Answer **all** the questions.

1 Estimate of populations in the year 2012 is shown in the table below.

World	6.98×10^9
China	1.35×10^9
Japan	1.27×10^8
Singapore	4.84×10^6

(a) Find the total population of China and Japan, giving your answer in standard form.

$1.35 \times 10^9 + 1.27 \times 10^8$ — M1

$= 1\,477\,000\,000$

$= 1.477 \times 10^9$ — A1

Answer (a) ..... 1.477×10^9 ..... [2]

(b) Find the ratio of the population of Singapore to that of the world.

B1

Answer (b) ..... 121 : 174 500 ..... [1]

2 Use your calculator to evaluate $\dfrac{\sqrt[3]{434.25}+21.6^3}{76.15}$, giving your answer correct to 3 significant figures.

$\dfrac{\sqrt[3]{434.25} + 21.6^3}{76.15} = 132.6137\ldots$

≈ 133 [M1]

B2

Answer ..... 133 ..... [2]

3 Make m the subject of the formula $P = 2m + 2b$.

$P = 2m + 2b$

$P - 2b = 2m$

$2m = P - 2b$ — M1

$m = \dfrac{P-2b}{2}$

penalise if $\dfrac{P-2b}{2}$

Answer ..... $m = \dfrac{P-2b}{2}$ ..... [2]

or $\dfrac{P}{2} - b$ — A1

4 A car travels a total distance of 480 km in 4 hours 48 minutes.

(a) Express 4 hours 48 minutes in hours.

Answer *(a)* ..... $4\frac{4}{5}$ ..... h [1] B1

(b) Find the car's average speed in

(i) kilometres per hour,

$\frac{480}{4\frac{4}{5}} = 100$

Answer *(i)* ..... 100 ..... km/h [1] B1

(ii) metres per second.

$480000 \div 17280$

$= 27\frac{7}{9}$

Answer *(ii)* ..... $27\frac{7}{9}$ ..... m/s [1] B1

5 A map is drawn to a scale of 1 : 300 000.

(a) This scale can be written in the form 1 cm : y km.

Find y.

1 cm : 300000 cm

1 cm : 3 km

Answer *(a)* $y =$ ..... 3 ..... [1] B1

1 cm : 3 km
$(1)^2$ cm^2 : $(3)^2$ km^2 } M1
1 cm^2 : 9 km^2

(b) On the map, the area of a lake is 14 cm^2.

Calculate the actual area of the lake, giving your answer in square kilometres.

1 cm^2 : 9 km^2 — M1

∴ Actual area of lake

= 14 × 9

= 126 km^2 — A1

Answer (b) ..... 126 ..... km^2 [2]

6 **(a)** Simplify $\frac{(p^2q)^3}{p^3q^4}$ and express your answer in positive index notation.

$\frac{(p^2q)^3}{p^3q^4} = \frac{p^6q^3}{p^3q^4}$ — M1 $= \frac{p^3}{q}$

$x = p^3q^{-1}$

✓ $= \frac{p^3}{q}$ — A1

Answer (a) ..... $\frac{p^3}{q}$ ..... [2]

(b) Given that $4^x = 8^3$, write down the value of x.

$4^x = 8^3$

change to common base → $(2^2)^x = (2^3)^3$ — M1

$2x = 9$

$x = 4\frac{1}{2}$ — A1

Answer (b) $x =$ ..... $4\frac{1}{2}$ ..... [2]

7 **(a)** Factorise $4w^2 - 9$ completely.

Answer *(a)* $(2w+3)(2w-3)$ B2 [2]

Completing square.

(b) **(i)** Given that $x^2 + 8x - 9 = (x+a)^2 + b$, find a and b.

