Mark schemes

Q1.

Alternative method 1

180 ÷ (5 + 7) or 180 ÷ 12 or 15

oe

M1

5 × their 15

or 180 – 7 × their 15 or 75

oe

M1dep

180 – their 75 – 20

or 180 – 95

oe

M1dep

85

A1

Alternative method 2

$x + \frac{7x}{5} = 180$

or $\frac{5y}{7} + y = 180$ or $y = 105$

oe correct elimination of a variable from equations $x + y = 180$ and $7x = 5y$

M1

(x=) $180 \times \frac{5}{12}$ or (x=) 75

oe

M1dep

180 – their 75 – 20

or 180 – 95

oe

M1dep

85

A1

[4]

Q2.

XYZ = 110 stated or shown **or** *BXZ* = 30 stated or shown

ABX and XZB = 80

B1

XYZ = 110 stated or shown **and** *BXZ* = 30 stated or shown

B1

40°

Must be from correct work
Answer only B1

B1

Alternative Method

BZY = 110 stated or shown **or** *BXZ* = 30 stated or shown

B1

BXY = 70 stated or shown **and** *BXZ* = 30 stated or shown

B1

40°

Must be from correct work
Answer only B1

B1

[3]

Q3.

angle *ABC* = x

M1

angle *BAC* = x and
alternate segment theorem

M1

angle *ABC* = x and
angle *BAC* = x and
alternate segment theorem and two equal angles so isosceles (*AC* = *BC*)

A1

[3]

Q4.

(a) 35

B1

(b) 100

B1

Angle at centre twice angle on circumference

Must use words 'centre' and 'circumference' (or 'perimeter')
Allow poor spelling even though both words given
oe (strand) (i)

Q1

[3]

Q5.

Any **one** of these equations

$2x + y + 20 = 180$
or
$x + 2y + y + 40 = 180$
or
$2x + y + 20 = x + 2y + y + 40$
or
$2x + y + 20 + x + 2y + y + 40 = 360$

oe

M1

Another of these equations

$2x + y + 20 = 180$
or
$x + 2y + y + 40 = 180$
or
$2x + y + 20 = x + 2y + y + 40$
or
$2x + y + 20 + x + 2y + y + 40 = 360$

oe

these simplify to ...

$2x + y = 160$ or

$x + 3y = 140$ or

$x − 2y = 20$ or

$3x + 4y = 300$

M1

equating coefficients and elimination of x or y for their equations

e.g.
$x + 3y = 140$ and $6x + 3y = 480$
or
$2x + 6y = 280$ and $2x + y = 160$

rearrangement and substitution for their equations

e.g.

$y = 160 − 2x$ and $x + 3(160 − 2x) = 140$

or

$x = 140 − 3y$ and $2(140 − 3y) + y = 160$

M1dep

Allow one numerical error for the 3rd M1, but not an error in method
(e.g. adding equations when they ought to be subtracted is an error in method, so M0)

$5x = 340$ or $5y = 120$

ft their elimination or substitution

M1dep

$x = 68$ and $y = 24$

A1

[5]

Q6.

65

B1

Alternate segment (theorem)

B1dep

Additional Guidance

65 alternative segment (theorem)

B1 B0

65 alternate angles

B1 B0

[2]

Q7.

Angle *CAD* = 46 **or**

Angle *ACD* = 37 **or**

Angle *CDE* = 83 **or** (37 + 46) **or**

Angle *ADC* = 97 **or** 180 − (37 + 46)

Any of these angles correctly marked or named ... could be on diagram

M1

Angle *DCE* = 46 **or**

Angle *ACE* = 83 **or** (37 + 46)

M1

51

A1

[3]

Q8.

