1.

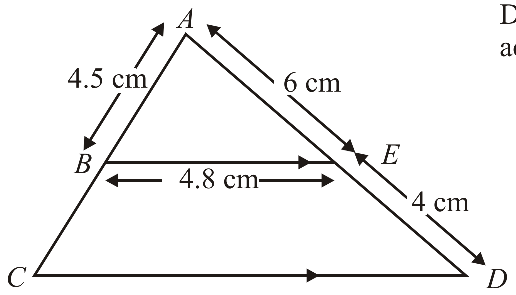


Diagram **NOT** accurately drawn

BE is parallel to *CD*.
AE = 6 cm, *ED* = 4 cm, *AB* = 4.5 cm, *BE* = 4.8 cm.

(a) Calculate the length of *CD*.

.......................cm
(2)

(b) Calculate the perimeter of the trapezium *EBCD*.

.......................cm
(2)
(Total 4 marks)

2.

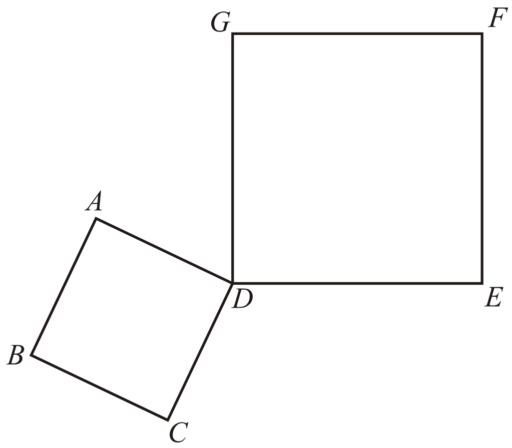


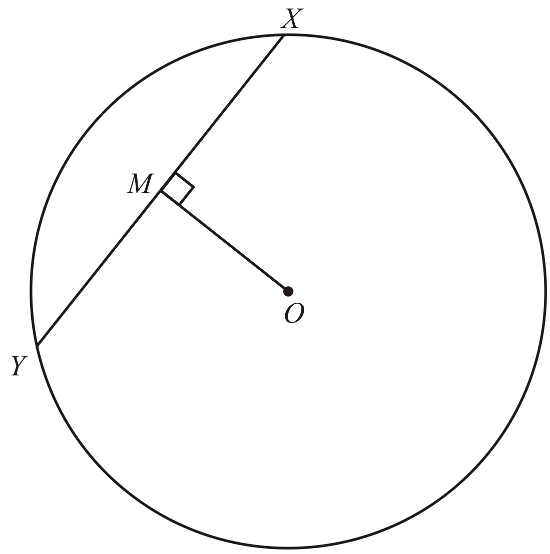
Diagram **NOT** accurately drawn

ABCD and *DEFG* are squares.

Prove that triangle *CDG* and triangle *ADE* are congruent.

(Total 3 marks)

3.

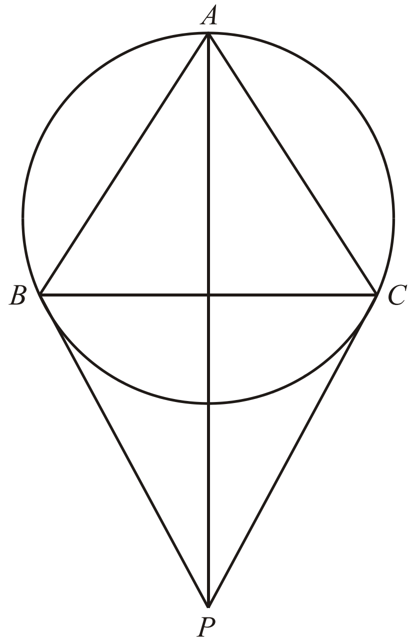


X and Y are points on the circle, centre O.
M is the point where the perpendicular from O meets the chord XY.

Prove that M is the midpoint of the chord XY.

(Total 3 marks)

4.



A, B and C are three points on the circumference of a circle.
Angle ABC = Angle ACB.
PB and PC are tangents to the circle from the point P.

(a) Prove that triangle APB and triangle APC are congruent.

(3)

Angle $BPA = 10°$.

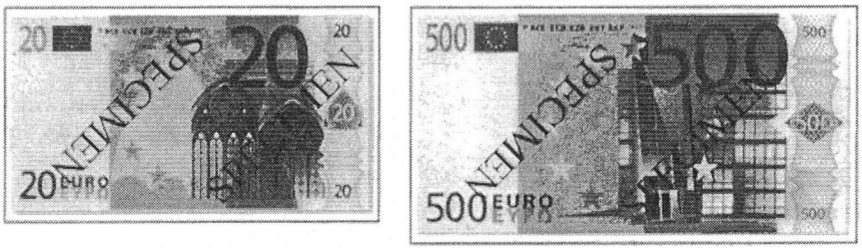
(b) Find the size of angle ABC.

