

Chapter 3

Angles

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Written by


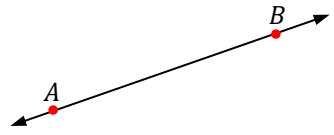
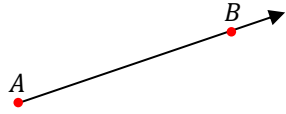
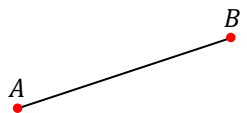
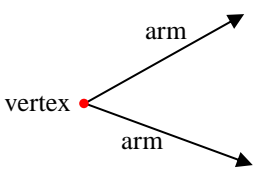
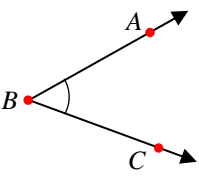
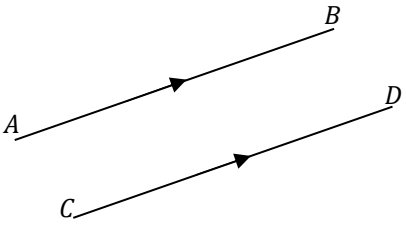
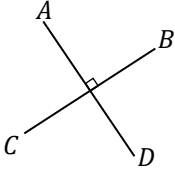
Benjamin Odgers

Mathematics Teacher

B Teaching / B Science

3A Angle Terminology <https://youtu.be/xw-yhbuwAgg>

Fill in the gaps in the appropriate spaces below (possible solutions are at the bottom of the page).

Name	Description	Figure
Point	Points are labelled with _____ letters.	
Line	A line goes on _____ in both directions as indicated by the arrows. The line at right can be called line _____ or line BA.	
Ray	A ray goes on forever in one _____ and _____ at a point in the other direction. The ray in the image can be called ray AB.	
Line Segment or Line Interval	Has a _____ length. It ends at a point in both directions. The line segment at right is called segment AB or segment _____.	
Vertex and Arms of an Angle	When two rays meet at a point, an _____ is formed. The point at which they meet is called the _____. The two rays are referred to as the _____ of the angle.	
Angle Notation	The angle at right could be called _____ or _____	
Parallel Lines	The two line segments at right are parallel. We say _____.	
Perpendicular Lines	The two line segments at right are perpendicular. We say _____.	

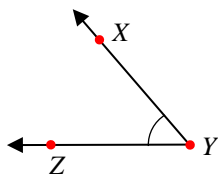
Fill in the spaces above with the following words/symbols:

AB	vertex	$\angle ABC$	direction	$AD \perp BC$	fixed	angle	BA	$\angle CBA$	forever
capital	$AB \parallel CD$	ends	arms						

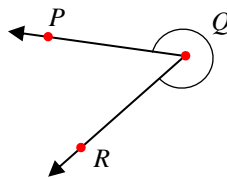
Example 1 <https://youtu.be/3QBFekvxA9M>

Name each angle marked below.

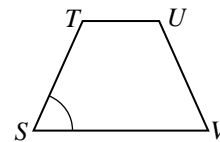
(a)



(b)



(c)



Question 1

Draw the following figures.

(a) line CD

(b) $\angle RST$

(c) line interval GH

(d) Two lines EF and GH , such that $EF \perp GH$

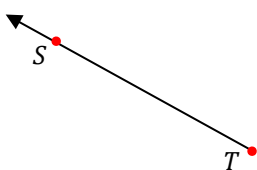
(e) reflex $\angle ABC$

(f) Two lines JK and LM , such that $JK \parallel LM$

Question 2

Name the following figures.

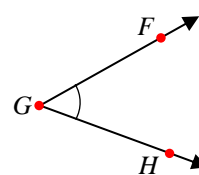
(a)



(b)



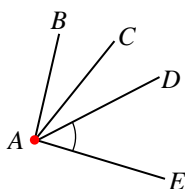
(c)



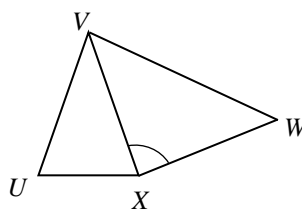
Question 3

Name each angle marked below.

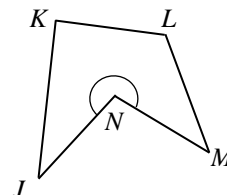
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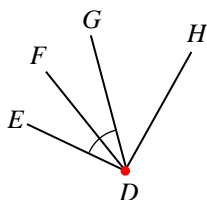
(b)



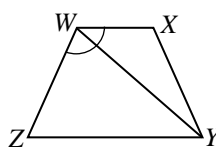
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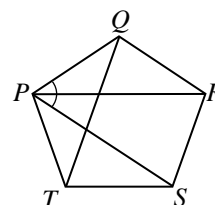
(d)



(e)

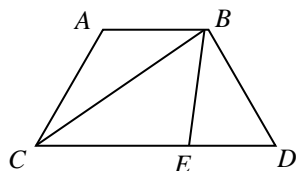


(f)



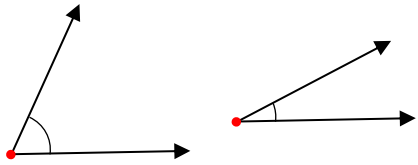
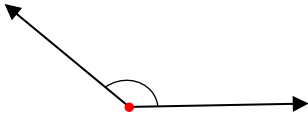

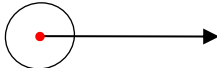
Question 4

Name every angle inside the figure below (excluding reflex and straight angles).



3B Classifying Angles <https://youtu.be/pdSRR0kdRPE>

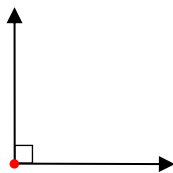
Fill in the gaps in the appropriate spaces below (possible solutions are at the bottom of the page).

Name of Angle	Size of Angle	Figure
Acute angle		
Right angle	90°	
	Between 90° and 180°	
Straight angle		
Reflex angle	Between 180° and 360°	
	360°	

Fill in the spaces above with the following words/symbols/diagrams:

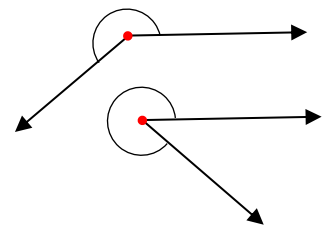
180°

Obtuse angle



Between 0° and 90°

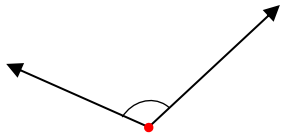
Revolution



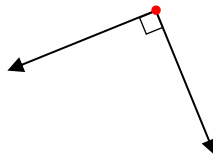
Question 1

Classify each angle as either acute, right, obtuse, straight, reflex or revolution.