$x^2 + 8x - 9 = (x-4)^2 - 25$

Answer *(b)* *(i)* $a = 4$ B2

$b = -25$ [2]

(ii) Solve $x^2 + 8x - 9 = 0$.

x	$+$	9	$+9x$
x	$-$	1	$-x$
x^2	$-$	9	$+8x$

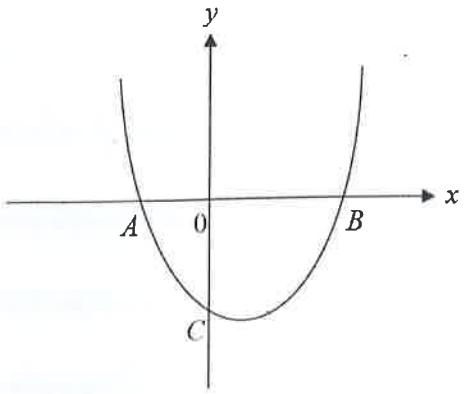
M1

$(x+9)(x-1) = 0$

$x = -9$ or $x = 1$ — A1

Answer *(b)* *(ii)* $x = -9$ or 1 [2]

8 The diagram shows the graph of $y = x^2 - 2x - 15$.



(a) The graph cuts the y-axis at C.

Write down the coordinates of C.

B1

Answer *(a)* $C = (\ 0\ ,\ -15\ )$ [1]

(b) The graph cuts the x-axis at $A\ (a,\ 0)$ and $B\ (b,\ 0)$.

Find the value of

(i) a,

B1

Answer *(b)(i)* $a =$ -3 [1]

(ii) b.

B1

Answer *(b)(ii)* $b =$ 5 [1]

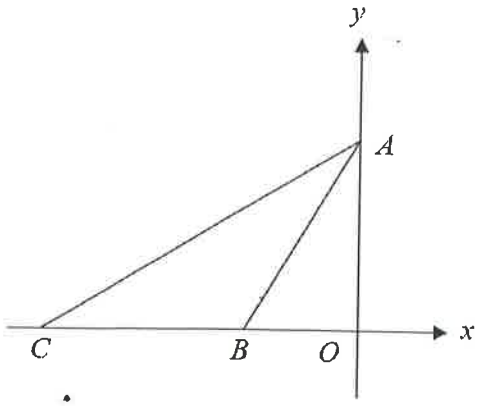
(c) Find the equation of the line of symmetry of the graph.

$x = \frac{-3+5}{2} = 1$

B1

Answer *(c)* $x = 1$ [1]

9 In the diagram, the equation of the line AC is $3y - 2x - 30 = 0$. The length of the line BC is 10 units.



(a) Find the coordinates of C.

penalise max 1m if no brackets

At C, $y = 0$

$\therefore\ 3(0) - 2(x) - 30 = 0$ — M1

$2x = -30$

$x = -15$ — A1

Answer (a) C(-15, 0) [2]

(b) Find the coordinates of B.

Since the length is 10 units (BC),

$\therefore$ x coordinate of B = $-15 + 10$

$= -5$

Answer (b) (-5, 0) B1 [1]

(c) Find the area of triangle ABC.

Area of $\Delta ABC = \frac{1}{2} \times BC \times OA$

$= \frac{1}{2} \times 10 \times 10$

$= 50$ units^2

B1

Answer (c) 50 units^2 [1]

10 Mr Lee wants to deposit \$10 000 in a bank for 5 years. He compares the interest rate offered by 2 different banks.

***ABC* Bank** 1.65% per year Simple Interest	***XYZ* Bank** 1.5% per year Compound Interest

Which bank should he choose? Justify your answer with the relevant working.

Circle your answer: (*ABC* Bank) / *XYZ* Bank [1] A1

Working [2]:

Simple interest for ABC Bank

$= \frac{(10000)(1.65)(5)}{100}$

$= \$825 + 10000$

$= \$10825$

Amount for XYZ Bank

$= 10000\left(1 + \frac{1.5}{100}\right)^5$

$= \$10722.84004$

① ABC Bank

② Correct formula used. (at least one)

③ Even the wrong answer, it is ok.

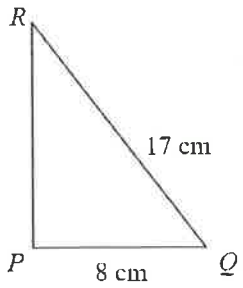
M1 + M1

Amount of ABC Amount of XYZ

Since \$10825 > \$10722.84004,

∴ ABC Bank is a better choice.

11 In the diagram, $PQ = 8$ cm, $PR = 15$ cm and $QR = 17$ cm. PQR is a right-angled triangle.



Prove that PR = 15.