..............................°

(4)

(Total 7 marks)

5.



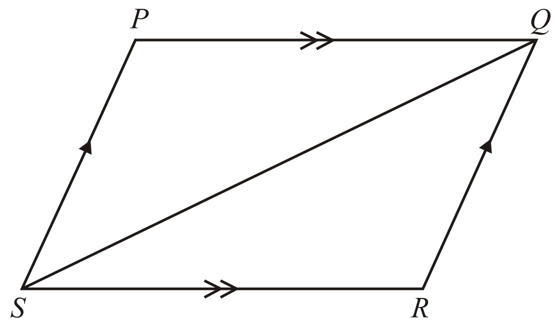
Pictures **NOT** accurately drawn

A 20 Euro note is a rectangle 133 mm long and 72 mm wide.
A 500 Euro Note is a rectangle 160 mm long and 82 mm wide.

Show that the two rectangles are **not** mathematically similar.

(Total 3 marks)

6. *PQRS* is a quadrilateral.



PQ is parallel to *SR*.
SP is parallel to *RQ*.

(a) Prove that triangle *PQS* is congruent to triangle *RSQ*.

(3)

(b) In quadrilateral *PQRS*, angle *SPQ* is obtuse.
Explain why *PQRS* cannot be a cyclic quadrilateral.

(2)
(Total 5 marks)

7.

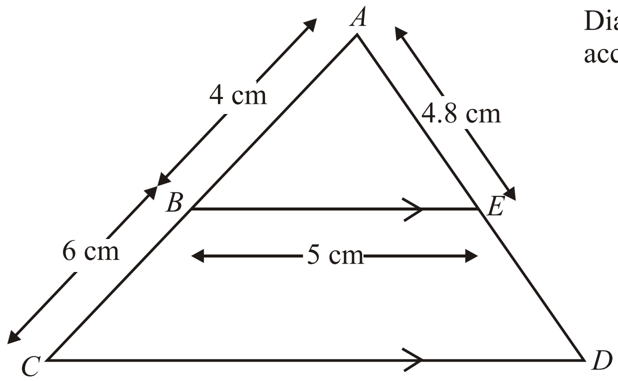


Diagram **NOT** accurately drawn

BE is parallel to *CD*.
ABC and *AED* are straight lines.
AB = 4 cm, *BC* = 6 cm, *BE* = 5 cm, *AE* = 4.8 cm.

(a) Calculate the length of *CD*.

.... cm
(2)

(b) Calculate the length of *ED*.

.... cm

(2)

(Total 4 marks)

8.

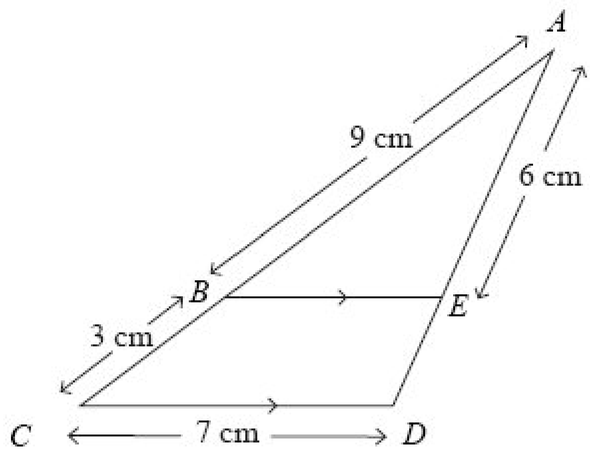


Diagram **NOT** accurately drawn

BE is parallel to *CD*.

AB = 9 cm, *BC* = 3 cm, *CD* = 7 cm, *AE* = 6 cm.

Calculate the length of *ED*.

…………………cm

(Total 2 marks)

9.

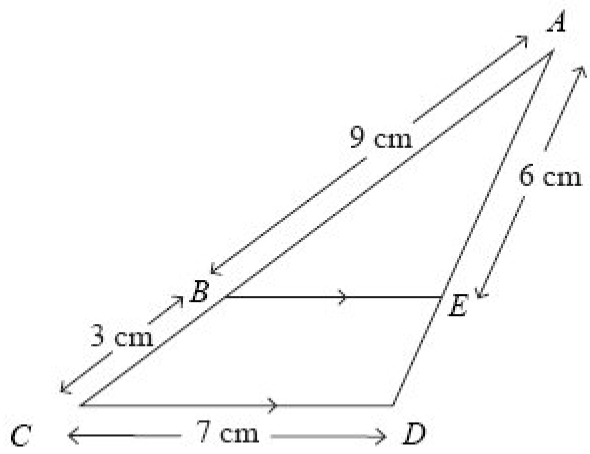


Diagram **NOT** accurately drawn

BE is parallel to *CD*.

AB = 9 cm, *BC* = 3 cm, *CD* = 7 cm, *AE* = 6 cm.