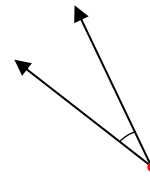
(a)



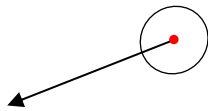
(b)



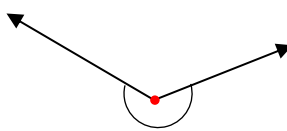
(c)



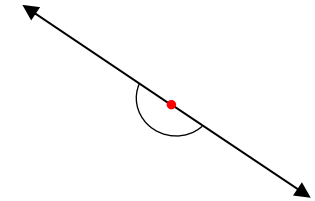
(d)



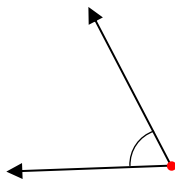
(e)



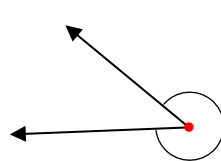
(f)



(g)



(h)



(i)



Question 2

Classify each angle as either acute, right, obtuse, straight, reflex or revolution.

(a) 50°

(b) 110°

(c) 90°

(d) 78°

(e) 360°

(f) 220°

(g) 180°

(h) 176°

(i) 1°

(j) 345°

(k) 136°

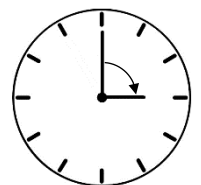
(l) 197°

Question 3

For each time below the angle is measured clockwise from the minute hand to the hour hand (as pictured at right). Classify each angle as either acute, right, obtuse, straight, reflex or revolution. If needed you can use a pencil to draw each time on the clock face pictured at right.

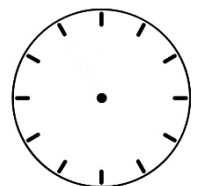
(a) 3:00

(b) 2:00



(c) 10:00

(d) 6:00

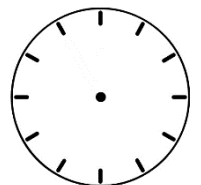


(e) 5:00

(f) 12:00

(g) 2:30

(h) 3:10

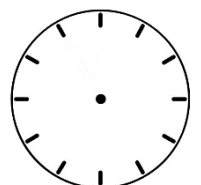


(i) 3:40

(j) 7:15

(k) 8:30

(l) 6:05

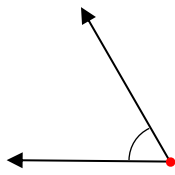


3C Measuring and Constructing Angles

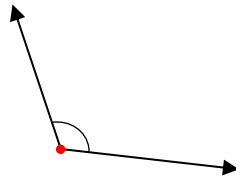
Example 1 <https://youtu.be/aX78OPbcoEk>

Measure the size of each angle below using a protractor. State the size and type for each angle.

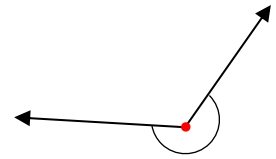
(a)



(b)



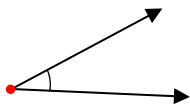
(c)



Question 1

Measure the size of each angle below using a protractor. State the size and type for each angle.

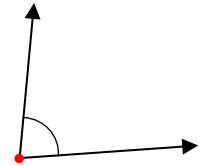
(a)



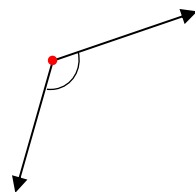
(b)



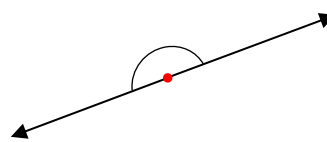
(c)



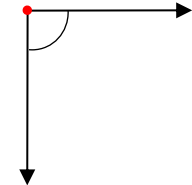
(d)



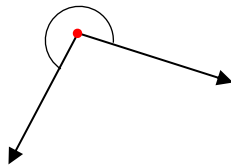
(e)



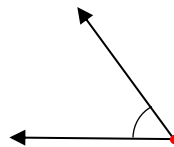
(f)



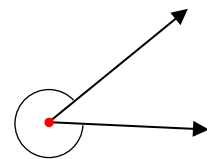
(g)



(h)



(i)



Example 2 <https://youtu.be/GvNF3jE8x6s>

Draw the following angles using a protractor

(a) 60° ($\angle ABC$)

(b) 115° ($\angle EFG$)

(c) 280° ($\angle XYZ$)

Question 2

Draw the following angles using a protractor

(a) 70° ($\angle BAC$)

(b) 45° ($\angle GHI$)

(c) 37° ($\angle RST$)

Question 3

Draw the following angles using a protractor

(a) 130° ($\angle PQR$)

(b) 165° ($\angle RTS$)

(c) 107° ($\angle DEF$)

(d) 230° ($\angle XYZ$)

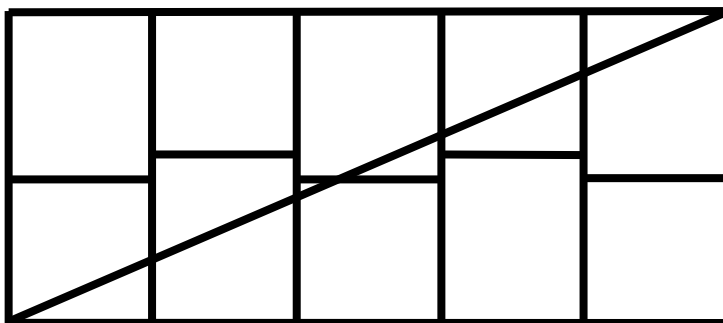
(e) 305° ($\angle UVW$)

(f) 297° ($\angle FHG$)

Question 4

The following image represents a wall frame that is to be built for a house. A thin piece of metal has been attached from one corner to the next to strengthen the frame. The thin piece of metal is called a brace.