(a) ~~Find the length of *PR*.~~

By Pythagoras' Theorem,

$PR^2 = RQ^2 - PQ^2$

$= (17)^2 - (8)^2$ — M1

$= 15$ cm — A1

Answer *(a)* ..... 15 ..... cm [2]

(b) (i) Find the area of triangle PQR.

B1

Answer *(b)* *(i)* ..... 60 ..... cm² [1]

(b) (ii) Hence or otherwise, find the shortest distance from P to QR.

let d to be the shortest distance,

Area of $\Delta PQR = \frac{1}{2} \times 17 \times d$

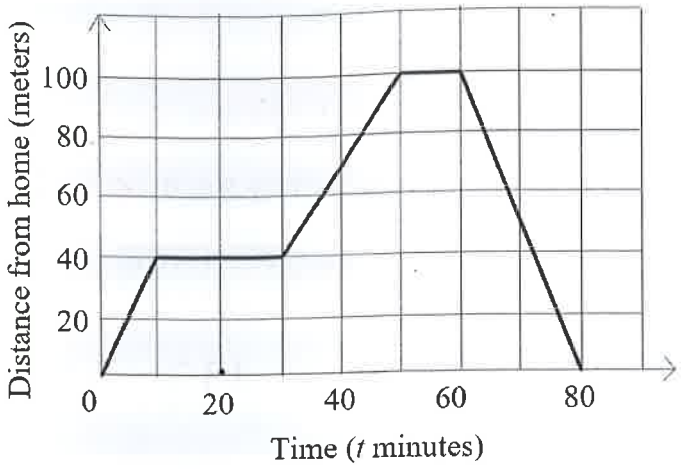
$60 = \frac{1}{2} \times 17 \times d$ — M1

$d = 7\frac{1}{17}$ — A1

7.06

Answer *(b)* *(ii)* ..... $7\frac{1}{17}$ ..... cm [2]

12 Mary walked from her home to a fast food restaurant and stopped to buy a burger. She then walked to the library and stopped to return a book, before heading home.
The diagram below shows her distance-time graph.



(a) Find Mary's speed if she took 10 minutes to walk to the restaurant.

Answer (a) 4 m /min [1] B1

(b) Find Mary's average speed for the entire journey in m/min.

Average speed = $\frac{200}{80}$ — M1 (when students identify that total distance is 200m)

= 2.5 m/min — A1

Answer (b) 2.5 m /min [2]

13 In a Mathematics lesson on Quadratic Equations, Jacer wrote the following working. However, his good friend Lance claimed that Jacer's working is incorrect.

Jacer's working:

$$4x^2 - 3x = 8$$

$$4x^2 - 3x + 8 = 0$$ ← M1: incorrect

$$x = \frac{-3 \pm \sqrt{3^2 - 4(4)(8)}}{2}$$

$$x = \frac{-3 \pm \sqrt{-119}}{2}$$

Hence, the equation has no real solution.

Do you agree with Lance? Justify your answer with the relevant working.

Circle your answer: (Agree) / Disagree [1] A1

Working [2]:

$4x^2 - 3x = 8$

$4x^2 - 3x - 8 = 0$ — M1

$x = \frac{-(-3) \pm \sqrt{(-3)^2 - 4(4)(-8)}}{2(4)}$ — M1

$= \frac{3 \pm \sqrt{137}}{8}$

$= 1.84$ or -1.09 (3 sf) ~~M1~~

∴ x has solutions which are 1.84 and −1.09.

14 Machine A can assemble a computer in x minutes.

(a) Write down an expression, in terms of x, for the number of computers Machine A can assemble in one hour.

x min → 1

60 min → $\frac{60}{x} \times 1 = \frac{60}{x}$

$\frac{60}{x}$ B1

Answer (a) ..... [1]

Machine B takes 5 minutes less than Machine A to assemble a computer.

(b) Write down an expression, in terms of x, for the number of computers Machine B can assemble in one hour.

$(x-5)$ min → 1

60 min → $\frac{60}{x-5} \times 1$

$= \frac{60}{x-5}$

$\frac{60}{x-5}$ B1

Answer (b) ..... [1]

(c) In an hour, Machine B can assemble 4 computers more than Machine A. Form an equation in x and show that it reduces to $x^2 - 5x - 75 = 0$.

