad\qquad y = -\frac{4}{7}x + 9$$

$$9 = -\frac{4}{7} \times 0 + c \qquad 17 = -\frac{4}{7}x + 9$$

$$9 = 0 + c \qquad\qquad 17 - 9 = -\frac{4}{7}x$$

$$9 = c \qquad\qquad\qquad 8 = -\frac{4}{7}x$$

$$8 \div -\frac{4}{7} = x$$

$$\boxed{-14 = x}$$

$x = $ -14

Commentary

Some students unnecessarily found the equation of the line as in this example here.

4 marks

Question 24, response 4

24 A straight line

is perpendicular to the straight line through (2, 8) and (6, 15)

and

passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks]

perpendicular to $(2, 8)$, $(6, 15)$

perpendicular = negative recip gradient

$1.75 \times 2 = 3.5$

$(2, 8)$ $(6, 15)$ $8 - 3.35 = 4.5$

$\frac{7}{4} = 1.75$ $y = 1.75x + 4.5$

negative recip $= -\frac{1}{1.75}x + 4.5$

$y = -\frac{1}{1.75}x + 9$

$17x - \frac{1}{1.75} = -9.714285714$

$x = -9.714285714$

Commentary

This student correctly finds the unsimplified line equation. However, they are unsure of how to use the point (x, 17) to make further progress. Instead of substituting 17 for y, they substitute it for x.

2 marks (M1,M1,M0,A0)

24   A straight line

is perpendicular to the straight line through (2, 8) and (6, 15)

and

passes through (0, 9) and (x, 17) $y = mx + c$

Work out the value of x.   **[4 marks]**

$$\frac{15-8}{6-2} = \frac{7}{4} \quad \leftarrow gradient$$

$$Perpendicular = \frac{4}{7} \quad \leftarrow reciprocal$$

$$Y = mx + c \qquad c = 9$$
$$\frac{m}{x} = \frac{4}{7}$$

$$Y = \frac{4}{7}x + 9$$

$$17 = \frac{4}{7}x + 9$$
$$-9 \qquad -9$$

$$8 = \frac{4}{7}x$$
$$\div\frac{4}{7} \quad \div\frac{4}{7}$$ $$\frac{17 \ 9}{14} = \frac{4}{7}$$

$$14 = x$$

$$7$$
$$x = \underline{\qquad 14 \qquad}$$

Commentary

This student knows how to tackle this problem, but incorrectly applies a very important rule, namely that a perpendicular gradient is the **negative** reciprocal of the initial gradient rather than just the reciprocal.

1 mark (M1,M0,M0,A0)

Question 24, response 6

24 A straight line

is perpendicular to the straight line through (2, 8) and (6, 15)

and

passes through (0, 9) and (x, 17)

Work out the value of x.

[4 marks

$$m_1 \times m_2 = -1 \quad \to \text{ perpendicular}$$

$x =$ _____

Commentary

Knowing a rule is not sufficient to score marks. Students need to know the rule and how to apply it. This student knows the rule connecting perpendicular gradients, but has not applied the rule to any numbers. If they had written down a random gradient and then found the perpendicular gradient, they could have been awarded the second method mark.

0 marks

25 $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

Question 25, response 1

25 $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$f(x) = 2x + 5$

$f^{-1}(x) = ?$

$3(2x+5) - 12\left(\dfrac{\frac{x}{y}-5}{2}\right) = \text{int}$

$y = 2x + 5$

$y - 5 = 2x$

$\dfrac{y-5}{2} = x$

$(6x+15) - (24(\frac{x}{y}-5))$

$(6x+15) - (24x - 120)$

$24 - 6 =$

$f^{-1}(x) = \dfrac{\frac{x}{y}-5}{2}$

$= 15 - 18x - 120$

$= 0$

$15 - 120 = 18x$

$6x + 15 - \left(12\left(\dfrac{x}{2} - \dfrac{5}{2}\right)\right)$

$6x + 15 \; \overline{7} \; \dfrac{12x}{2} - 30 = 0$

$\times 2 \qquad\qquad \times 2$

$6x$

$12x + 15 - 12x - 30$

$15 - 30 = \underline{-15}$

integer

Commentary

This student has a good understanding of inverse functions. They correctly substituted $f(x)$ and $f^{-1}(x)$ into the required expression, but incorrectly multiplied by -12.