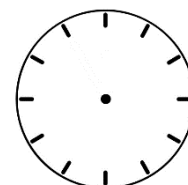
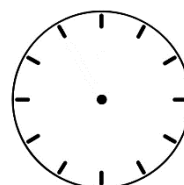
- How many right-angles can be seen on the frame?
- Measure the angle between the bracing and the horizontal?



Question 5

When it is 8:00 on a clock two angles are formed between the minute hand and the hour hand. One angle is obtuse and the other angle is a reflex angle.

- Measure the size of both angles



- What two times have a 150° angle between the hour and minute hand?

3D Adjacent and Vertically Opposite Angles <https://youtu.be/a3vwEMbFxTE>

Fill in the gaps in the appropriate spaces below (possible solutions are at the bottom of the page).

Name	Description	Figure
Adjacent Angles	Adjacent angles are 'next to' each other. Adjacent also means '_____'. $\angle XOY$ is adjacent to _____.	
Complementary Angles	Add up to _____. $\angle AOB =$ _____.	
Supplementary Angles	Add up to _____. $\angle TOU =$ _____.	
Angles in a Revolution	Add up to _____. Reflex $\angle FOG =$ _____.	
Vertically Opposite Angles	When two lines _____, the opposite angles are _____. $\angle LOM =$ _____.	

Fill in the spaces above with the following words/symbols/diagrams:

30°

70°

adjoining

$\angle YOZ$

180°

90°

intersect

360°

equal

50°

260°

Question 1

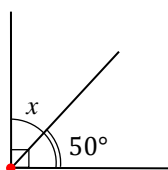
For each set of angles below, state whether they are complementary (C), supplementary (S) or neither (N)

- (a) 30°, 60° (b) 110°, 70° (c) 40°, 80° (d) 42°, 48°
 (e) 25°, 75° (f) 125°, 55° (g) 179°, 1° (h) 55°, 145°

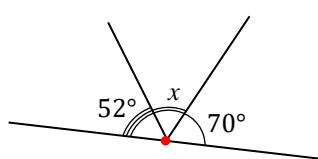
Example 1 <https://youtu.be/MirpYUplKMO>

Calculate the value of the angle x in each diagram below without the use of a protractor.

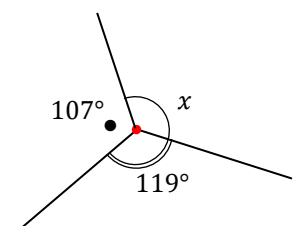
(a)



(b)

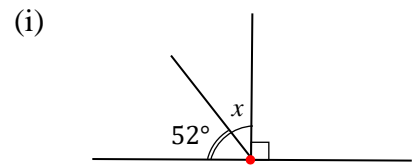
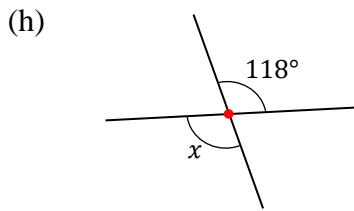
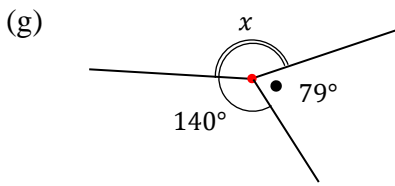
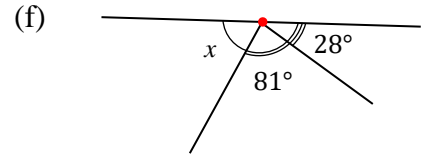
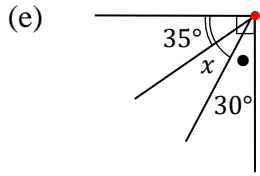
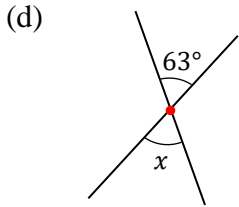
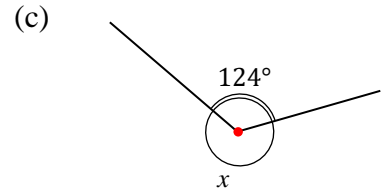
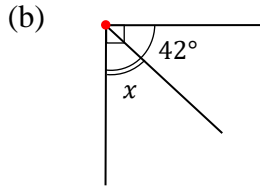
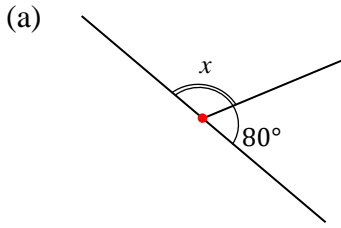


(c)



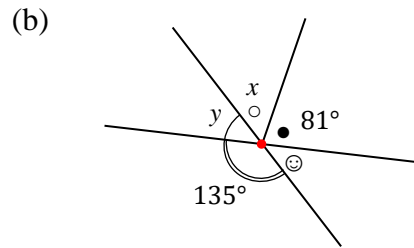
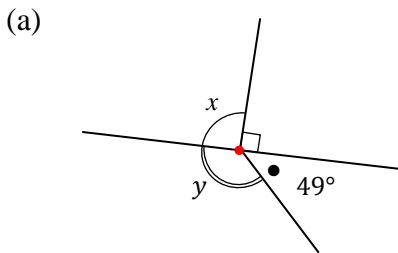
Question 2

Calculate the value of the angle x in each diagram below without the use of a protractor.



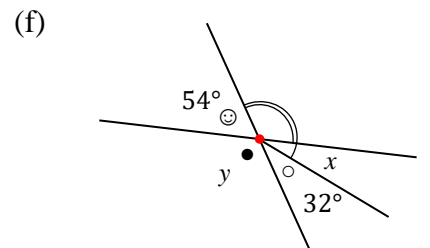
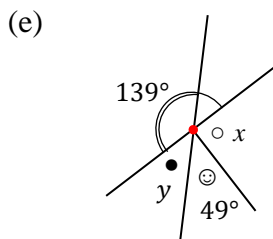
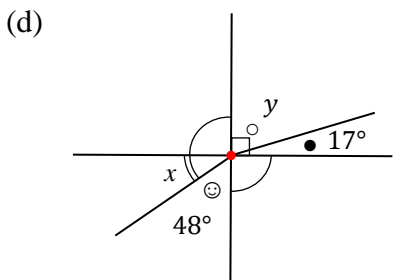
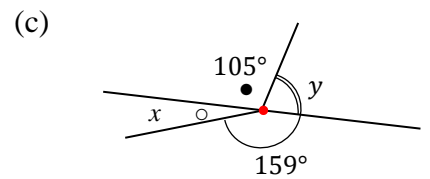
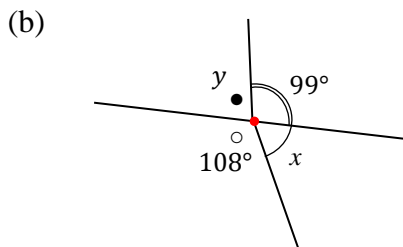
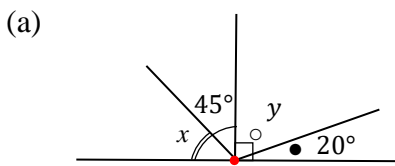
Example 2 <https://youtu.be/vW15I8xTCQY>

Calculate the value of the angles x and y in each diagram below without the use of a protractor.