$\frac{60}{x-5} - \frac{60}{x} = 4$ — M1

$60x - 60(x-5) = 4x(x-5)$

$60x - 60x + 300 = 4x^2 - 20x$

$4x^2 - 20x - 300 = 0$

$x^2 - 5x - 75 = 0$ — A1

(shown)

Answer (c) Show in your working [2]

(d) Solve the equation $x^2 - 5x - 75 = 0$ shown in part **(c)** to find the **maximum** number of computers Machine A can assemble in 5 hours.

$$x^2 - 5x - 75 = 0$$

$$x = \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(-75)}}{2(1)} \quad \text{— M1}$$

$$= \frac{5 \pm \sqrt{325}}{2}$$

$x = 11.5138$ or $x = -6.5138$ (rej) — M1

Note: Award M1 if students get both values of x.
Students must reject negative x values.

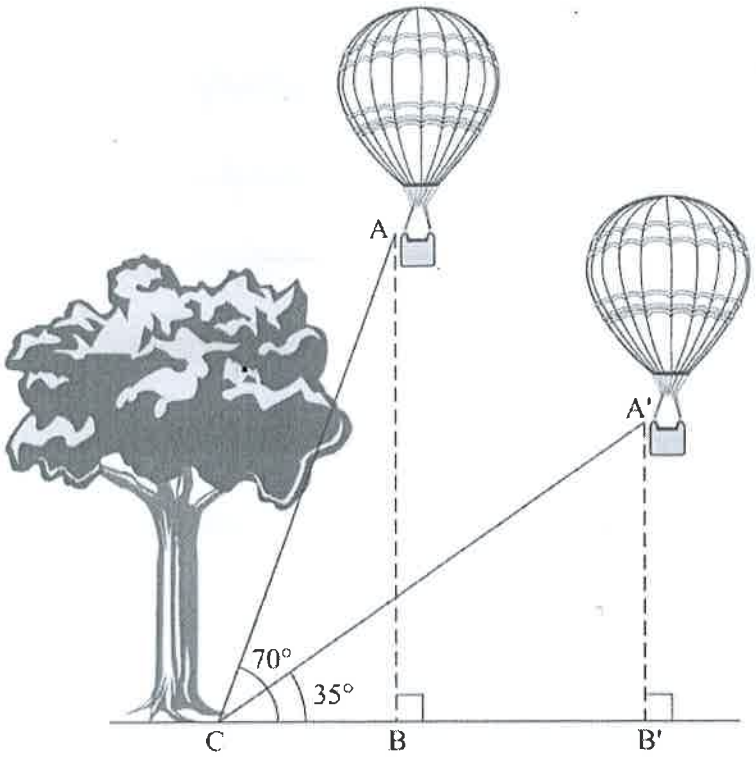
$\therefore$ No of computers $= \frac{60}{11.5138} \times 5$ (11.5138 from part (a))

$= 26.055$

≈ 26 # — A1

Answer *(d)* 26 computers [3]

15 A hot air balloon was tied with a 300 m rope to the bottom of a tree. At first, the angle between the rope and the ground was 70° and finally decreased to 35°.



(a) Find the distance AB.

$\sin 70 = \frac{AB}{300}$ — M1

$\therefore AB = \sin 70 \times 300$

$= 281.908 \approx 282$ — A1

Answer (a) 282 m [2]

(b) Find the vertical distance that the hot air balloon descended.

$\sin 35 = \frac{AB'}{300}$ — M1

$AB' = 172.073$

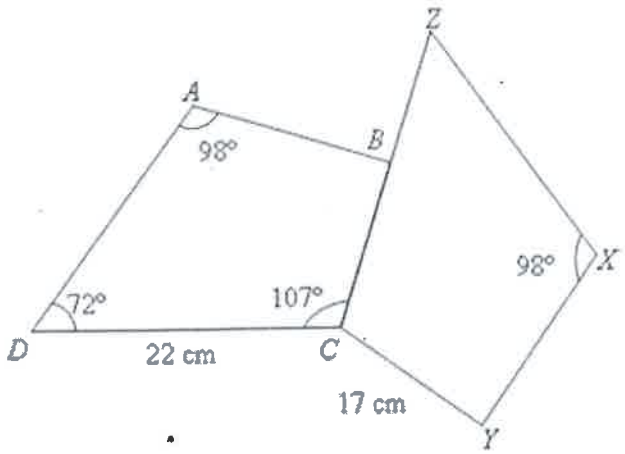
$\therefore$ Height descended $= 281.908 - 172.073$

