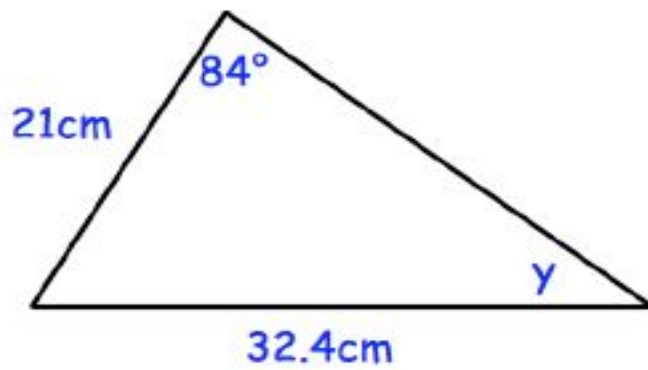


Advanced Topics

Year 11 Easter Booklet

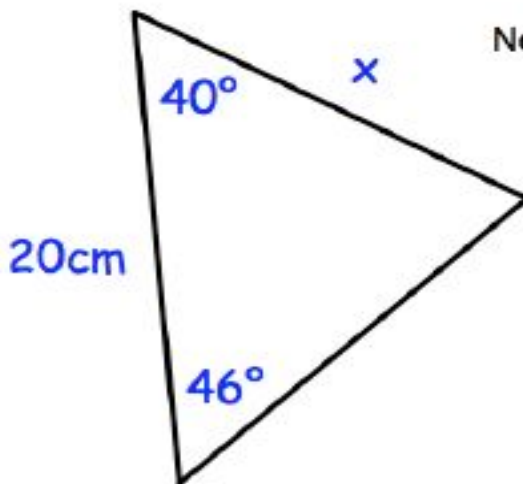
Name

Topic 1: Advanced Trigonometry



Calculate the size of the angle labelled y .

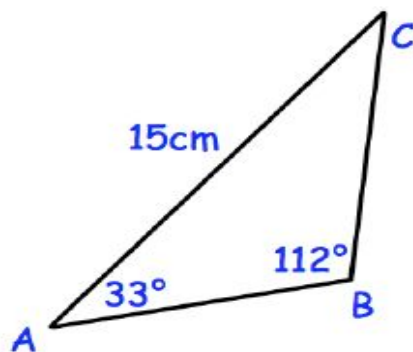
.....[°]
(3)



Not drawn is scale.

Find the size of x .

.....cm
(3)



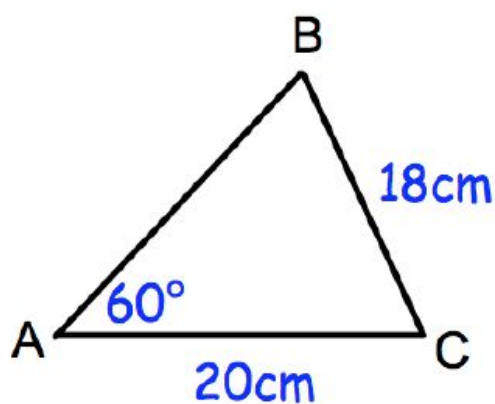
In triangle ABC the length of AC is 15cm.

Angle ABC = 112°

Angle BAC = 33°

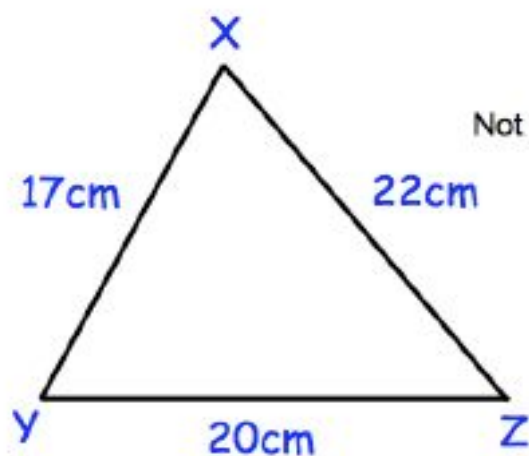
Work out the length of BC.

.....cm
(3)



Calculate the size of angle ABC.

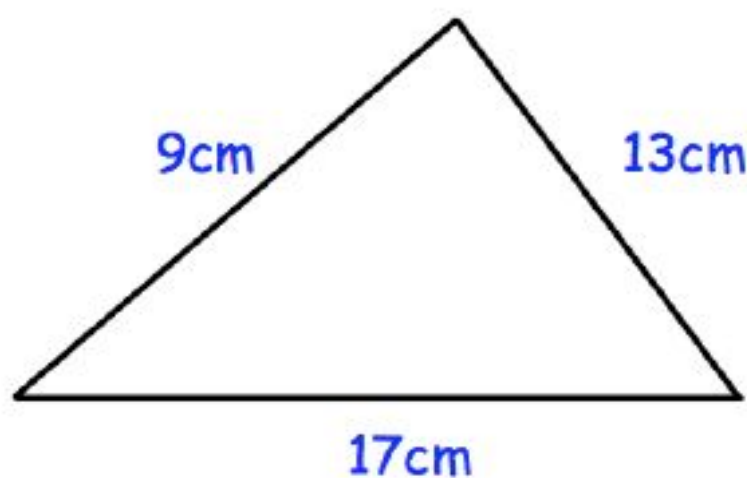
.....°
(3)



Not drawn to scale.