Question 3

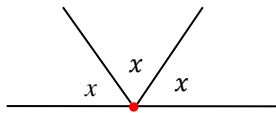
Calculate the value of the angles x and y in each diagram below without the use of a protractor.



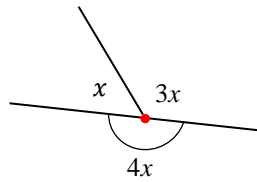
Example 3 https://youtu.be/F_0BxDH_P3M

Calculate the value of x in each diagram below without the use of a protractor.

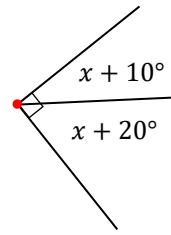
(a)



(b)



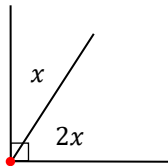
(c)



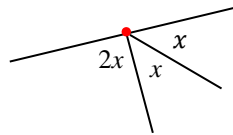
Question 4

Calculate the value of x in each diagram below without the use of a protractor.

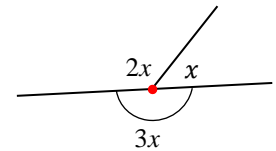
(a)



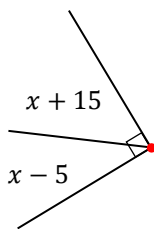
(b)



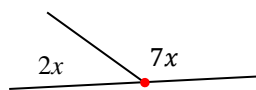
(c)



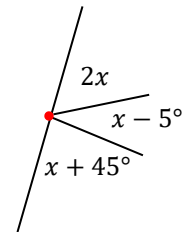
(d)



(e)



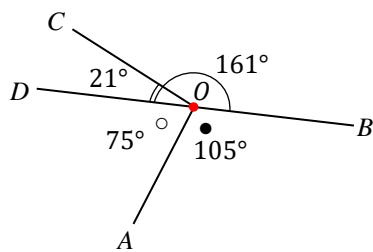
(f)



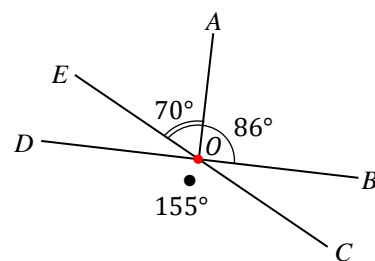
Question 5

Explain what is wrong with the following diagrams.

(a)

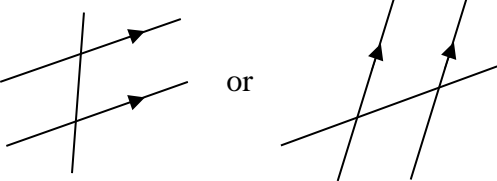
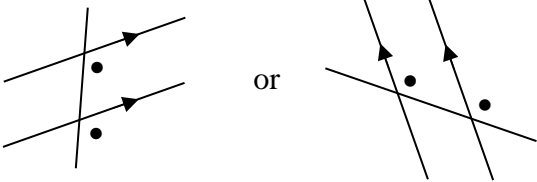
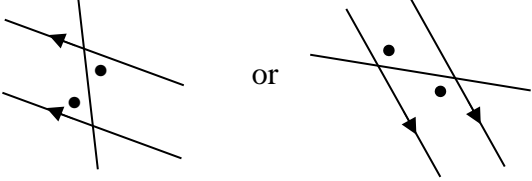
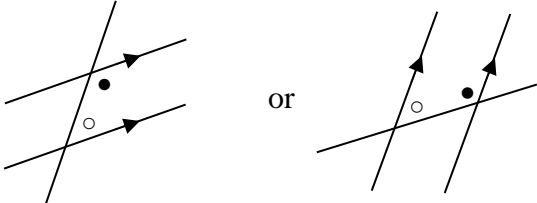


(b)



3E Parallel Lines and the Transversal <https://youtu.be/uSATyJ2S5jk>

Fill in the gaps in the appropriate spaces below (possible solutions are at the bottom of the page). Use a coloured pencil to colour in the F, Z and C shapes in the figures below.

Name	Description	Figure
Transversal	A transversal cuts _____ or more _____.	
Corresponding Angles	Make an ____ shape. Corresponding angles are _____.	
Alternate Angles	Make a ____ shape. Alternate _____ are equal.	
Cointerior Angles	Make a ____ shape. Cointerior angles add up to _____.	

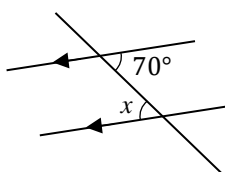
Fill in the spaces above with the following words/symbols/diagrams:

-

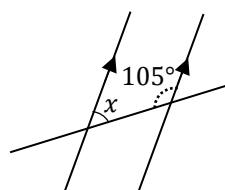
Example 1 <https://youtu.be/RipkysjNzUc>

Calculate the value of x in each diagram below, giving reasons.

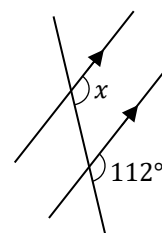
(a)



(b)



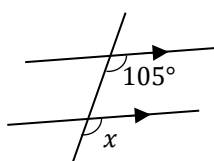
(c)



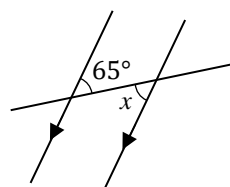
Question 1

Calculate the value of x in each diagram below, giving reasons.