(a) Calculate the length of *ED*.

………………… cm

(2)

(b) Calculate the length of *BE*.

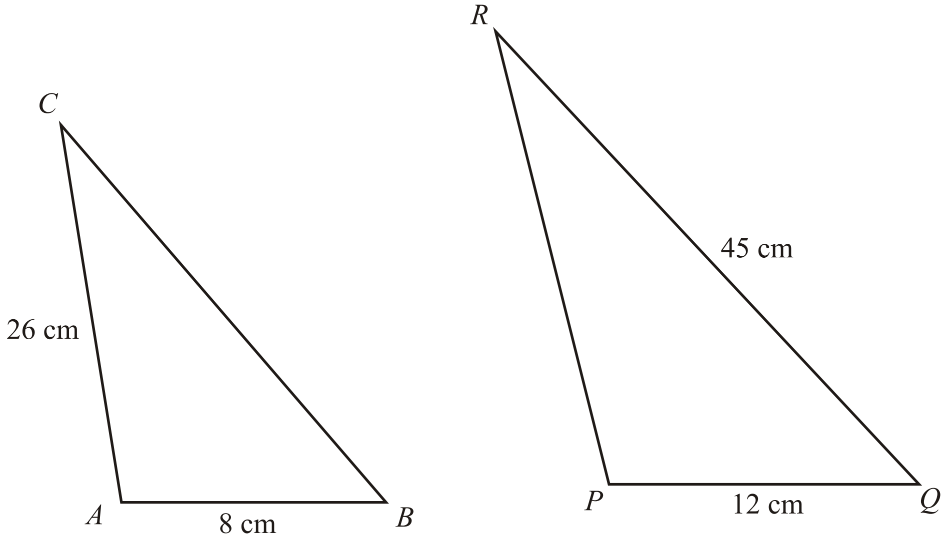
………………… cm

(2)

(Total 4 marks)

10.

Diagrams **NOT** accurately drawn



The two triangles *ABC* and *PQR* are mathematically similar.

Angle *A* = angle *P*.
Angle *B* = angle *Q*.
AB = 8 cm.
AC = 26 cm.
PQ = 12 cm.
QR = 45 cm.

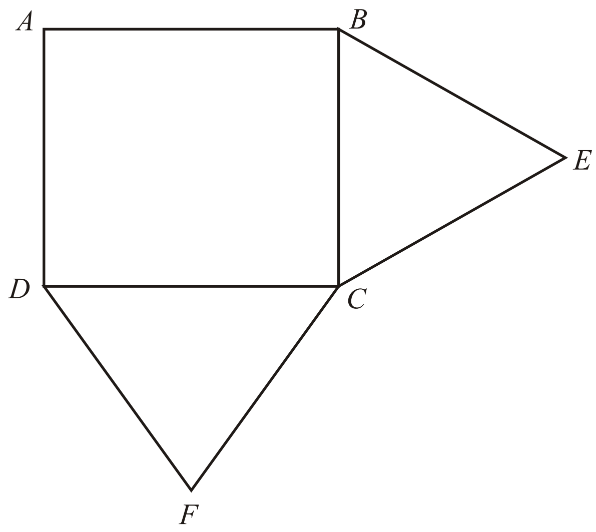
(a) Work out the length of *PR*.

………………………cm
(2)

(b) Work out the length of *BC*.

………………………cm
(2)
(Total 4 marks)

11. Diagram **NOT** accurately drawn



ABCD is a square.
BEC and *DCF* are equilateral triangles.

(a) Prove that triangle *ECD* is congruent to triangle *BCF*.

(3)

G is the point such that *BEGF* is a parallelogram.

(b) Prove that $ED = EG$

(2)
(Total 5 marks)

12. The diagram shows two quadrilaterals that are mathematically **similar**.

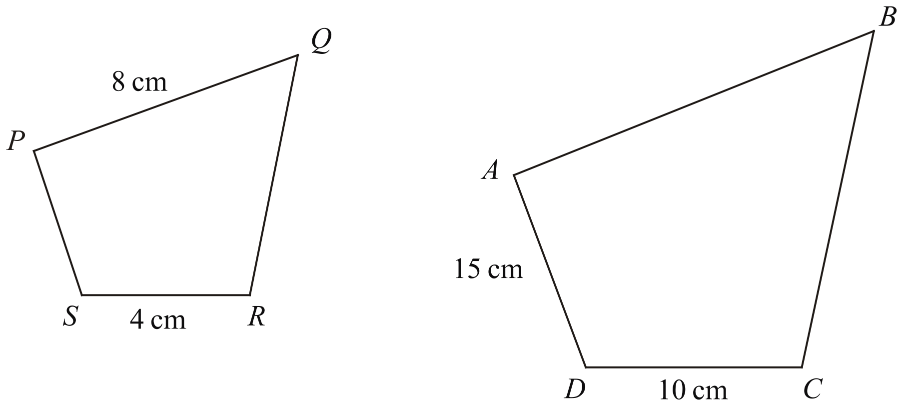


Diagram **NOT** accurately drawn

In quadrilateral $PQRS$, $PQ = 8$ cm, $SR = 4$ cm.
In quadrilateral $ABCD$, $AD = 15$ cm, $DC = 10$ cm.
Angle PSR = angle ADC.
Angle SPQ = angle DAB.