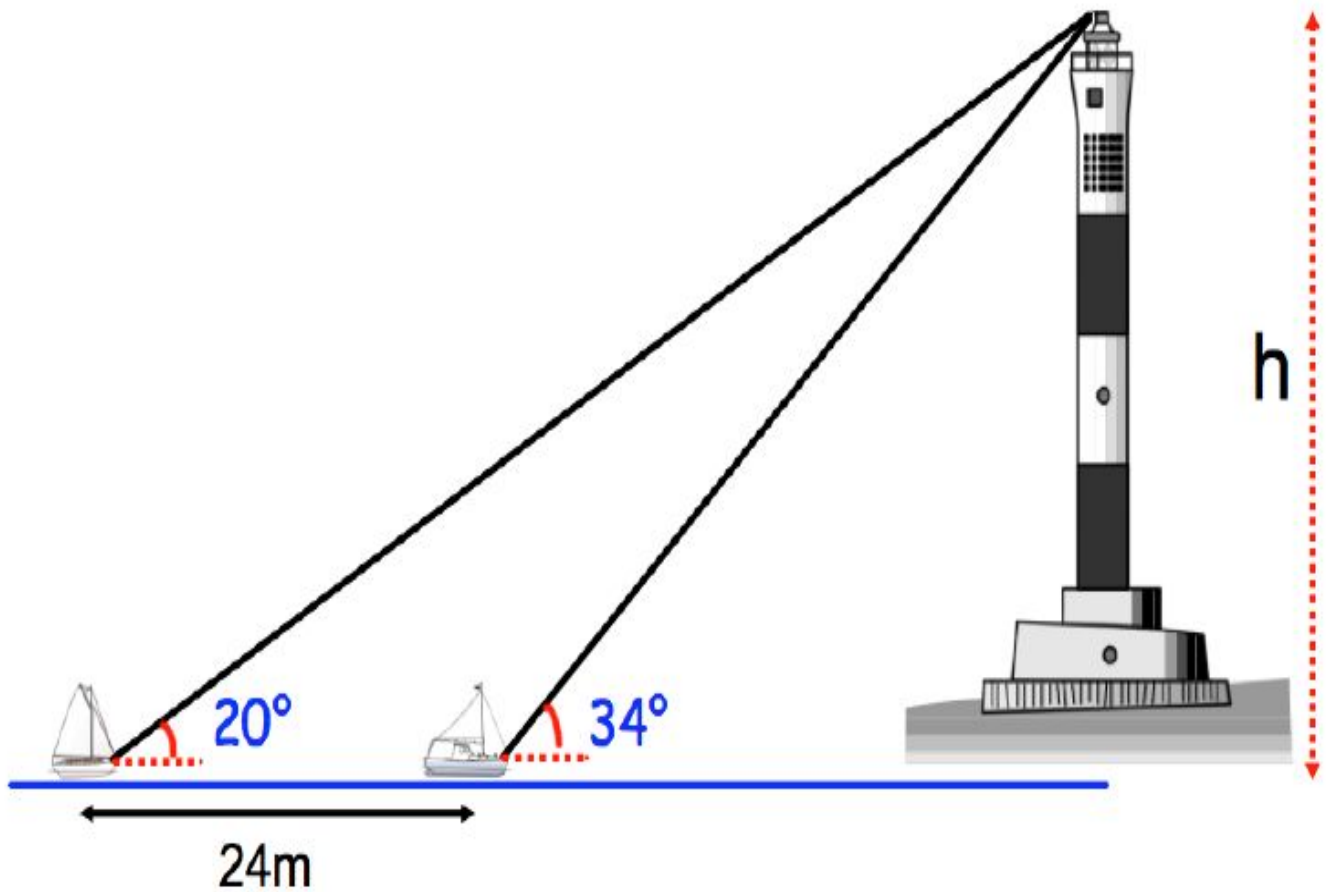
Find the size of angle XZY.

.....°
(3)



Calculate the smallest angle in the triangle.

.....°
(3)

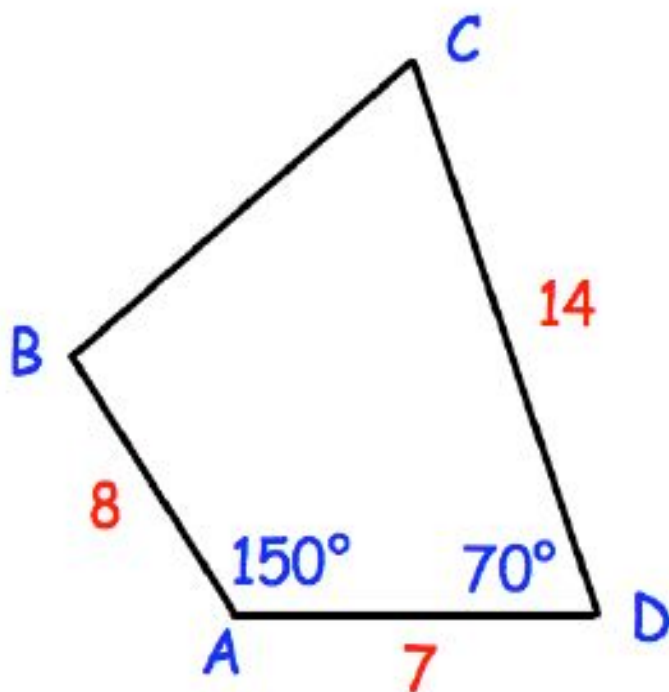


Two small boats are 24m apart.

The angle of elevation of the boats to the top of a lighthouse are 20° and 34° respectively.

Calculate the height of the lighthouse.

18. In a quadrilateral ABCD, $AD = 7\text{cm}$, $AB = 8\text{cm}$ and $CD = 14\text{cm}$.
Angle $BAD = 150^\circ$ and Angle $ADC = 70^\circ$



Calculate the length BC.

Topic 2: Reverse Mean

7. Shown below are five cards which are arranged in order from smallest to largest



5				
---	--	--	--	--

The range of the cards is 4.
The median of the cards is 8.
The mean of the cards is 7.

Work out the 4 missing numbers.

.....,, and

8. 8 boys and 8 girls from a class run 100m.



The times taken, to the nearest second, for each girl are:

15 20 24 18 19 21 26 29


The mean of the boys' times is 25 seconds.

The range of the boys' times is 14 seconds.

Thomas says that "the boys in our class are faster than the girls."

Is he correct?

7. Simon rolls a fair six-sided dice 30 times.
He records the results in a table, however misses two of the frequencies.



Number	Frequency
1	6
2	3
3	5
4	
5	
6	6

The mean result is 3.5

Work out the two missing numbers.

8. The star rating, from 1 to 5, of hotels in a city are summarised below.



Star rating	Frequency
1	4
2	17
3	23
4	x
5	18

The mean star rating of a hotel in the city is 3.575

Calculate the value of the missing frequency, x.

Topic 3: Equations of Lines Advanced

-
13. The point A $(-3, 5)$ and the point B $(1, -15)$ lie on the line L.

Find the equation of the line L.