$= 109.835$

≈ 110 (3sf) — A1

Answer (b) 110 m [2]

16 In the diagram, quadrilaterals $ABCD$ and $XYCZ$ are congruent.



Find

(a) $\angle ABC$,

B1

Answer (a) 83 ° [1]

(b) the length of BZ.

B1

Answer (b) 5 cm [1]

17

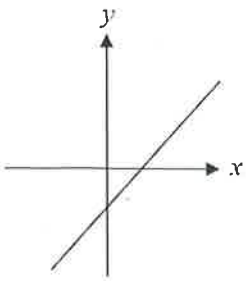


Figure 1

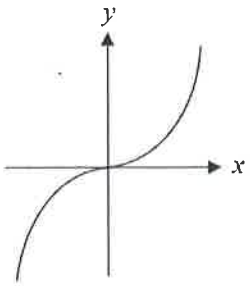


Figure 2

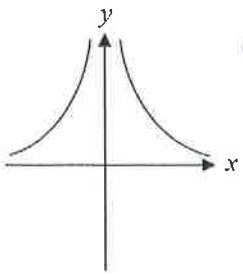


Figure 3

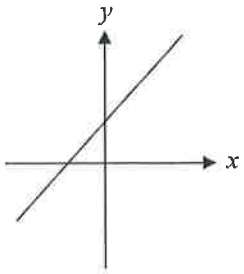


Figure 4

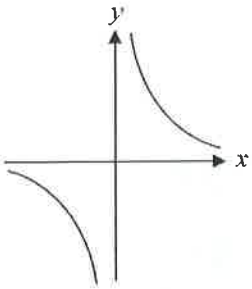


Figure 5

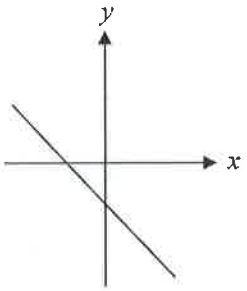


Figure 6

Which of the graphs shown above could be the graph of

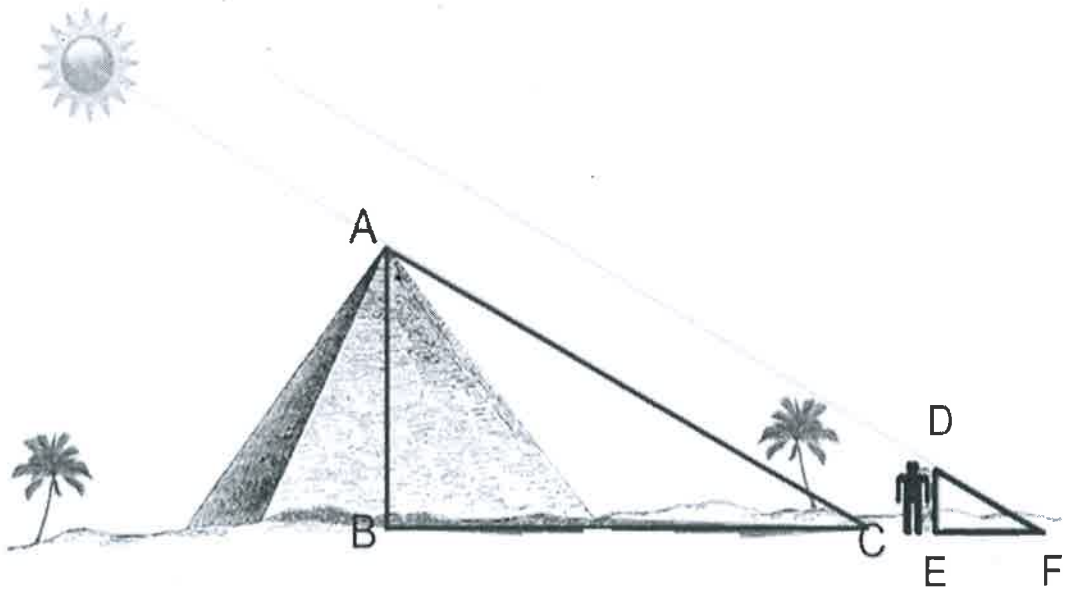
(a) $y = \frac{1}{x^2}$,

Answer *(a)* Figure 3 [1] B1

(b) $y = 3x - 1$?