(a) Calculate the length of AB.

.... cm

(2)

(b) Calculate the length of *PS*.

.... cm

(2)

(Total 4 marks)

13.

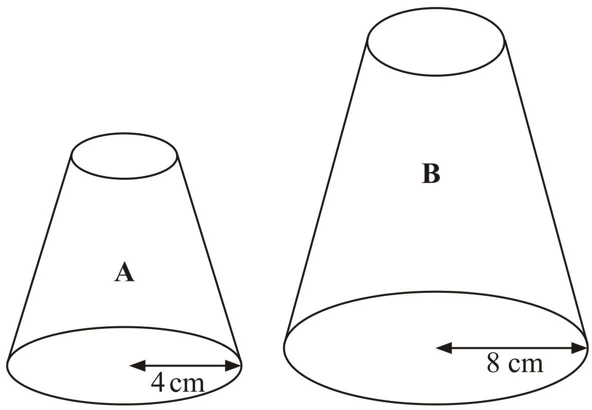


Diagram **NOT** accurately drawn

Two solid shapes, **A** and **B**, are mathematically similar.
The base of shape **A** is a circle with radius 4 cm.
The base of shape **B** is a circle with radius 8 cm.

The surface area of shape **A** is 80 cm^2.

(a) Work out the surface area of shape **B**.

.... cm^2

(2)

The volume of shape **B** is 600 cm^3.

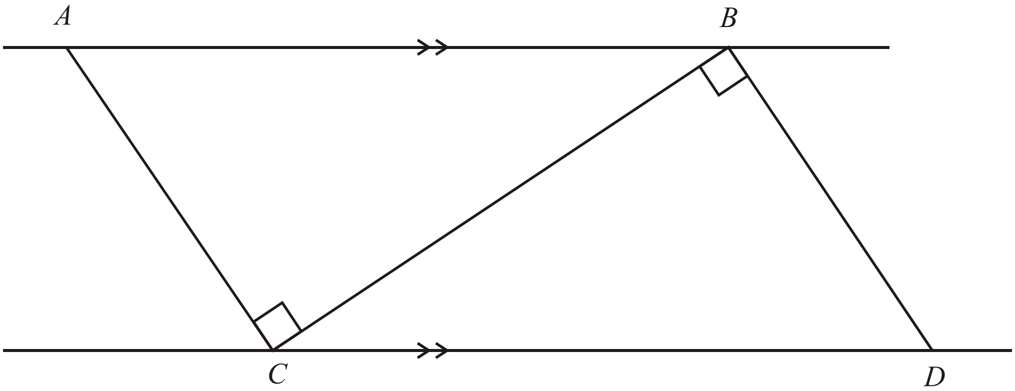
(b) Work out the volume of shape **A**.

.... cm^3

(2)

(Total 4 marks)

14.



AB is parallel to *CD*.
Angle *ACB* = angle *CBD* = 90°.

Prove that triangle *ABC* is congruent to triangle *DCB*.

(Total 3 marks)

15.

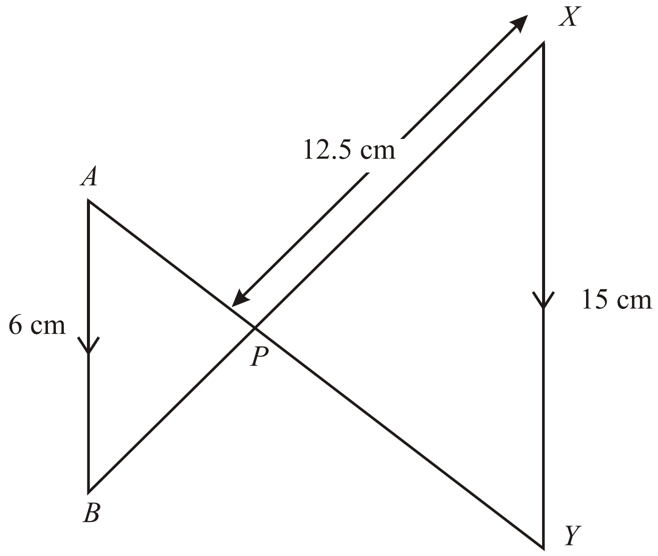


Diagram **NOT** accurately drawn

AB is parallel to XY.
The lines AY and BX intersect at P.
$AB = 6$ cm.
$XP = 12.5$ cm.
$XY = 15$ cm.

Work out the length of BP.