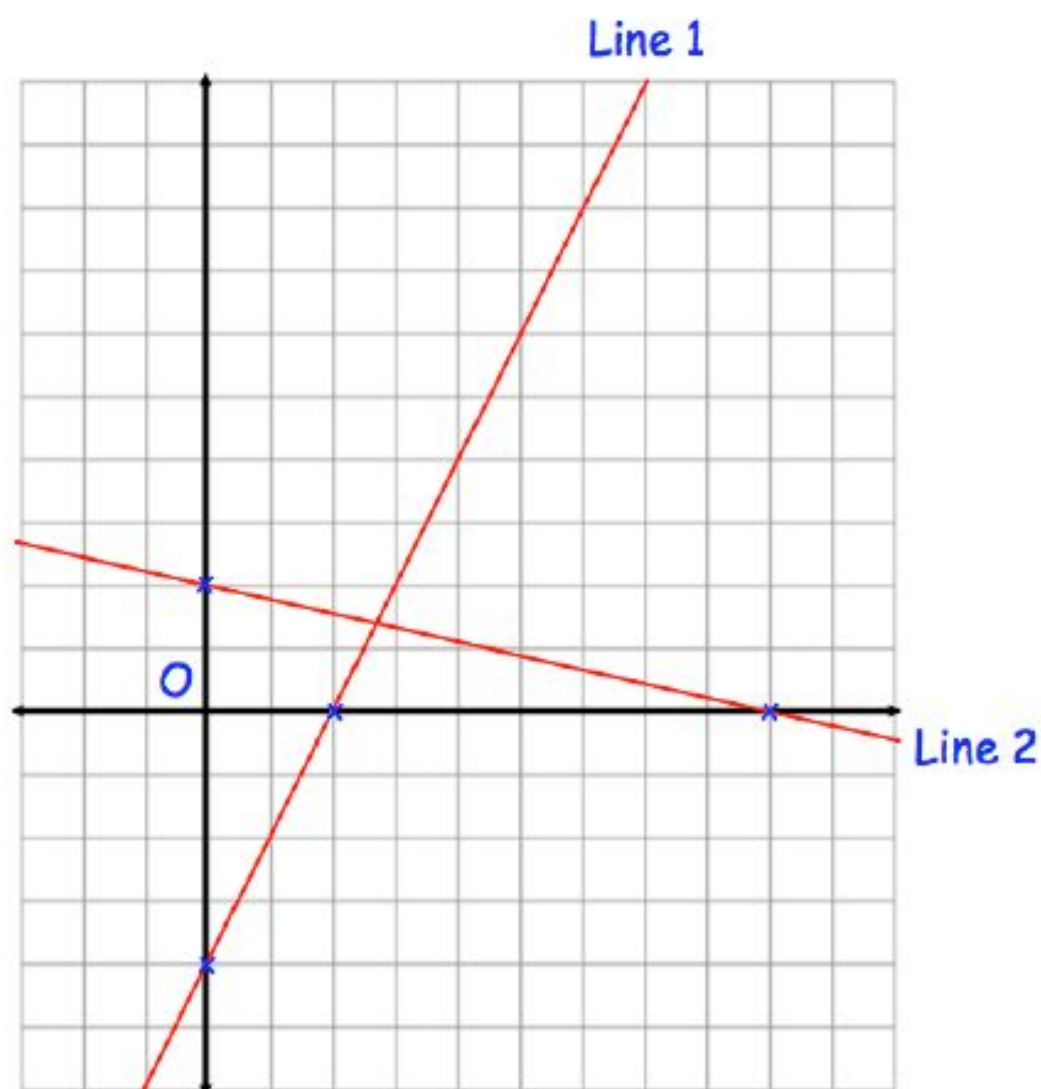
.....
(4)

-
14. The point A $(1, 1)$ and the point B $(5, -1)$ lie on the line L.

Find the equation of the line L.

.....
(4)

28. Shown are two straight lines drawn on the grid.



Line 1 has equation $y = 3x - 12$

(a) Find the equation of Line 2

.....
(4)

(b) Are the two lines perpendicular?
Explain your answer.

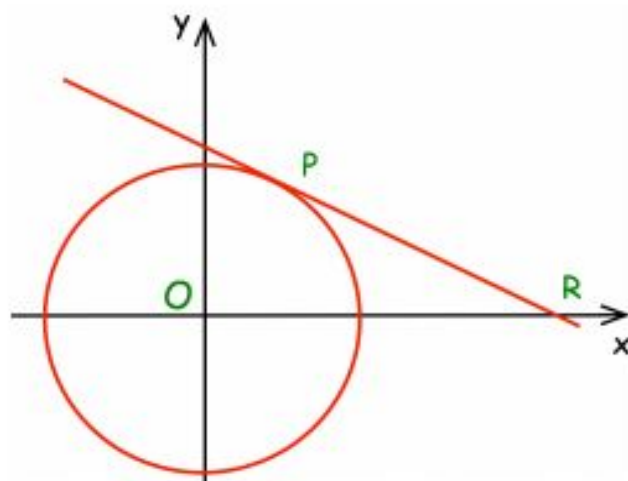
.....
.....
(1)

The line l is a tangent to the circle $x^2 + y^2 = 68$ at the point P .
 P is the point $(2, 8)$

Work out the equation of the line l

.....
(3)

The diagram shows the circle $x^2 + y^2 = 17$



P lies on the circle and has x -coordinate 1.
The tangent at P intersects the x -axis at R .

Work out the coordinates of R

.....
(5)

The line l is a tangent to the circle $x^2 + y^2 = 90$ at the point P.

P is the point (3, 9)

The line l crosses the x-axis at the point Q.

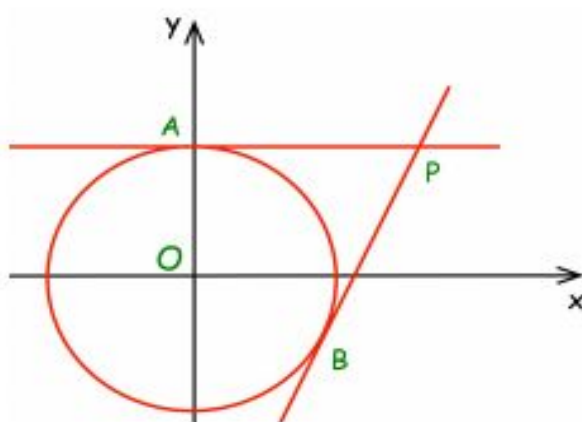
Work out the area of triangle OPQ.