2 marks (M1,A1,M0,A0)

25     $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$f(x) = 2x + 5$

$y = 2x + 5$

$x = 2y + 5$

$3f(x) - 12f^{-1}(x)$

$3f(y) - 12f^{-1}(y)$

Commentary

This student appears to have remembered a method to find an inverse function, but is unsure of how to proceed after swapping the x and y.

1 mark (M1,A0,M0,A0)

Question 25, response 3

25    $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$f^{-1}(x) =$

$x = 2x + 5$

$y = 2x + 5$

-5

$y - 5 = 2x$

$\div 2$

$\dfrac{y-5}{2} = x$

$f^{-1}(x) = x = \dfrac{y-5}{2}$

$3(2x+5) = 6x + 15$

$12f^{-1} = 12\left(x = \dfrac{y-5}{2}\right)$

$\quad = 12x = \dfrac{12y-60}{24}$

$12x = \dfrac{12y-60}{24}$

$-6x + 15$

$= 6x = \dfrac{12y-45}{24} \times 24$

$144x = 288y - 1080$

$+1080$

$1080 + 144x = 288y$

$\div 144$

$1080 + x = 144y$

$x = 144y - 1080$

Commentary

This student has remembered an initial step to finding an inverse function, correctly rearranging their equation to make x the subject. Unfortunately, they forget to swap x and y, and consequently confuse themselves when they substitute into the required expression.

1 mark (M1,A0,M0,A0)

25    $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$f^{-1}(x) = \dfrac{x-5}{2}$ $y = 2x+5$

$x = 2y + 5$

$x - 5 = 2y$

$\dfrac{x-5}{2} = y$

$3(2x+5) - \left(12\left(\dfrac{x-5}{2}\right)\right)$

$6x + 15 - \left(\dfrac{12x-60}{2}\right)$ $\dfrac{12x-60}{2} = 6x - 30$

$6x + 5 - (6x - 30)$

$\boxed{6x} + 5 \boxed{-6x} + 30$

$5 + 30 = \underline{\underline{35}}$

Commentary

This is a good solution with a clear method. The error is a miscopy from the 6th line to the 7th line.

3 marks (M1,A1,M1,A0)

Question 25, response 5

25    $f(x) = 2x + 5$

Show that $3f(x) - 12f^{-1}(x)$ simplifies to an integer.

[4 marks]

$$3(2x+5) - 12(-2x-5)$$
$$6x+15 + 24x + 60$$
$$\quad -15 \qquad\qquad -15$$

$$6x + 24x + 45$$
$$-\tfrac{1}{2}x - 6x$$

$$18x + 45$$
$$\div 18 \quad \div 18$$
$$f(x) = 2.5$$

Question 26

26   Two objects, J and K, are applying pressure to areas of ground.

$$pressure = \frac{force}{area}$$

For J, the force is 18.9 newtons and the area is $0.45\,m^2$

pressure for J : pressure for K $= 7 : 8$

area for J : area for K $= 9 : 5$

Work out the force for K.

[4 marks]

Answer _____ newtons

Question 26, response 1

26 Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

For J, the force is 18.9 newtons and the area is 0.45 m²

pressure for J : pressure for K = 7 : 8

area for J : area for K = 9 : 5

Work out the force for K.

[4 marks]

pressure of J = $\frac{18.9}{0.45}$ = 42.

pressure for J : pressure for K = 7 : 8.

×6 $\left(\begin{array}{c}7 : 8 \\ 42 : 48\end{array}\right)$ ×6   pressure for K = 48.

area for J : area of K = 9 : 5.

×0.05 $\left(\begin{array}{c}9 : 5 \\ 0.45 : 0.25\end{array}\right)$ ×0.05   area of K = 0.25.

force of K = P×A = 48 × 0.25 = 12

F = P + a

Answer _____12_____ newtons

Commentary

This student adopts a very systematic approach to this question, and shows their method clearly.

4 marks

26   Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

For J, the force is 18.9 newtons and the area is $0.45\,\text{m}^2$

pressure for J : pressure for K $= 7 : 8$

area for J : area for K $= 9 : 5$

Work out the force for K.

[4 marks]

$$\text{J pressure} = \frac{18.9\text{N}}{0.45\text{m}^2}$$

Answer _____ newtons

Commentary

This student appears to be unsure of how to tackle this problem question. However, they correctly substitute into the given formula, which is sufficient to score the first mark.