.... cm
(Total 3 marks)

16.

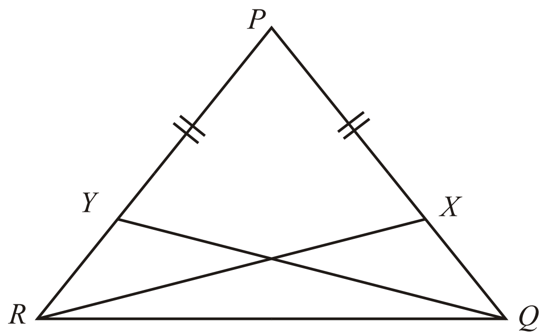


Diagram **NOT** accurately drawn

Triangle *PQR* is isosceles with *PQ* = *PR*.
X is a point on *PQ*.
Y is a point on *PR*.
PX = *PY*.

Prove that triangle *PQY* is congruent to triangle *PRX*.

(Total 3 marks)

17.

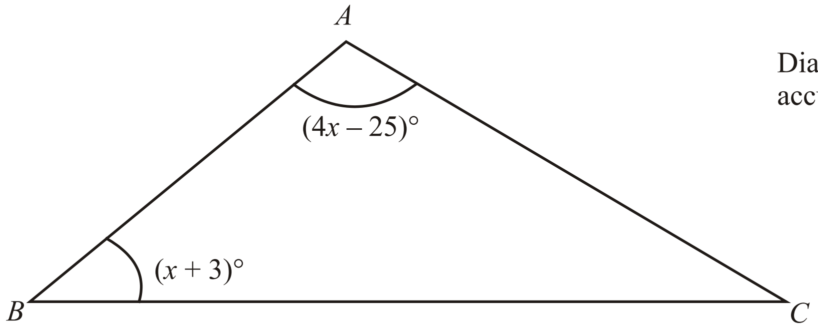


Diagram **NOT** accurately drawn

ABC is a triangle.
Angle $A = (4x - 25)°$.
Angle $B = (x + 3)°$.

The size of angle *A* is **three** times the size of angle *B*.

Work out the value of x.

x = ...

(Total 3 marks)

1. (a) 8 — 2

SF = $\frac{10}{6}$

$\frac{10}{6} \times 4.8 = 8$

M1 for sight of $\frac{10}{6}$ *or* $\frac{10}{6}$ *or 1.67 or better or* $\frac{CD}{10} = \frac{4.8}{6}$

A1 cao

(b) 19.8 — 2

$\frac{10}{6} \times 4.5 - 4.5 = 3$

M1 for use of SF from (a) to find AC or BC or

$\frac{BC}{4.5} = \frac{4}{6}$ *and adding 4 sides*

A1 cao

[4]

2. *CD = AD & DG = DE*

$\angle CDG = \angle ADE$ (= $\angle ADG$ + 90°)

2 sides & included angle

M1 for CD = AD & DG = DE

M1 for $\angle CDG = \angle ADE$ *since both equal* $\angle ADG + 90°$

A1 for SAS oe in words

[3]

3. — 3

OY = OX (radii)

OM = OM or OM is common

OMX = OMY = 90°

B1 for any one line

B1 for remaining two lines

B1 (dep on 2 previous Bs) for

$\Delta OMY \equiv \Delta OMX$ *RHS and conclusion*

[3]

4. (a) (I) *AB* = *AC* (triangle *ABC* is isosceles)

(II) *PB* = *PC* tangents (from a point to a circle are) equal

(III) *AP* = *AP* (common side)

so the 2 triangles are congruent, SSS. 3

B3 for I, II, III with congruency reason
(B2 for any two of I, II or III)
(B1 for any one of the I, II or III)

(b) 50° 4

BPC = 20°
PBC (or *PCB*) = 90–1/2 "20" (= 80°)
BAC = *PBC* = "80"

B4 for 50°
(B3 for BAC = 80°)
(B2 for PBC = 80° or PCB = 80°)
(B1 for APC = 10° or BPC = 20° or a middle angle = 90°)
SC if clear numerical slip seen eg "PBC = 180 – 90 – 10 = 70" then goes on to get correct ft angle ABC = 55 deduct 1 from total so this cand would get B4 – 1 = B3

[7]

5. 1.84.. ≠ 1.95..
1.20.. ≠ 1.13.. 3

$\frac{133}{72} = 1.8472$, $\frac{160}{82} = 1.9512$
OR
$\frac{72}{133} = 0.54135, \frac{82}{160} = 0.5125$
OR
$\frac{160}{133} = 1.203...., \frac{82}{72} = 1.1388....$
OR
$\frac{133}{160} = 0.83125...., \frac{72}{82} = 0.878$