.....
(5)

The circle $x^2 + y^2 = 25$ has tangents at the points A and B.

The point A has coordinates (0, 5)

The point B has coordinates (3, -4)



The tangents meet at the point P.

Work out the coordinates of the point P.

.....
(5)

Topic 4: Upper and Lower Bounds

14. Sophie estimated that the distance between Bristol and Newcastle is about 290 miles and that her average driving speed would be 60 mph.



She estimated the distance to the nearest 10 miles and the speed to the nearest 10 mph.

Calculate the lower bound of the time the journey should take.

Give your answer in hours and minutes.

Give your answer to the nearest minute.

.....hoursminutes
(4)

15. The final velocity of a traveling object is given by the formula



$$v = u + at$$

where v is the final velocity

u is the initial velocity

a is the acceleration

and t is the time

Given $u = 2.4$ m/s correct to 2 significant figures,
 $a = 12$ m/s² correct to 2 significant figures,
and $t = 5$ seconds correct to 1 significant figure.

Calculate the lower bound for v .

.....m/s
(4)

16. The curved surface area of a cone is given by the formula



$$A = \pi r l$$

where A is the curved surface area

r is the radius of the base of the cone


and l is the slant height

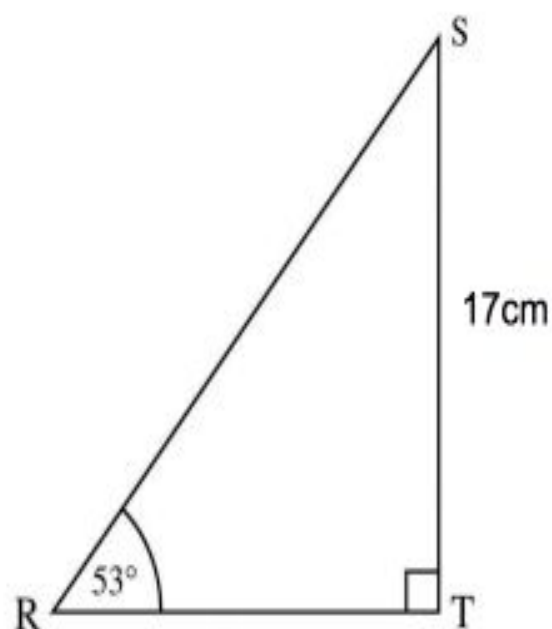
Given $A = 220 \text{ cm}^2$ correct to 3 significant figures,
and $r = 8 \text{ cm}$ correct to 1 significant figure.

Calculate the upper bound for l .

.....cm

(3)

17. Shown below is triangle RST.
-  Angle SRT is 53° , to the nearest degree.
ST is 17cm to the nearest centimetre.



Work out the upper bound for the length of RS.

.....cm
(4)

18. The length of the base of a triangle is 10cm, correct to 2 significant figures.



The length of the perpendicular height of a triangle is 15cm, correct to 2 significant figures.

(a) Calculate the upper bound for the area of the triangle

.....cm²
(2)

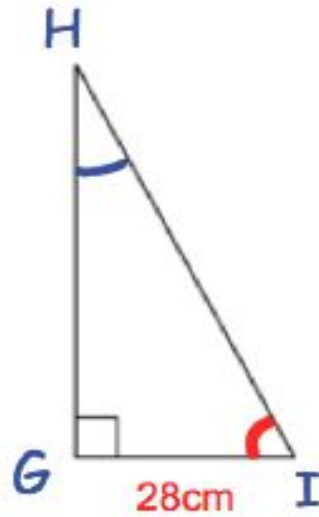
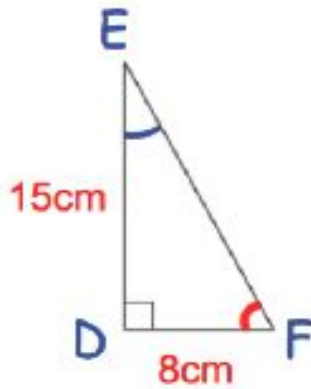
(b) Calculate the lower bound for the area of the triangle

.....cm²
(2)

Topic 5: Similarity – Area and Volume



Not drawn to scale



DEF and GHI are similar right angled triangles.