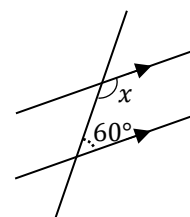
(a)



(b)



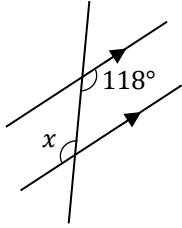
(c)



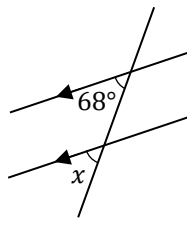
Question 1 continued

Calculate the value of x in each diagram below, giving reasons.

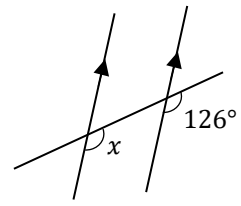
(d)



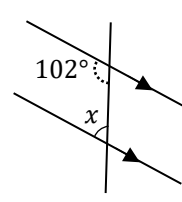
(e)



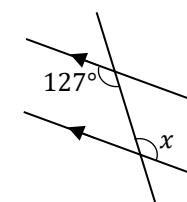
(f)



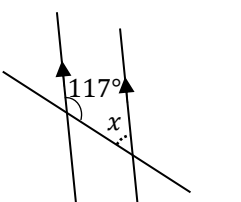
(g)



(h)



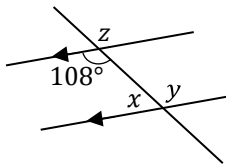
(i)



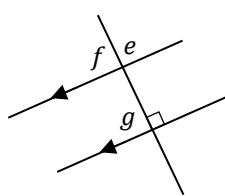
Question 2

Calculate the value of every pronumeral (letter) in each diagram below.

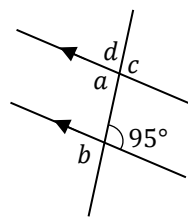
(a)



(b)



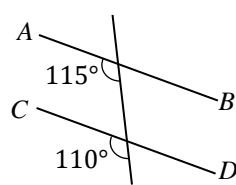
(c)



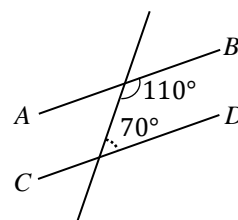
Example 2 <https://youtu.be/1MVP3fjDACQ>

Check whether the two lines AB and CD are parallel, giving reasons.

(a)



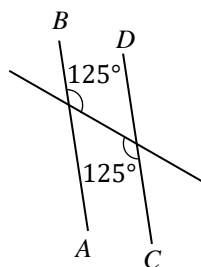
(b)



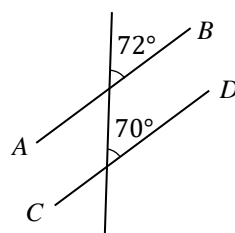
Question 3

Check whether the two lines AB and CD are parallel, giving reasons.

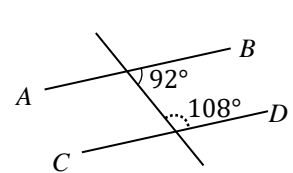
(a)



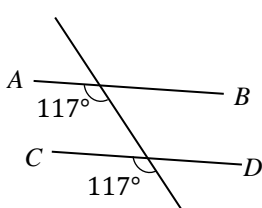
(b)



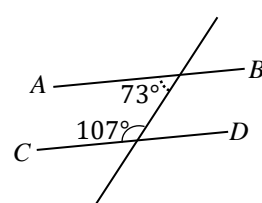
(c)



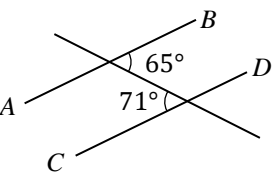
(d)



(e)

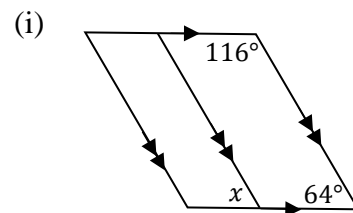
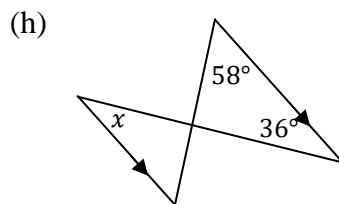
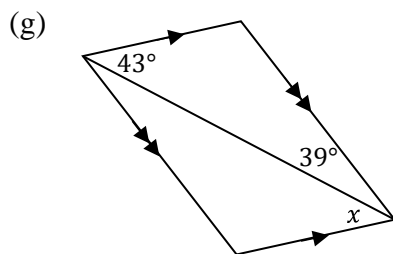
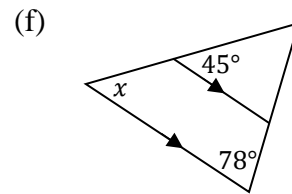
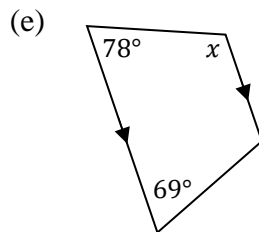
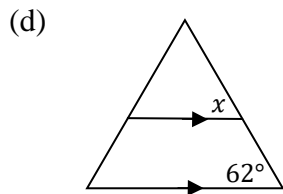
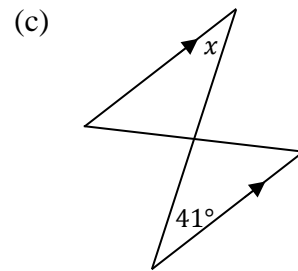
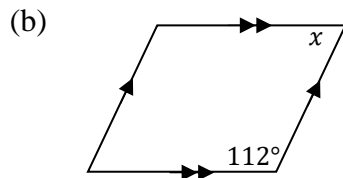
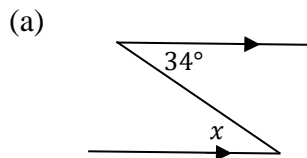


(f)



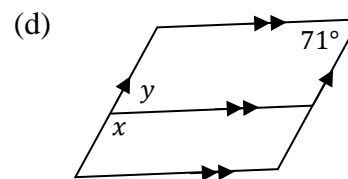
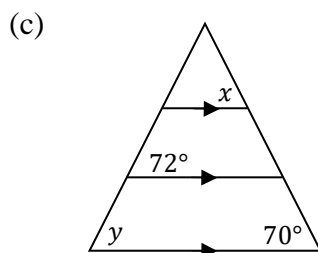
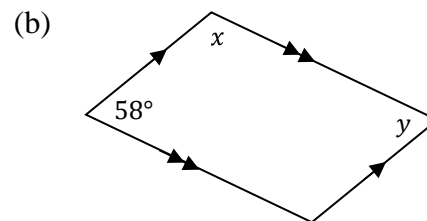
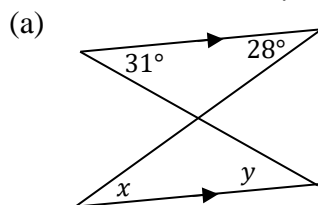
Question 4

Calculate the value of x in each diagram below.