1 mark (M1,M0,M0,A0)

Question 26, response 3

26   Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

$$5 = \frac{10}{2}$$

For J, the force is 18.9 newtons and the area is $0.45 \, m^2$

pressure for J : pressure for K = 7 : 8

area for J : area for K = 9 : 5

Work out the force for K.

[4 marks]

$$J: \text{ pressure} = \frac{18.9}{0.45}$$

$$= 42$$

$$\begin{array}{l} J:K \\ 7:8 \end{array} \qquad \frac{42}{15} = 2.8$$

42

pressure for K = 2.8

$$\begin{array}{l} J:K \\ 9:5 \end{array} \qquad \text{Force} = 6.3 \times 2.8$$

$$0.45 \overline{)6.3} \qquad = 17.64$$

Answer   17.64   newtons

Commentary

This student uses the given formula to find the pressure applied by object J. However, they then misinterpret the pressure ratio. Instead of dividing by 15 (from 7 + 8), they should have divided by 7 and multiplied by 8 to find the pressure for K.

1 mark (M1,M0,M0,A0)

26   Two objects, J and K, are applying pressure to areas of ground.

$$pressure = \frac{force}{area}$$

For J, the force is 18.9 newtons and the area is 0.45 m²

pressure for J : pressure for K = 7 : 8

area for J : area for K = 9 : 5

Work out the force for K.

[4 marks]

pressure   J : K   are   J : K
    7 : 8   = pressure   9 : 5

pres   pressure = 18.9
                     0.45   J : K   are
pressure = 42
  J : 8   7 : 8   ÷20   9 : 5
          42 : 46   0.45 : 0.25
                                                 area

Pressure = force
              area

46 = force   46 × 0.25 = 11.5
       0.25

Answer _____ 11.5 _____ newtons

Question 26, response 5

26   Two objects, J and K, are applying pressure to areas of ground.

$$\text{pressure} = \frac{\text{force}}{\text{area}}$$

For J, the force is 18.9 newtons and the area is $0.45\,\text{m}^2$

pressure for J : pressure for K $= 7 : 8$

area for J : area for K $= 9 : 5$

Work out the force for K.

[4 marks]

force = pressure × area

$0.45 \div 9 = | \quad 0.05 \times 5 \quad = 0.25$

K area = $0.25\,\text{m}^2$

18.9 × 0.45 = 8.505 pressure

$0.505 \div 7 = 1.215$

$1.215 × 8 = 9.72$

Answer _____ 9.72 _____ newtons

Commentary

This student has calculated the area for K first. They correctly used the ratio 9 : 5 to find the area as 0.25 m². Unfortunately, they then use the given formula incorrectly, multiplying 18.9 and 0.45 instead of dividing.

1 mark (M0,M0,M1,A0)

Question 27

27 To be rented, a bedroom must have a floor area of at least $6.51\,m^2$

A bedroom has a rectangular floor.

The floor measures $2.4\,m$ by $2.9\,m$, each correct to 2 significant figures.

Show that the bedroom can be rented.

[3 marks]

Question 27, response 1

27   To be rented, a bedroom must have a floor area of at least 6.51 m^2

A bedroom has a rectangular floor.

The floor measures 2.4 m by 2.9 m, each correct to 2 significant figures.

Show that the bedroom can be rented.

[3 marks]

$2.4 \times 2.9 = 6.960 \text{ m}^2$

$\downarrow$ big enough

$6.96 > 6.51$

2.4   2.9

lower bounds

2.35   2.85

$2.35 \times 2.85 = 6.69 \text{ m}^2$

$\downarrow$

also big enough

$6.69 > 6.51$

Commentary

This student has successfully compared 6.51 m² with the minimum possible area of the bedroom by using the lower bounds of its dimensions.

3 marks

27   To be rented, a bedroom must have a floor area of at least 6.51 m²

A bedroom has a rectangular floor.

The floor measures 2.4 m by 2.9 m, each correct to 2 significant figures.

Show that the bedroom can be rented.

[3 marks]

$$2.4 \times 2.9 = 6.96 m^2$$

$$6.51 < 6.96 m^2$$

so, it can be rented.