Alternative method 1

$x + y + 70 = 180$
or $x + 2y + 40 = 180$

oe

M1

$x + y = 110$
and $x + 2y = 140$

$2x + 2y = 220$
and $x + 2y = 140$

oe

Collects terms and equates coefficients

Equations may be implied from 110 or 140 on diagram in correct place

M1dep

$x = 80$ or $y = 30$

A1

$x = 80$ and $y = 30$

A1

Alternative method 2

$x + y + 70 = 180$
or $x + y + 70 + x + 2y + 40 = 360$

oe

M1

$2x + 2y = 220$
and $2x + 3y = 250$

$3x + 3y = 330$
and $2x + 3y = 250$

oe

Collects terms and equates coefficients

Equations may be implied from 110 or 140 on diagram in correct place

M1dep

$x = 80$ or $y = 30$

A1

$x = 80$ and $y = 30$

A1

Alternative method 3

$x + 2y + 40 = 180$
or $x + y + 70 + x + 2y + 40 = 360$

oe

M1

$2x + 4y = 280$
and $2x + 3y = 250$

$3x + 6y = 420$
and $4x + 6y = 500$

oe

Collects terms and equates coefficients

Equations may be implied from 110 or 140 on diagram in correct place

M1dep

$x = 80$ or $y = 30$

A1

$x = 80$ and $y = 30$

A1

Alternative method 4

$x + y + 70 = 180$
or $x + 2y + 40 = 180$
oe

M1

$2y + 40 – (y + 70) = 0$
or $2x + 140 – (x + 40) = 360 – 180$
oe
Eliminates a variable

M1dep

$x = 80$ or $y = 30$

A1

$x = 80$ and $y = 30$

A1

Additional Guidance

$y = 30$ must come from correct equations not from $x + 2y = 70$ and $x + y = 40$

M0 M0 A0

[4]

Q9.

Join *BD*

Angle *BDC* = $2x$
Alternate segment theorem

M1

Angle *BDO* = x

M1

Angle *DBO* = x
Isosceles triangle BOD

M1

Angle *BOD* = $180 − 2x$
Angle sum of triangle BOD

M1

$y = 360 − 90 − 90 − (180 − 2x)$

$y = 2x$
Angle sum of quadrilateral ABOD
$y = 2x$ clearly shown from simplification

A1

Must have at least two different reasons stated in the proof

B1ft

Alternative method 1

Angle $OBC = 90 - 2x$

Tangent-radius property

M1

Angle $OCB = 90 - 2x$

Isosceles Δ OBC

M1

Angle $OCD = x$

Isosceles Δ OCD

M1

Angle $BCD = 90 - 2x + x$

$= 90 - x$

hence

Angle $BOD = 180 - 2x$

Angle at centre = 2 × angle at circumference

M1

$y = 360 - 90 - 90 - (180 - 2x)$

$y = 2x$

Angle sum of quadrilateral ABOD

$y = 2x$ clearly shown from simplification

A1

Must have at least two different reasons stated in the proof

B1ft

Alternative method 2

Angle $OBC = 90 - 2x$

Tangent-radius property

M1

Angle $OCB = 90 - 2x$

Isosceles Δ OBC

M1

Angle $OCD = x$

Isosceles Δ OCD

M1

Angle $BCD = 90 - 2x + x$

$= 90 - x$

hence

Angle $BOD = 180 - 2x$

Angle at centre = 2 × angle at circumference

M1

Angle $BOD = 360 - 90 - 90 - y$

$= 180 - y$

hence $y = 2x$

Angle sum of quadrilateral ABOD

$y = 2x$ clearly shown from simplification

A1

Must have at least two different reasons stated in the proof

B1ft

Alternative method 3

Angle *OBC* = $90 - 2x$

Tangent-radius property

M1

Angle *OCB* = $90 - 2x$

Isosceles Δ OBC

M1

Angle *OCD* = x

Isosceles Δ OCD

M1

Angle *BCD* = $90 - 2x + x$

$= 90 - x$

M1

$y = 360 - 90 - (90 - 2x) - (90 - x) - x - 90$

hence $y = 2x$

Angle sum of quadrilateral ABCD

$y = 2x$ clearly shown from simplification

A1

Must have at least two different reasons stated in the proof

B1ft

Alternative method 4

Angle *BOD* = $180 - y$

Angle sum of quadrilateral ABOD

M1

Angle *OCD* = x

Isosceles Δ OCD

M1

Angle *OBC* = $90 - 2x$

Tangent-radius property

M1

Angle *BCO* = $90 - 2x$

hence

Angle *BOD* reflex = $360 - (90 - 2x) - (90 - 2x) - x - x = 180 + 2x$

Isosceles Δ OBC

Angle sum of quadrilateral BODC

... this can also come from Angle BOC ($4x$) + Angle DOC ($180 - 2x$)

M1

$180 - y + 180 + 2x = 360$
hence $y = 2x$

Angles round a point

$y = 2x$ clearly shown from rearranging

A1

Must have at least two different reasons stated in the proof

B1ft

[6]

Q10.