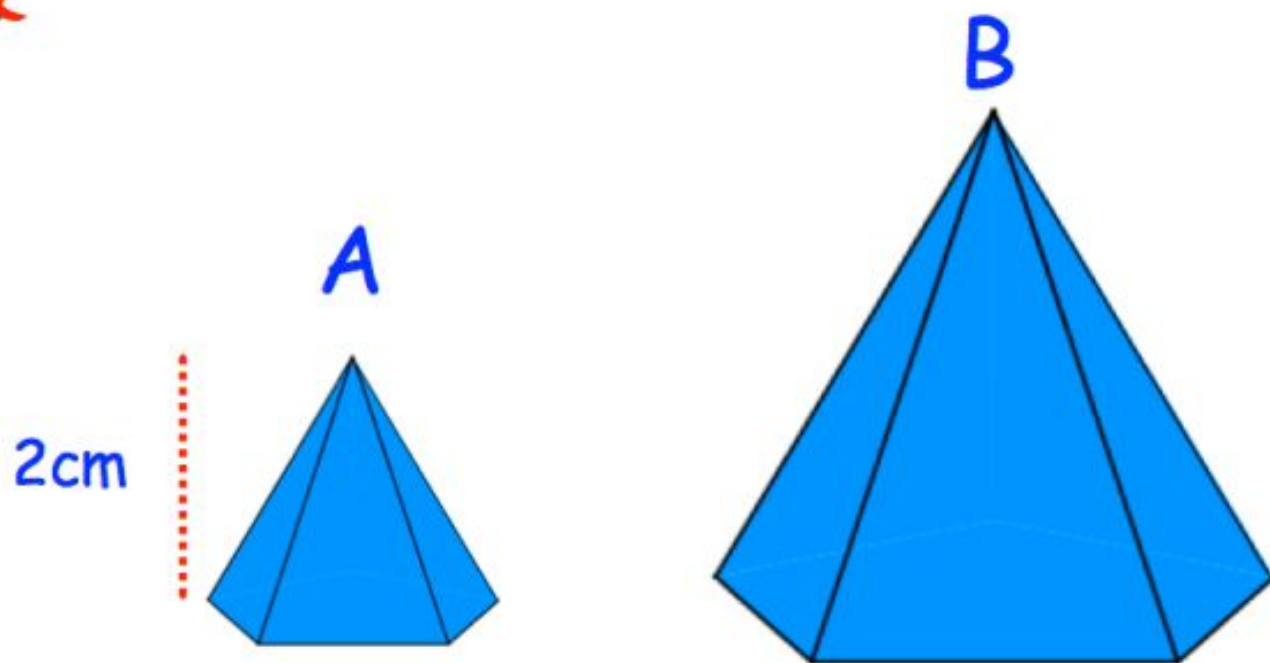
DE = 15cm

DF = 8cm

GI = 28cm

Work out the length of HI

20. Two pyramids are mathematically similar.



Pyramid A has a surface area of 20cm^2
Pyramid B has a surface area of 320cm^2
The height of pyramid A is 2cm

- (a) Work out the height of pyramid B.

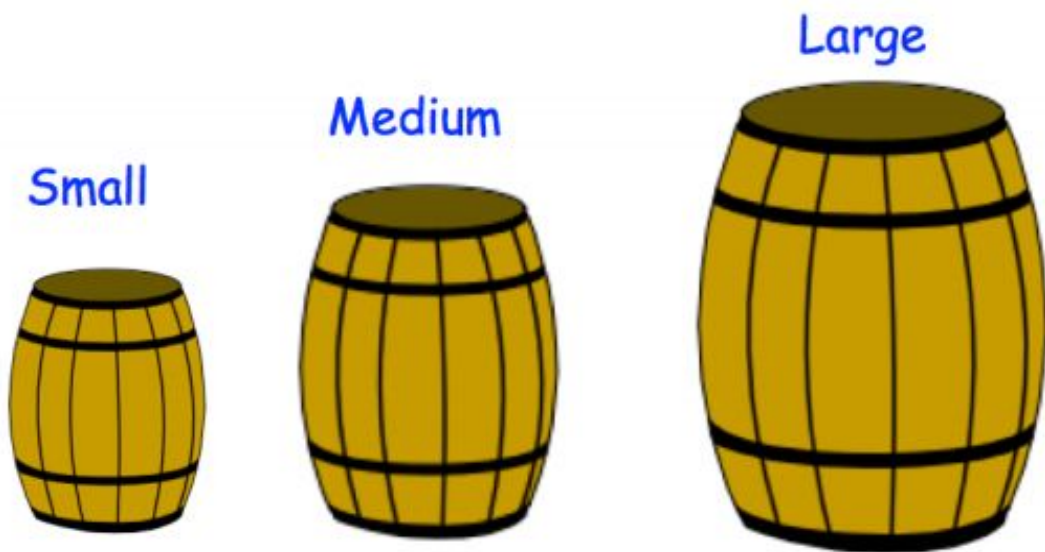
.....cm
(3)

Pyramid A has a weight of 800g
Both pyramids are made of the same material.

- (b) Work out the weight of pyramid B.
Include suitable units.

.....
(4)

15. Wine is kept in three different sized barrels that are mathematically similar.



The table below shows information about the barrels.

	Height	Capacity
Small	24 inches	100 litres
Medium	30 inches	
Large		240 litres

Complete the table.

21. Two solids are mathematically similar.
The surface area of the smaller solid is $42\pi \text{ cm}^2$
The surface area of the larger solid is $1512\pi \text{ cm}^2$



The height of the larger solid is 96cm.

Work out the height of the smaller solid.

.....cm
(3)

22. The areas of two mathematically similar shapes are in the ratio 49 : 81



The length of the smaller shape is 24.5cm

Work out the length of the larger shape.

.....cm
(3)