M1 for $\frac{133}{72}$ (= 1.8472…) oe Accept 1.8, 1.85
M1 for $\frac{160}{82}$ (= 1.9512…) oe consistent pairing
Accept 2.0, 1.9
***OR** M1 for $\frac{160}{133}$ (= 1.203…) oe*
M1 for $\frac{82}{72}$ (= 1.1388) oe
A1 for enough decimal places to show that the ratios are not equal; since the scale factors are different the shapes cannot be similar.
NB Do Not need conclusion

[3]

6. (a) Angle PQS = QSR
Angle RQS = PSQ
SQ is common
Triangles are congruent ASA 3
B1 for 1 condition + reason
B1 for 2nd condition + reason
B1 for 3rd condition + reason + statement of congruency

(b) Opposite angles of parallelograms are equal.
2 obtuse angle added are > 180° therefore they cannot add up to 180 therefore the shape cannot be cyclic 2
B1 for states P and R are both obtuse
B1 sum greater than 180 for angles P and R or less than 180 for angles Q and S

[5]

7. (a) 12.5 2

$\frac{CD}{5} = \frac{10}{4}$

B1 for sight of $\frac{10}{4}$ *or* $\frac{4}{10}$ *or 2.5 or 0.4 or 1.25 oe*
B1cao for 12.5

(b) 7.2 2

$4.8 \times 2.5 - 4.8$

M1 for 4.8 × "2.5" or sight of 12
A1 cao

[4]

8. 2 2

$\text{SF} = \frac{12}{9}$

$\frac{12}{9} \times 6 = 8$

M1 for $\frac{12}{9}$ *or* $\frac{9}{12}$ *or 1.33... seen or 0.75 seen or 8 seen*
or $\frac{6}{9}$ *or* $\frac{9}{6}$ *or 0.66... or 1.5 or* $\frac{1}{3}$ *or 3 oe seen*
A1 cao

[2]

9. (a) 2 2

$\text{SF} = \frac{12}{9}$

$\frac{12}{9} \times 6 = 8$

M1 for $\frac{12}{9}$ *or* $\frac{9}{12}$ *or 1.33... seen or 0.75 seen or 8 seen*
or $\frac{6}{9}$ *or* $\frac{9}{6}$ *or 0.66... or 1.5 or* $\frac{1}{3}$ *or 3 oe seen*
A1 cao

(b) 5.25 2

SF = $\frac{9}{12}$, $\frac{9}{12} \times 7 = 5.25$

M1 for $\frac{BE}{7} = \frac{9}{12}$ *oe*

A1 cao

[4]

10. (a) SF = 1.5

39 cm 2

M1 SF = $\frac{12}{8}, \frac{8}{12}$*, 1.5, 0.6 ... oe*

A1 cao

(b) $45 \times \frac{8}{12}$

30cm 2

M1 $45 \times \frac{8}{12}$, $45 \div \frac{12}{8}$ *oe*

A1 cao

[4]

11. (a) *BC* = *CE* equal sides

CF = *CD* equal sides

BCF = *DCE* = 150°

BFC is congruent to *ECD* **(SAS)** 3

B1 for either BC = CD or BC = CE

CF = CE or CF = CD

B1 for BCF = DCE = 150° or correct reason

B1 for proof of congruence

(b) So *BF*=*ED* (congruent triangles)

BF = *EG* (opp sides of parallelogram) 2

B1 BF = EG or BF = ED

B1 fully correct proof

[5]

12. (a) $8 \times \frac{10}{4} = 20$ 2

M1 $\frac{10}{4}$ *or* $\frac{4}{10}$ *or 0.4 or 2.5 oe seen*

A1 cao

NB ratios get M0 unless of the form 1:n

or

M1 $\frac{8}{4}, \frac{4}{8}$ *oe seen*

A1 cao

(b) $15 \times \frac{4}{10}$

6 2

M1 $15 \times \frac{4}{10}$ *oe*

A1 cao

[4]

13. (a) $\left(\frac{8}{4}\right)^2 \times 80$

320 2

M1 for $\left(\frac{8}{4}\right)^2$ *or* $\left(\frac{4}{8}\right)^2$ *oe or* $8^2:4^2$ *or* $4^2:8^2$ *or 1:4 or 4:1*

A1 for 320 cao

(b) $\left(\frac{4}{8}\right)^3 \times 600$

75 2

M1 for $600 \times \left(\frac{4}{8}\right)^3$ *or* $600 \times \left(\frac{8}{4}\right)^3$ *oe*

A1 for 75 cao

[4]

14. $\angle ABC = \angle BCD$ (alternate angles)
BC common
$\angle ACB = \angle CBD = 90°$ (given) 3

M1 for $\angle ABC = \angle BCD$ (alternate angles)
M1 for BC common oe
A1 for both < ACB = < CBD (given or both 90°)and ASA

[3]

15. 5 3

$$\frac{BP}{12.5} = \frac{6}{15}$$

M1 for sight of $\frac{15}{6}$ oe or sight of $\frac{6}{15}$ oe OR correct ratio involving 4 terms
M1 for $BP = 6 \times \frac{12.5}{15}$
A1 cao