Answer *(b)* Figure 1 [1] B1

18 A wise man looks up at a pyramid and wants to find the height of the pyramid. After some observation, he sketches the diagram shown below. It is given that ΔABC is similar to ΔDEF, $\angle ABC = 90°$, $\angle DEF = 90°$, $BC = 20$ m and $EF = 3$ m. The man's height is 1.8 m.



(a) If $\angle ACB = 38°$ find $\angle EDF$.

$\angle ACB = \angle DFE = 38°$

$\therefore \angle EDF = 180° - 90° - 38°$ — M1

$= 52°$ — A1

Answer *(a)* 52 ° [2]

(b) If DE represents the man's height, find the height of the pyramid, AB.

$\frac{BC}{EF} = \frac{AB}{DE}$ $\therefore AB = 12$ m — A1

$\frac{20}{3} = \frac{AB}{1.8}$ — M1

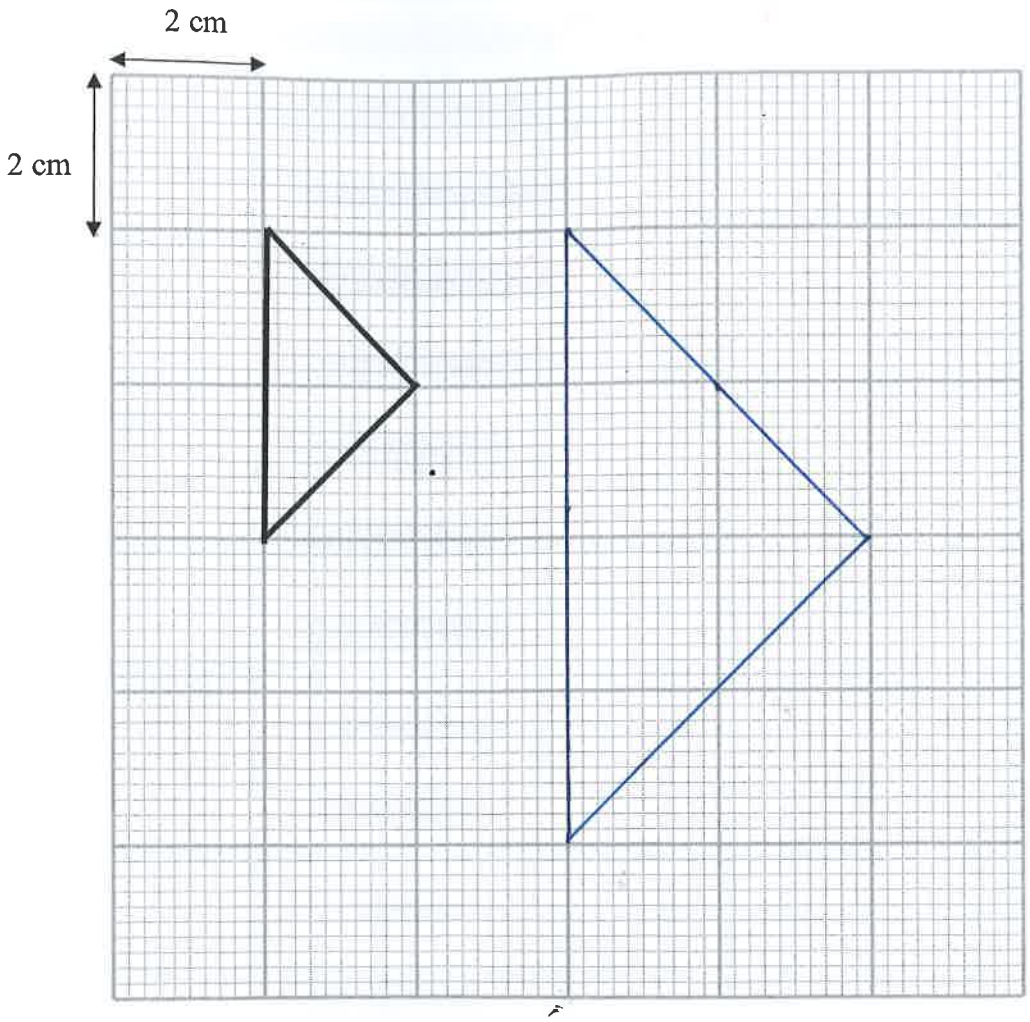
Answer *(b)* 12 m [2]