23. The volumes of two mathematically similar solids are in the ratio 8 : 125

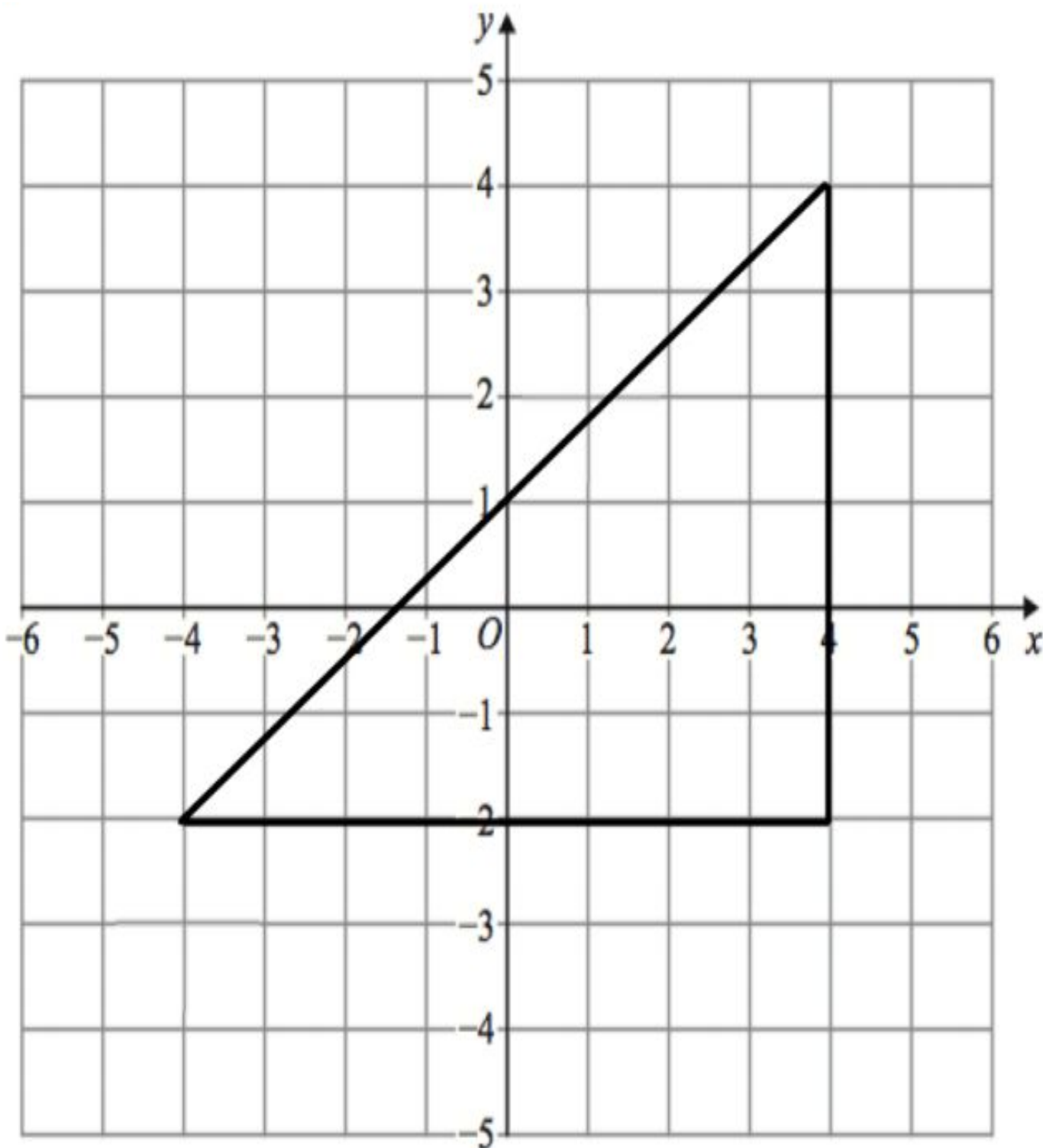


The surface area of the smaller solid is 24 cm^2

Work out the surface area of the larger solid.

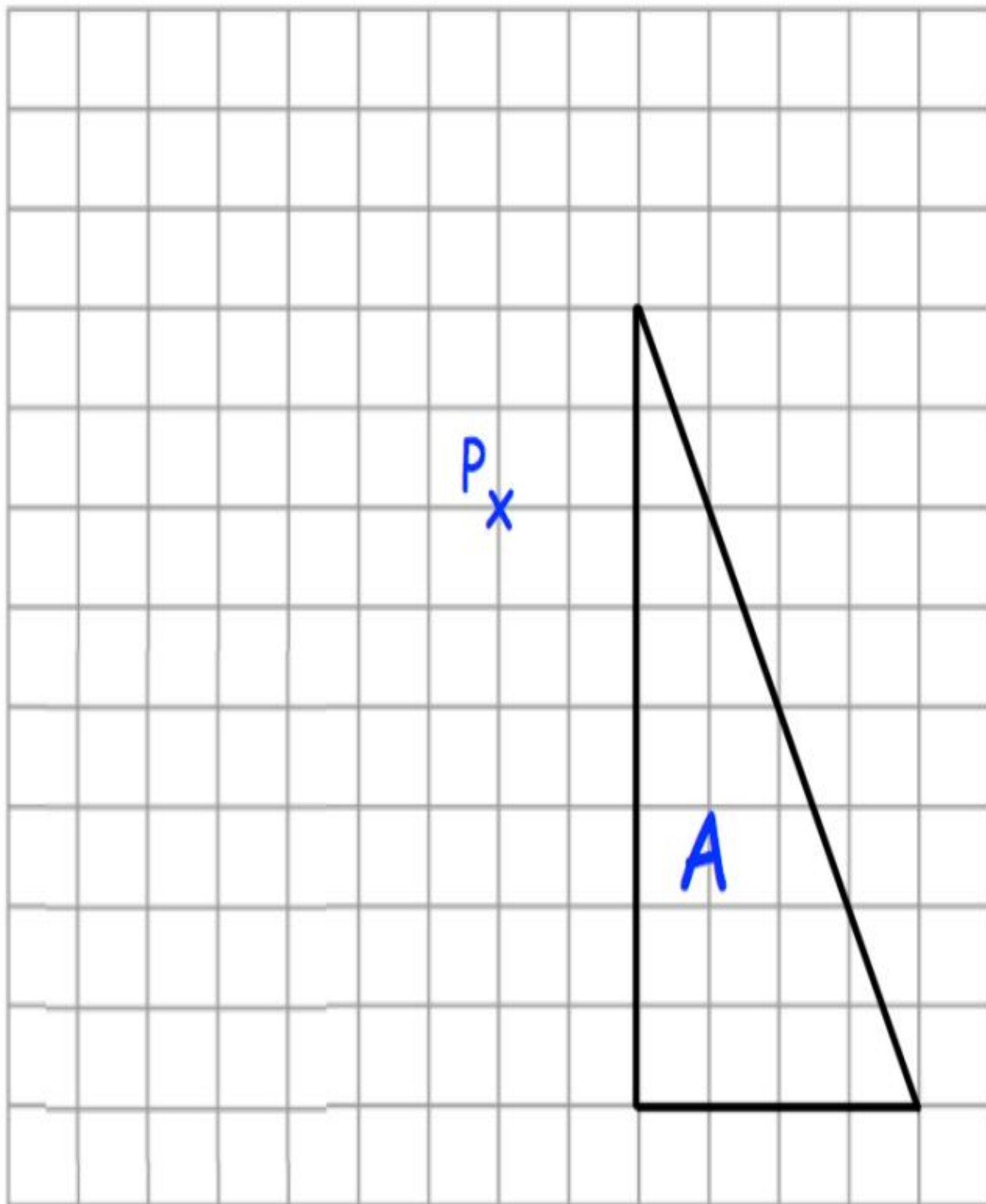
..... cm^2
(3)

Topic 6: Enlargement – Negative Fractional



Enlarge the triangle by scale factor $-\frac{1}{2}$, using centre of enlargement (2, 0)

3.



Enlarge shape A by scale factor $-\frac{1}{2}$, using the point P as centre of enlargement.