Question 5

Calculate the value of x and y in each diagram below.



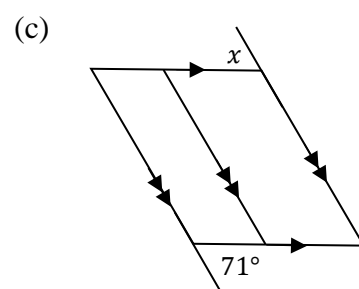
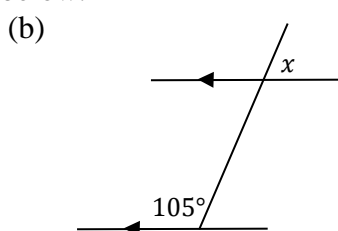
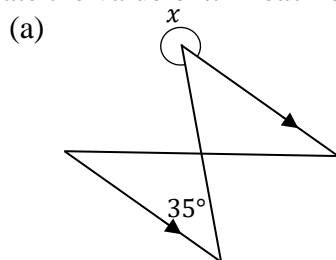
3F Complex Angle Problems <https://youtu.be/c1xrnKulpMU>

The diagrams below show what we have learned so far from chapters 3D and 3E.

Complementary Angles (add up to 90°)	Supplementary Angles (add up to 180°)	Angles in a Revolution (add up to 360°)	
Corresponding Angles (F shape) (are equal)	Alternate Angles (Z shape) (are equal)	Cointerior Angles (C shape) (add up to 180°)	Vertically Opposite Angles (are equal)

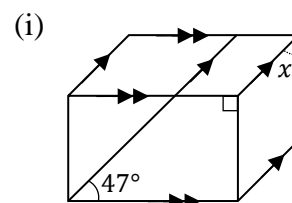
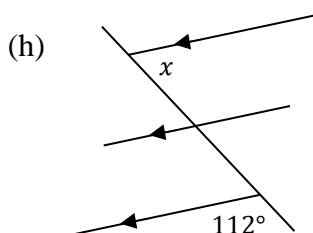
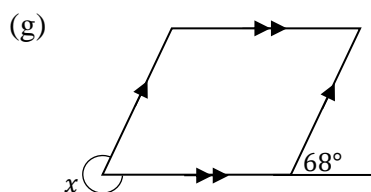
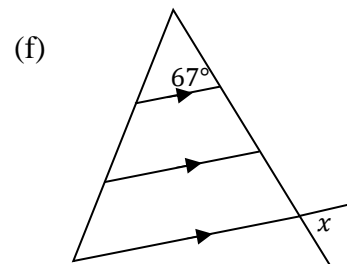
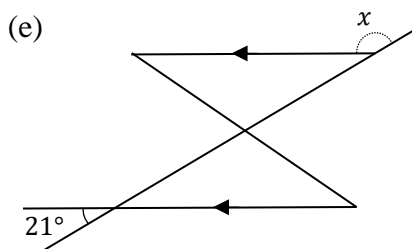
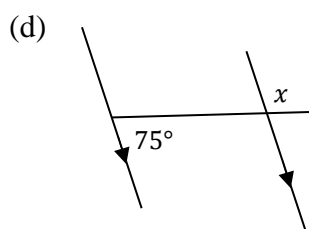
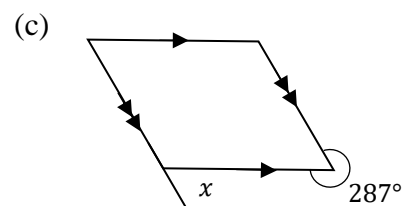
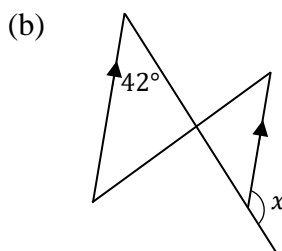
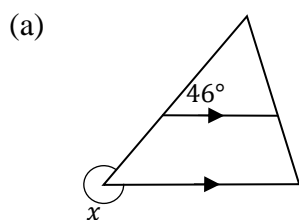
Example 1 <https://youtu.be/Dk4Ug9FibEk>

Calculate the value of x in each diagram below.



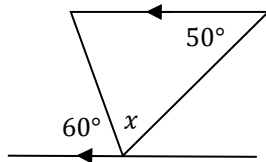
Question 1

Calculate the value of x in each diagram below.



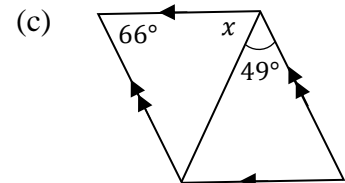
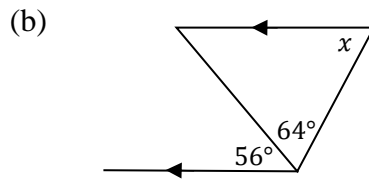
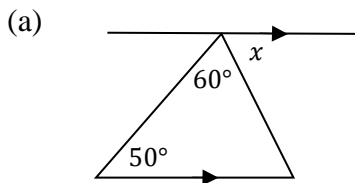
Example 2 <https://youtu.be/vSpZWjc5nRc>

Calculate the value of x below.



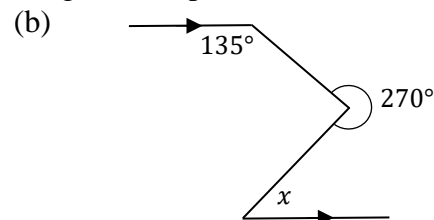
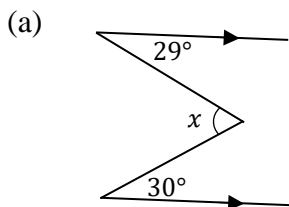
Question 2

Calculate the value of x in each diagram below.