[3]

16. $PQ = PR$ given
$PY = PX$ given
Angle P common
SAS 3

M1 for PQ = PR with reason or PY = PX with reason
M1 for P identified as a common angle
A1 for completion of proof and SAS

[3]

17. $4x - 25 = 3(x + 3)$
$4x - 25 = 3x + 9$
34 3

M1 for $4x - 25 = 3(x + 3)$ oe
B1 for $(3x + 9)$ or $(12x - 75)$ or $\left(\frac{x}{3} + 1\right)$
or $\left(\frac{4x}{3} - \frac{25}{3}\right)$
A1 cao
[SC: B1 for ax + b = cx + d correctly rearranged]

[3]

1. **Paper 4**

This was a very poorly attempted question. Those candidates who recognised similar triangles were usually unable to identify the correct scale factor, with $\frac{6}{4}$ often being used. Some candidates gained one mark in part (b) for correctly calculating the length of *BC* but many assumed the trapezium to be isosceles with *BC* = *ED*.

Paper 6

Candidates who realised that this was the standard question on similar triangles, or enlargement had little trouble with the question. However, there was a great deal of confusion over which sides to use in order to find the scale factor. Few candidates opted to use the expedient of drawing the two triangles separately and specifically identifying the corresponding sides.
Part (b) was a more unusual question. Many candidates tried to find the perimeter of the triangle.
There was a great deal of confusion what to use as scale factors.

2. This question was not answered well. It is not sufficient just to mark information on a diagram to answer a formal proof question. Some candidates assumed a value for angle *ADG* which was not acceptable. Some good candidates obtained the first two marks but then stated that the triangles were congruent with the reason "angle and 2 sides" without stating that the angle was 'the included angle'. The examiners accepted "SAS" as implying the 'included angle'. Many grade B candidates mixed up the terms 'congruent' and 'similar' or assumed incorrectly that having got two pairs of sides equal, the remaining pair of sides must automatically be equal, (SSS).

3. This question was designed to test the ability of candidates to demonstrate a formal proof. There were two methods of approach:

A formal proof that triangles *OMX* and *OMY* are congruent (RHS).

A formal use, with justification, of Pythagoras in each of the triangles *OMX* and *OMY*.

In general, candidates omitted essential details and so lost marks.

4. Very few candidates displayed good presentation of a geometric proof. The writing of three equalities with concise reasoning was often replaced by a rambling essay usually centred around the idea of 'showing' the triangles to be similar. The idea of congruency was lost to the majority. Although very few candidates gained full marks for part (b) many did gain partial credit, normally from the work they did on the diagram as labelling of angles in the working space was often absent. Weaker candidates, gaining any credit for this question, normally showed angle *APC* as 10° or marked a relevant right angle. Better candidates went on to show angle *PBC* as 80° but it was usually only the top grade candidates who indicated that BAC was also 80°. Such candidates usually went on to obtain the correct answer for the size of angle *ABC*. A common error, was to assume that angle BAP was 10° (the same as BPA).

5. **Mathematics A**

Paper 4

Most answers showed no understanding of mathematical similarity, most making some comparison of areas or perimeters, or subtracted the lengths of the sides. Of those who did attempt a division, most gained the full marks, since they were then able to justify their results in the context of the question.

Paper 6

Candidates did well on this unusual question. There were many successful approaches involving the calculation of appropriate scale factors and showing that they were not equal. Almost as popular was to calculate a scale factor from say 160/133 and then multiplying 72 by this and showing the answer was not equal to 82.

Mathematics B Paper 17

The great majority of candidates did not understand the concept of similarity. Many simply worked out the areas of the two notes, offering no explanation. Some tried to use the monetary value of the notes to disprove similarity. A few did calculate ratios and explain their findings well.

6. Only 7% of candidates were able to give a full solution to proving that the two triangles were congruent in part (a); they often took for granted what they were trying to prove. In part (b) candidates did not give sufficient reasons as to why two obtuse angles had a swn of greater than 180° though 20% of candidates gave a complete solution and a further 10% a partial solution,

7. **Paper 4**

This question commonly appears on the Intermediate paper, yet this time is was very badly done, one of the worst attempted questions on the paper, with nearly 95% of candidates achieving no marks on either part. It was rare to see a correct scale factor. Most jumped straight into the incorrect method of adding and subtracting values between the two triangles.

Paper 6

Although these questions are standard the response to them was not as successful as we may have hoped. There was a great deal of confusion in what was the appropriate scale factor, especially in part (a), where the answer 7.5 was frequently seen. All the candidates who drew the two triangles themselves as separate shapes got the correct answers to both parts.

8. About one third of candidates were able to give the length of *ED* as 2 cm and many did so without showing any working. Answers of 1.5 and 3 were very common. Where working was shown, some had tried to use scale factors with varying degrees of success. A worrying number of candidates attempted to use Pythagoras' theorem or even trigonometry.