Commentary

This student has not understood that a measurement of 2.4 m, correct to 3 significant figures, could be any length in the interval 2.35 m ≤ 2.4 m (2sf) < 2.45 m. Similarly for the measurement of 2.9 m.

0 marks

Question 27, response 3

27   To be rented, a bedroom must have a floor area of at least 6.51 m^2

A bedroom has a rectangular floor.

The floor measures 2.4 m by 2.9 m, each correct to 2 significant figures.

Show that the bedroom can be rented.

[3 marks]

$$2.35 < 2.4_m < 2.45$$
$$2.85 < 2.9 < 2.95$$

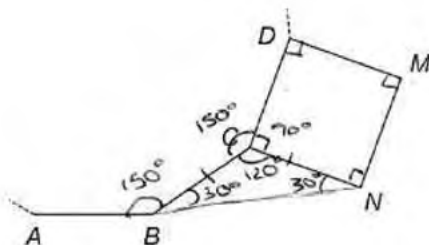$$2.45 \times 2.95 = 7.2275 \text{ m}^2$$

Commentary

This student has understood that they must consider the bounds of the measurements given. Unfortunately, they use the upper bounds rather than the lower.

1 mark (M1,M0,A0)

28   *AB*, *BC* and *CD* are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn accurately

Prove that points *A*, *B* and *N* lie on a straight line.

[4 marks]

Question 28, response 1

28   AB, BC and CD are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn
accurately

Prove that points A, B and N lie on a straight line.

[4 marks]

$10 \times 180 = 1800°$ = angles in the 12-sided polygon

$1800 \div 12 = 150°$ → at each angle

→ Lines BC and CN are equal because CDMN is a square (equal sides

∴ angles CBM = CNB (30°) because it is an isoseles triangle

$150 + 90 = 240$

$360 - 240 = 120$

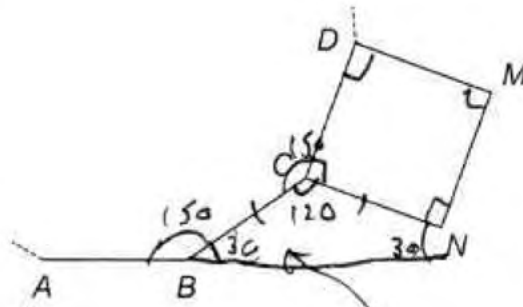$180 - 120 = 60$

$\div 2 = 30$

Commentary

This student has calculated all the relevant angles, clearly showing their calculations for each one. Unfortunately, they have not been able to show how these angles demonstrate that A, B and N lie on a straight line. This is a good example of a student who does not know how to answer the question, but sensibly works out everything they do know, scoring most of the available marks in the process.

3 marks (B1,B1,B1,B0)

28   AB, BC and CD are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn accurately

Prove that points A, B and N lie on a straight line.

Bore angles in an isosceles triangle are equal

[4 marks]

$(12-2) \times 180 = 1800$

$\frac{1800}{12} = 150$

$150 + 90 = 240$

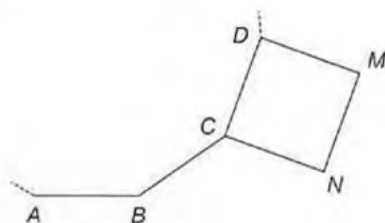$360 - 240 = 12$

$180 - 120 = 60$

Commentary

This student has correctly calculated the interior angle of a regular dodecagon. However, they do not prove that angle CBN is 30°. To do so, they could have simply written 60 ÷ 2 = 30 after the last line.

2 marks (B1,B1,B0,B0)

Question 28, response 3

28   AB, BC and CD are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn accurately

Prove that points A, B and N lie on a straight line.

[4 marks]

$(n - 2) \times 180$

$(12 - 2) \times 180$

$10 \times 180 = 1800$

$\dfrac{1800}{360} = 5$

$\dfrac{360}{5} = 72$

72   interior

180   exterior   up to

add up to 180

angles on a straight line add up to 180

Commentary

This student has forgotten how to calculate the interior and exterior angles of a regular polygon. Consequently, they are unable to make any progress in this question. Regular polygons will be assessed in most exam papers, so it's useful to learn this relatively straightforward skill.
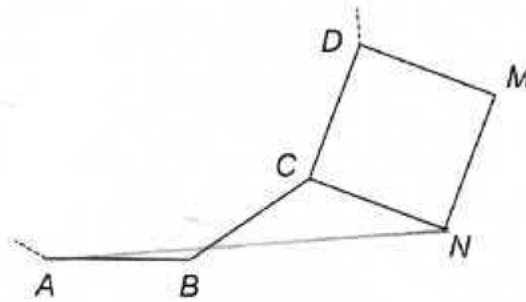
0 marks

28   *AB*, *BC* and *CD* are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn
accurately

Prove that points *A*, *B* and *N* lie on a straight line.