Topic 7: Composite & Inverse Functions

3. The functions $f(x)$, $g(x)$ and $h(x)$ are given by the following:

$$f(x) = x^2 - 3$$

$$g(x) = 2x + 1$$

$$h(x) = \frac{x}{2}$$

- (a) Find $fg(x)$

- (b) Find $gh(x)$

- (c) Find $h^{-1}(x)$

.....
(2)

.....
(2)

.....
(2)

-
4. The function f is such that $f(x) = 4x - 7$

- (a) Solve $f(x) = 17$

- (b) Find $f^{-1}(x)$

.....
(2)

.....
(2)

5. Given $f(x) = x^2 + 2$ and $g(x) = x + 14$

Find the values of a such that $f(a) = g(a)$

.....
(3)

6. The functions $f(x)$ and $g(x)$ are given by the following:

$$f(x) = 8 - 3x$$

$$g(x) = 4x$$

(a) Calculate the value of $gf(3)$

.....
(2)

(b) Solve the equation $gf(x) = 80$

.....
(4)

7. $f(x) = \frac{3x}{5} + 1$

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

.....
(3)

8. Given $f(x) = x^2 + 3x - 5$

Express $f(2x - 1)$ in the form $ax^2 + bx + c$

.....
(3)

9. The function f is such that $f(x) = kx + 3$

The function g is such that $g(x) = 2x - 4$

Given that $gf(2) = 34$

work out the value of k

.....
(3)

10. For all values of x ,

$$f(x) = x^2 + 4$$

$$g(x) = x - 9$$

Solve $fg(x) = gf(x)$

.....
(4)

11. $f(x) = x^2 + 2x + 1$

Show that $f(x + 2) - f(x) = 4x + 8$

Topic 8: Compounds Units

9. The mass of 3m^3 of tin is 21840kg .



(a) Work out the density of tin.

..... kg/m^3
(2)

The density of aluminium is 2712kg/m^3 .

(b) Work out the difference in mass between 5m^3 of tin and 5m^3 of aluminium.

..... kg
(3)

10. Mr.Dixon is building a toy boat for his son.
He has three different planks of wood to choose from.



Plank A

Volume = 750cm^3
Mass = 900g

Plank B

Volume = 0.0152m^3
Mass = 7.6kg

Plank C

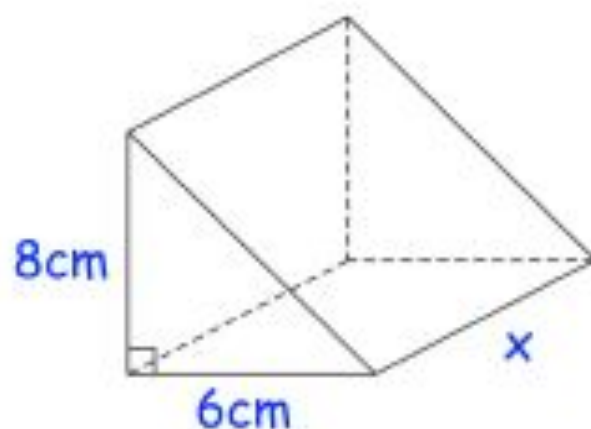
Volume = 1000cm^3
Mass = 1.02kg

If wood has a density under 1g/cm^3 , it will float.

Which plank of wood is the most suitable?
Explain your answer.

Plank
(4)

13. The diagram shows a solid triangular prism.



The prism is made from wood and has a mass of 643.8g
The density of wood is 1.85g/cm^3

Calculate the length of the prism.

.....cm
(4)

14. Material A has a density of 5.8g/cm^3 .
Material B has a density of 4.1g/cm^3 .

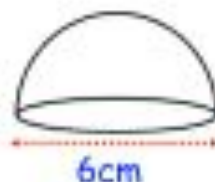


377g of Material A and 1.64kg of Material B form Material C.

Work out the density of Material C.

..... g/cm^3
(4)

15. The diagram shows a solid glass paperweight.



The paperweight is a hemisphere with diameter 6cm.
The glass has a density of 3g/cm^3 .

Calculate the mass of the paperweight.

.....g
(4)

16. A solid metal sphere has a radius of 4cm, correct to the nearest centimetre.
Mass of the sphere is 720g, correct to two significant figures.



Work out the greatest possible density of the metal.
Give your answer to three significant figures.

.....g/cm³
(4)