9. These questions always prove to be challenging for some candidates. Part (a) was generally well answered as many candidates noted the 9 : 3 ratio. Part (b) proved to be more difficult with $7 \div 3 = 2.33$ and $7 \div 3 \times 2$being common incorrect answers. Candidates who used a scale factor of $\frac{12}{9}$ were generally successful although marks were lost when this was used as 1.3.

10. **Specification A**

Intermediate Tier

The common approach to this question was to assume that values were added on to give the enlarged triangle, rather than the adoption of an approach which involved factors. A few attempted to apply Pythagoras. Credit was available for finding factors alone, but there was little evidence to substantiate the award of these method marks. It was clear that most candidates failed to associate "similar" with scale factors.

Higher Tier

Many candidates scored full marks on this question, and there were relatively few incorrect methods involving Pythagoras' theorem. Common mistakes occurred in simplifying the scale factor $\frac{12}{8}$ to $\frac{4}{3}$ or 1.4; and in part (b), errors in calculating $45 \div 1.5$. Some of the weaker candidates, not understanding the need for a scale factor, simply added 4 (derived from the difference of *PQ* and *AB*) to *AC* to obtain $RP = 30$.

Specification B

Intermediate tier

It was disappointing to see so many candidates merely adding or subtracting 4 cm from the given lengths to give answers of $PR = 30$ (26 + 4) and $BC = 41$ (45 − 4). A small number used RQ in (a) instead of (b), and AC likewise; they then contrived to get the desired results by wrongly manipulating the measurements given on the diagram. This gained no marks. Few candidates quoted any scale factor of enlargement although some did use the "once and a half again" method, usually to good effect. Very few quoted the equivalence of the ratios of corresponding sides. Quite a few tried to use Pythagoras ignoring that the question did not have right angled triangles.

11. Setting out these proofs was not done well. Many used very wordy explanations rather than concise mathematical reasons and failed to identify the key stages required. About half the candidates were able to score at least one mark in part (a), usually for identifying a pair of equal sides in the triangles. Candidates often failed to give a reason for the equal angles (this was merely stated as fact), and some failed to identify the appropriate congruence. Generally part (b) was done a little better than part (a), but many candidates identified EDG as an equilateral triangle, or stated that EDF and EGF were identical isosceles triangles, without supporting evidence or explanation.

12. **Higher Tier**

This was generally well answered. When working was shown it tended to be to display the use of a scale factor of $\frac{10}{4} = 2.5$ in both parts, where the availability of a calculator made part (b) fairly accessible.

Intermediate Tier

This was the worst question on the paper for which little working was shown, if any. The most common mistake was to add for the enlargement and to subtract for the reduction, giving answers of 14 and 9. An assumption of a factor of 2 in part (a) sometimes led to an incorrect answer of 7.5 in part (b).

13. Only the best candidates were able to score full marks in this question. For the surface area in part (a), the vast majority of candidates simply multiplied 80 by 2 (the linear scale of the enlargement). Similarly for the volume in part (b), the vast majority of candidates simply divided 600 by 2.

14. This question was poorly answered. A number of candidates clearly understood the conditions for congruence but were unable to give a rigorous proof. A very wide spread misapprehension was to assume that a condition of congruence was AAA. It was also very common to read phrases such as 'since *AB* is parallel to *CD*, *AB* = *CD*' in candidates' solutions.

15. **Paper 16**

This was not done well other than by the more able candidates. Quite often a correct scale factor of 2.5 was obtained but then candidates failed to divide it into 12.5 correctly or were unable to go any further. It was rare to see the more formal method of equating the ratios between corresponding sides of similar triangles, to find the unknown side.
Weaker candidates often stumbled across 2.5 by subtracting 12.5 from 15, but then usually subtracted this from 6 to give an answer of 3.5
It must be noted that a significant number of candidates quoted an answer of 5, without showing any working, some of which I feel sure were guesses.

Paper 18

Many candidates were able to score full marks on this question showing either a good use of scale factors or use of similar triangles. A minority of candidates incorrectly attempted to use Pythagoras' Theorem (or the sine or cosine rule) and thus scored no marks.

16. Few candidates understood the nature of proof. This question was very poorly done. it is important that candidates do recognise that they must qualify any statements they make. It was not sufficient to write *PR* = *PQ* without including that this was because triangle *PQR* was isosceles or that the information was given.

17. **Intermediate Tier**

Very few candidates used correct algebra in an attempt to solve this problem many preferring trial and improvement methods. These usually failed. It was encouraging to see some algebraic attempts and credit was given for quoting a correct equation or for a correct interpretation of 3 times an angle.

Higher Tier

Candidates found this a demanding question. Disappointingly, relatively few candidates were able to write down a correct equation from the given information. Those candidates that were able to write down a correct equation generally went on to score full marks for the question.