(a) 70

May be on diagram

B1

(Opposite angles of) cyclic quadrilateral (add up to 180°)

Dependent on 70

In a quadrilateral in a circle the opposite angles add up to 180°

Q1

(b) One correct angle

DAE = 70 or BAD = 25 or DBC = 70

Angles can ft from their 70 in (a)

M1

Two correct angles

DAE = 70 or BAD = 25 or DBC = 70 or ADE = 40

M1

Three correct angles

DAE = 70 or BAD = 25 or DBC = 70 or ADE = 40 or BDC = 95 or BAE = 95

A1

15

A1

[6]

Q11.

90 seen or implied

90 may be on diagram

or may implied by use of Pythagoras or trigonometry

M1

$8.3^2 + 5.2^2$

sin 32.(067…) or cos 57.(9326…) = $\frac{5.2}{OB}$

or cos 32.(067…) or sin 57.(9326…) = $\frac{8.3}{OB}$

M1

$\sqrt{8.3^2 + 5.2^2}$

$\frac{5.2}{\sin 32.(067...)}$ or $\frac{5.2}{\cos 57.(9326..)}$

or $\frac{8.3}{\cos 32.(067...)}$ or $\frac{8.3}{\sin 57.(9326...)}$

M1dep

9.79 … or 9.8

Accept 10 if working seen

A1

[4]

Q12.

AD

B1

[1]

Q13.

43

B1

Alternate segment (theorem)

Strand (i) Do not accept Alternate

Dependent on B1

Q1

[2]

Q14.

(a) 70

B1

(b) *ADE* = 34

or *AED* = 180 − 70 or 110

or *ADC* = 180 − 70 − 34 or 76

Angles seen on diagram must be in correct place

M1

ADE = 34

and *AED* = 180 − 70 or 110

M1dep

36

A1

[4]

Q15.

(a) 56

B1

(b) 70

B1

Alternate segment (theorem)

Strand (i)

Dependent on B1

Q1dep

(c) 2 × 47 or 94

or Angle BOA = 47

or Angle BOC = 47

or Angle BAC = 47

or Angle BCA = 47

May be on diagram (obtuse angle)

M1

90 or right angle symbol seen at A or

C

or 180 − 90 − 47

or (180 − 2 × 47) ÷ 2

oe

M1

43

A1

[6]

Q16.

(a) 64

B1

Alternate segment (theorem)

B1

(b) 97

B1

[3]

Q17.

Alternative method 1

BDC = 24

May be on the diagram

B1

$DFC = \frac{180 - 24}{2}$

or $DCF = \frac{180 - 24}{2}$

or $\frac{156}{2}$ or 78

May be on the diagram

Finding a base angle in triangle CDF

B1dep

($3x$ =) 180 – their 78

or ($3x$ =) 24 + their 78

or ($3x$ =) 102

oe

May be on the diagram

M1

34

May be on the diagram

A1

Alternative method 2

BDC = 24

May be on the diagram

B1

DFC = 180 – $3x$

May be on the diagram

M1

2(180 – $3x$) + 24 = 180 or 360 – $6x$ + 24 = 180

or $3x$ + 78 = 180 or ($3x$ =) 102

oe

M1dep

34

May be on the diagram

A1

Additional Guidance

If angles in the same segment are not used i.e. all the working is using triangle *ABF* then award maximum of 2 marks

If triangle *ABF* is assumed to be isosceles and there is no evidence of angle *BDC* = 24 being used then award maximum of 2 marks

If triangle *ABF* is used as isosceles and correctly justified then all marks are available e.g. ‘triangle *ABF* is similar to triangle *CDF* ’

Answer of 34 does not imply full marks

Answer of 34 with no working

B0B0M1A1

'their 78' must come from an attempt to calculate $\frac{180 - 24}{2}$

Angles must be clearly identified
e.g. D = 24

B1

24 (unless shown on diagram)

B0

[4]