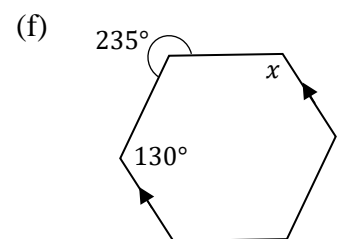
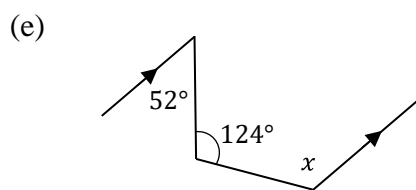
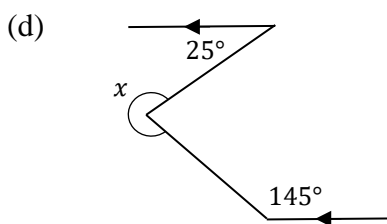
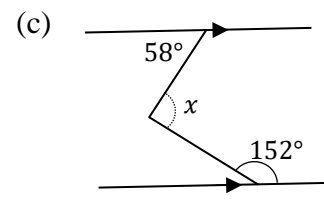
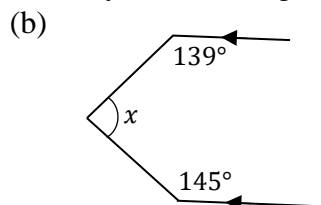
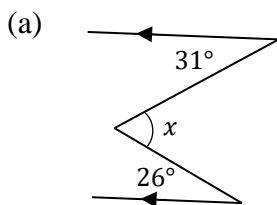
Example 3 https://youtu.be/PuN-fA_4FDs

Calculate the value of x in each diagram below by first drawing another parallel line.



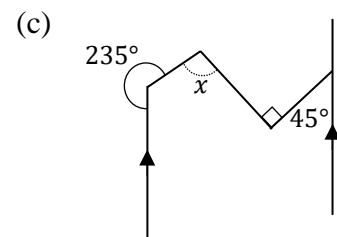
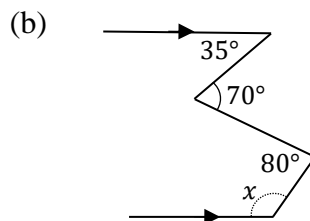
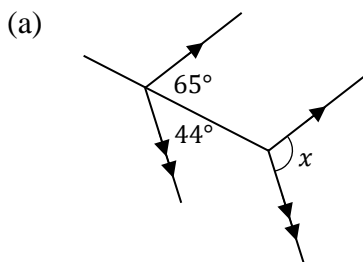
Question 3

Calculate the value of x in each diagram below by first drawing another parallel line.



Question 4

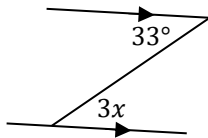
Calculate the value of x in each diagram below.



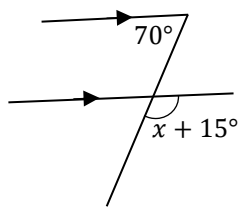
Example 4 <https://youtu.be/IP6h3YCr1SE>

Calculate the value of x in each diagram below.

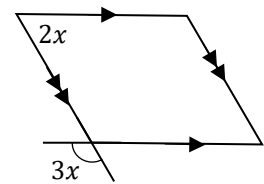
(a)



(b)



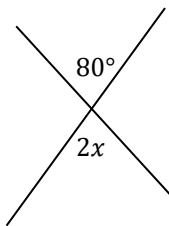
(c)



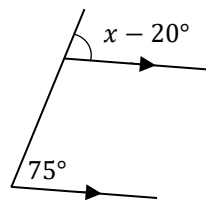
Question 5

Calculate the value of x in each diagram below.

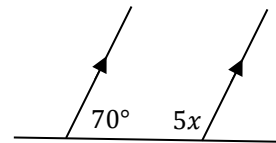
(a)



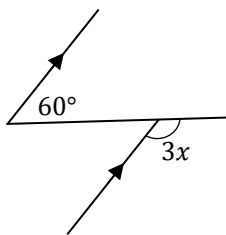
(b)



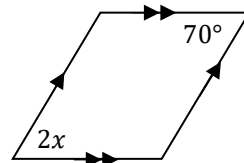
(c)



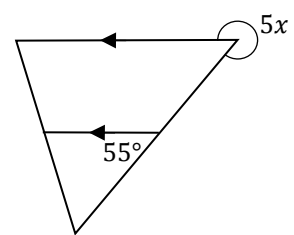
(d)



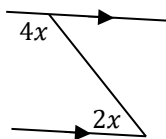
(e)



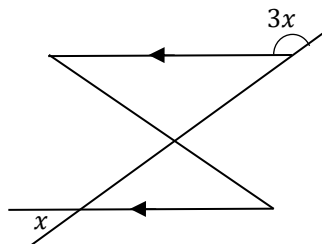
(f)



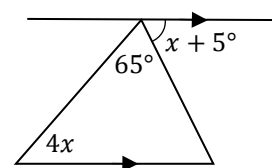
(g)



(h)



(i)

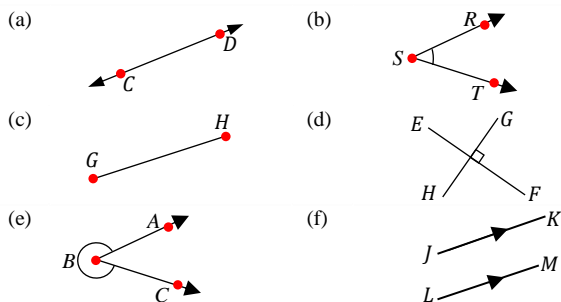


Solutions

Chapter 3A

Terminology – capital, forever, AB , direction, ends, fixed, BA , angle, vertex, arms, $\angle ABC$, $\angle CBA$, $AB \parallel CD$, $AD \perp BC$

Q1 –



Q2 – (a) ray ST (b) point Q (c) $\angle FGH$

Q3 – (a) $\angle DAE$ (b) $\angle VXW$ (c) $\angle JNM$ (d) $\angle EDG$ (e) $\angle ZWX$ (f) $\angle SPQ$

Q4 – $\angle ABC$, $\angle ACB$, $\angle ABE$, $\angle ABD$, $\angle ACE$, $\angle BAC$, $\angle BCA$, $\angle BCE$, $\angle BDE$, $\angle BEC$, $\angle BED$, $\angle CBD$, $\angle DBE$