[4 marks]

> A B is a straight line due to being part of
> the regular polygon.
>   CD = AB because all lie on polygon
> ∴ CN = AB because all sides of a
> Square are the same.
> BN must = 2 × BC ∴ A B and N lie on a
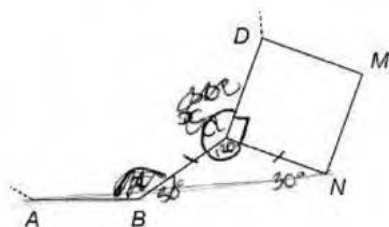> straight line.

Commentary

This student has not calculated any angles. Geometric proofs will always require at least one angle to be calculated.

0 marks

Question 28, response 5

28 AB, BC and CD are sides of a regular 12-sided polygon.

CDMN is a square.

Not drawn accurately

Prove that points A, B and N lie on a straight line.

[4 marks]

DC = NC (square shares a side with regular 12 sided polygon)

BC = NC

Let ∠ABC = x Let ∠BCD = x

Reflex angle BCN = x + 90

360 − (x + 90) = 270 + x (angles around a point = 360°)

360 ÷ 12 = interior angle

= 30°

Total interior angles = 10 × 180 = 1800

30 + 90 = 120°   1800 ÷ 12 = 150°

③ ∠BCD = 150°

150 + 90 = 240

360 − 240 = 120° = ∠BCN

180 − 120 = 60°, 60 ÷ 2 = 30° = ∠BCBN & ∠CNB

∠ABC = 150°, 150° + 30° = 180°, so A, B & N

lie on a straight line.

Commentary

This solution has not been set out in the conventional fashion, but it has sufficient evidence to justify the required proof. This student has proved that angles *ABC* and *CBN* add up to 180°, and has therefore correctly concluded that *A*, *B* and *N* must lie on a straight line.

4 marks

29 The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.

You **must** show your working.

[3 marks]

Answer (_____ , _____)

Question 29, response 1

29   The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.

You **must** show your working.

[3 marks]

$$(x - 9) - 81 + 70$$

$$(x - 9)_{A} - 11$$

$$x^2 - 9x - 11$$

Answer (___9___ , ___11___)

Commentary

This student has remembered part of the completing the square process but has forgotten to include a power 2 on the bracket.

0 marks

29   The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.
You **must** show your working.

[3 marks]

$$y = x^2 - 18x + 70$$
$$y = (x - 9)^2 - 81 + 70$$
$$y = (x - 9)^2 - 11$$

$$9 - 9 = 0$$

Answer (___9___ , ___-11___)

Commentary

This student has efficiently completed the square, and then correctly identified the turning point.

3 marks

Question 29, response 3

29   The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.

You **must** show your working.

[3 marks]

$$(x-9)^2 - 81 + 70 = 0$$

$$(x-9)^2 - 11 = 0$$

$$-9 \times 9 = +81$$

Answer ($+9$, -11)

Commentary

This student has completed the square correctly, but has also incorrectly included = 0. However, this does not affect the square completing process or the identification of the turning point, so this student is not penalised.

3 marks

29   The equation of a curve is $y = x^2 - 18x + 70$

By completing the square, work out the coordinates of the turning point.

You **must** show your working.

[3 marks]

$$70 = x^2 - 18x$$
$$70 = (x - 9)^2$$
$$0 = (x - 9)^2 - 11$$

Answer ($\underline{\quad 0 \quad}$, $\underline{\quad -11 \quad}$)

Commentary

This student has correctly completed the square, although they have incorrectly equated it to zero. They have correctly identified the y-coordinate of the turning point, but have included the wrong x-coordinate.

2 marks (M1,M1,A0)

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E: maths@aqa.org.uk

T: 0161 957 3852