b) $\frac{20}{\sin 52} = \frac{AB}{\sin 38}$

$AB = 15.625$

≈ 15.6 m

19 **(a)** Draw on the grid an enlargement of the given shape ***A***, with a scale factor of 2. [1]



(b) Shape ***B*** is a reduction of Shape ***A*** using scale factor x.
The longest side of shape B has length 3cm.

Find x.

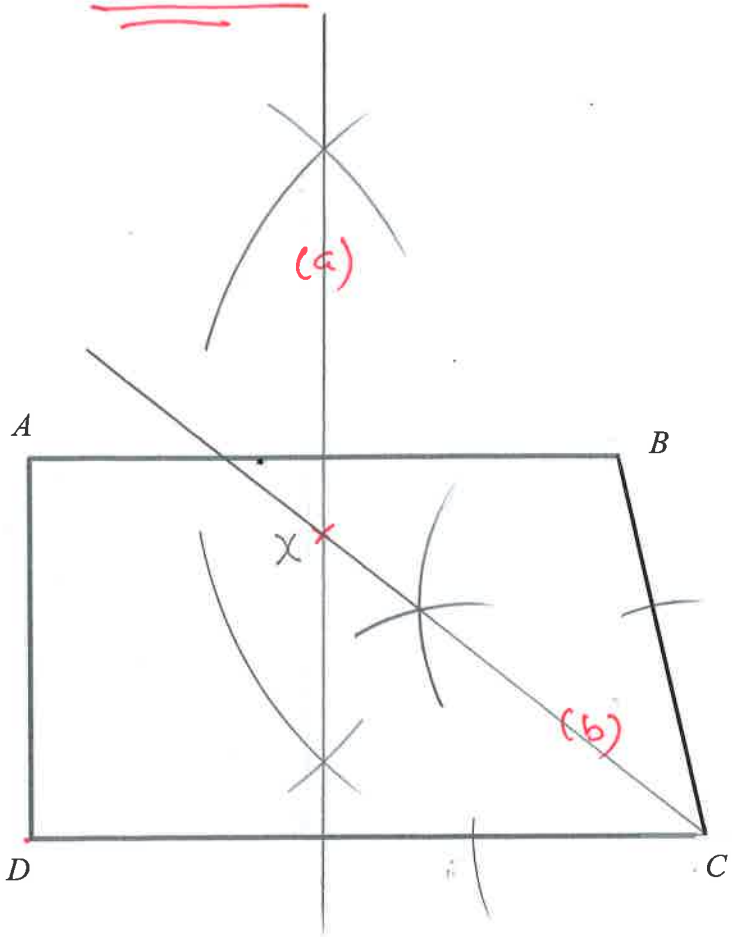
scale factor > 1 : enlargement

< 1 : reduction.

Answer *(b)* ..... 0.75 or $\frac{3}{4}$ ..... B1 [1]

20 The diagram shows a scale drawing of a field *ABCD*.

It is drawn to a scale of 1 cm to 10 km.



(a) Construct the perpendicular bisector of *AB*. [1] B1

(b) Construct the angle bisector of angle *BCD*. [1] B1

(c) **(i)** A treasure is hidden at point X which is equidistant from lines *CB* and *CD* as well as points *A* and *B*. Mark the point X. [1] B1

(ii) Measure the length *DX*, giving your answer in kilometres

54, 55, 56 km. DX = 5.5 cm (± 0.1) ←

1 cm : 10 km

Answer (ii) 55 km [1] B1

54, 55, 56

END OF PAPER