Chapter 3B

Filling in the gaps – between 0° and 90° , Obtuse angle, 180° , Revolution

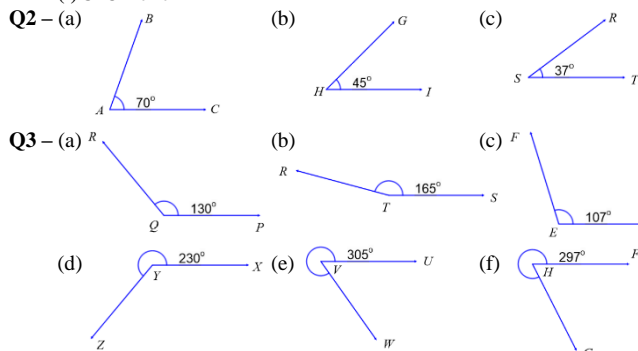
Q1 – (a) obtuse (b) right (c) acute (d) revolution (e) reflex (f) straight (g) acute (h) reflex (i) obtuse

Q2 – (a) acute (b) obtuse (c) right (d) acute (e) revolution (f) reflex (g) straight (h) obtuse (i) acute (j) reflex (k) obtuse (l) reflex

Q3 – (a) right (b) acute (c) reflex (d) straight (e) obtuse (f) revolution (g) reflex (h) acute (i) reflex (j) obtuse (k) acute (l) obtuse

Chapter 3C

Q1 – (a) 30° acute (b) 160° obtuse (c) 80° acute (d) 125° obtuse (e) 180° straight (f) 90° right (g) 260° reflex (h) 56° acute (i) 318° reflex



Q4 – (a) 40 (b) 23°

Q5 – (a) 120° and 240° (b) 7:00 and 5:00

Chapter 3D

Filling in the gaps – adjoining, $\angle YOZ$, 90° , 30° , 180° , 50° , 360° , 260° , intersect, equal, 70°

Q1 – (a) C (b) S (c) N (d) C (e) N (f) S (g) S (h) N

Q2 – (a) $x = 100^\circ$ (b) $x = 48^\circ$ (c) $x = 236^\circ$ (d) $x = 63^\circ$ (e) $x = 25^\circ$ (f) $x = 71^\circ$ (g) $x = 141^\circ$ (h) $x = 118^\circ$ (i) $x = 38^\circ$

Q3 – (a) $x = 45^\circ$, $y = 70^\circ$ (b) $x = 72^\circ$, $y = 81^\circ$ (c) $x = 21^\circ$, $y = 75^\circ$ (d) $x = 42^\circ$, $y = 73^\circ$ (e) $x = 90^\circ$, $y = 41^\circ$ (f) $x = 22^\circ$, $y = 126^\circ$

Q4 – (a) $x = 30^\circ$ (b) $x = 45^\circ$ (c) $x = 60^\circ$ (d) $x = 40^\circ$ (e) $x = 20^\circ$ (f) $x = 35^\circ$

Q5 – (a) $\angle COB + \angle DOC = 182^\circ$ when they should be supplementary (b) $\angle BOE = 70^\circ + 86^\circ = 156^\circ$ but $\angle BOE$ is vertically opposite to $\angle COD$ which is 155°

Chapter 3E

Filling in the gaps – 2, lines, F, equal, Z, angles, C, 180°

Q1 – (a) $x = 105^\circ$ (corresponding angles are equal)

(b) $x = 65^\circ$ (alternate angles are equal)

(c) $x = 120^\circ$ (cointerior angles add up to 180°)

(d) $x = 118^\circ$ (alternate angles are equal)

(e) $x = 68^\circ$ (corresponding angles are equal)

(f) $x = 126^\circ$ (corresponding angles are equal)

(g) $x = 78^\circ$ (cointerior angles add up to 180°)

(h) $x = 127^\circ$ (alternate angles are equal)

(i) $x = 63^\circ$ (cointerior angles add up to 180°)

Q2 – (a) $x = 72^\circ$, $y = 108^\circ$, $z = 108^\circ$ (b) $e = 90^\circ$, $f = 90^\circ$, $g = 90^\circ$

(c) $a = 95^\circ$, $b = 95^\circ$, $c = 95^\circ$, $d = 85^\circ$

Q3 – (a) $AB \parallel CD$ (alternate angles are equal)

(b) AB is not parallel to CD (corresponding angles are not equal)

(c) AB is not parallel to CD (cointerior angles don't add up to 180°)

(d) $AB \parallel CD$ (corresponding angles are equal)

(e) $AB \parallel CD$ (cointerior angles add up to 180°)

(f) AB is not parallel to CD (alternate angles are not equal)

Q4 – (a) $x = 34^\circ$ (b) $x = 68^\circ$ (c) $x = 41^\circ$ (d) $x = 62^\circ$ (e) $x = 102^\circ$

(f) $x = 45^\circ$, (g) $x = 43^\circ$ (h) $x = 36^\circ$ (i) $x = 64^\circ$

Q5 – (a) $x = 28^\circ$, $y = 31^\circ$ (b) $x = 122^\circ$, $y = 58^\circ$ (c) $x = 70^\circ$, $y = 72^\circ$

(d) $x = 109^\circ$, $y = 71^\circ$

Chapter 3F

Q1 – (a) $x = 314^\circ$ (b) $x = 138^\circ$ (c) $x = 73^\circ$ (d) $x = 105^\circ$ (e) $x = 159^\circ$

(f) $x = 67^\circ$ (g) $x = 292^\circ$ (h) $x = 68^\circ$ (i) $x = 43^\circ$

Q2 – (a) $x = 70^\circ$ (b) $x = 60^\circ$ (c) $x = 65^\circ$

Q3 – (a) $x = 57^\circ$ (b) $x = 76^\circ$ (c) $x = 86^\circ$ (d) $x = 300^\circ$ (e) $x = 108^\circ$

(f) $x = 105^\circ$

Q4 – (a) $x = 109^\circ$ (b) $x = 135^\circ$ (c) $x = 100^\circ$

Q5 – (a) $x = 40^\circ$ (b) $x = 95^\circ$ (c) $x = 22^\circ$ (d) $x = 40^\circ$ (e) $x = 35^\circ$

(f) $x = 61^\circ$ (g) $x = 30^\circ$ (h) $x = 45^\circ$ (i) $x = 22^\circ$