17. The diagram below shows a solid cone.

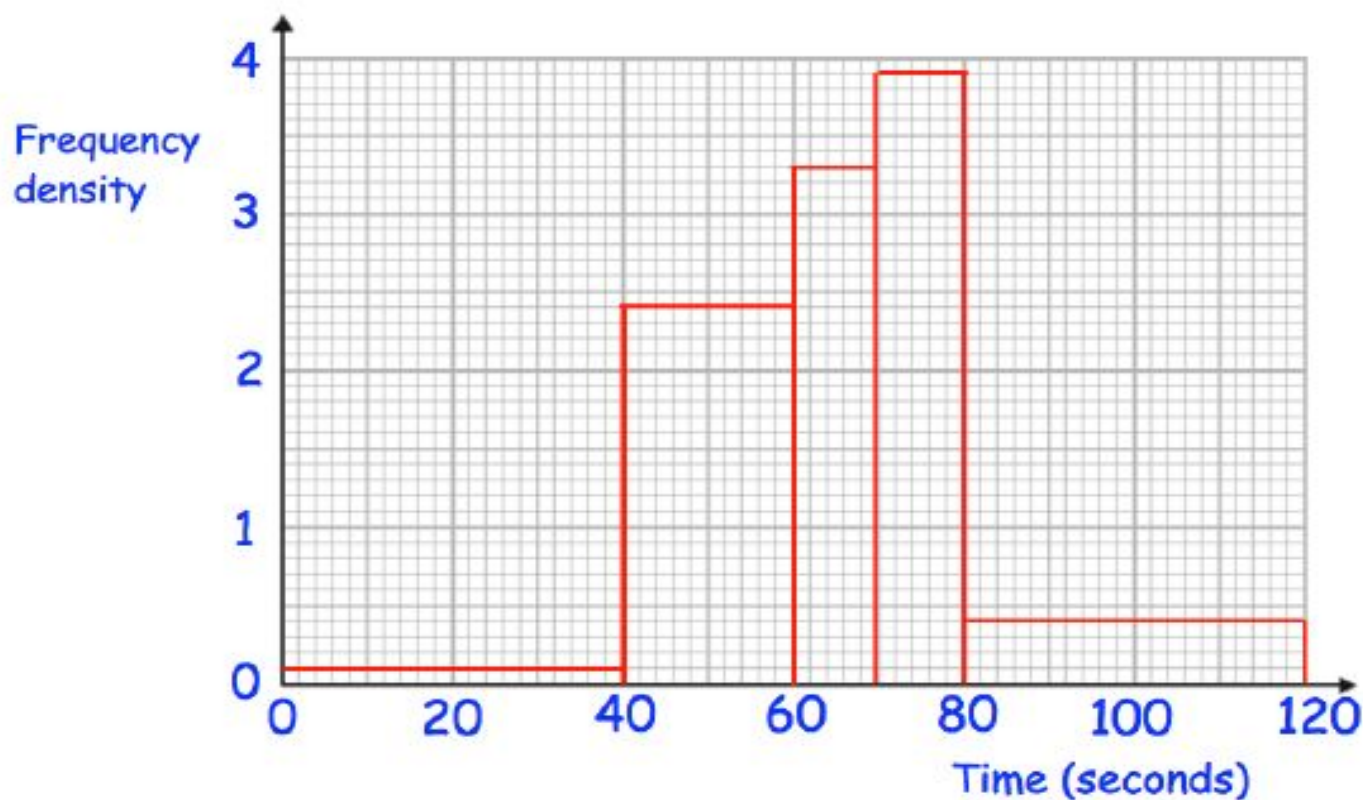


The cone is made from a material with density 5g/cm^3 .

Write an expression for the mass of the cone, in terms of x .

Topic 9: Histograms

17. The histograms shows information about the time taken by 140 students to complete a puzzle.



(a) Complete this frequency table.

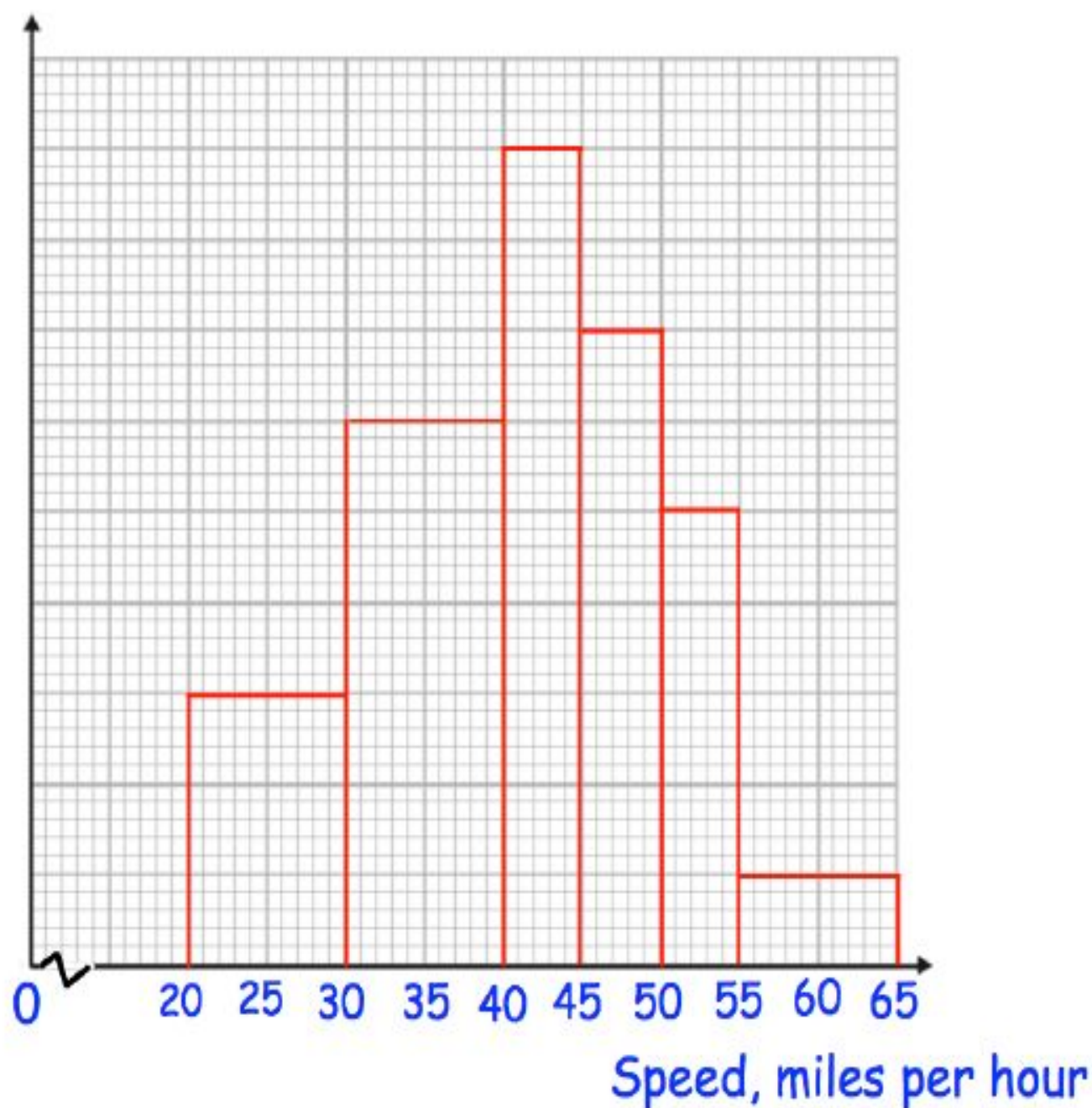
Time, t seconds	Frequency
$0 < t \leq 40$	4
$40 < t \leq 60$	
$60 < t \leq 70$	33
$70 < t \leq 80$	
$80 < t \leq 120$	16

(b) Calculate an estimate of the median.

(2)

(3)

15. The histogram shows the speeds in miles per hour of 82 cars on a road.



14 cars were travelling over 50 mph.

Calculate an estimate of the number of cars that were travelling between 42 and 49 mph.

18. The histogram shows the weights of 700 dogs.



(a) Calculate an estimate of the median.

.....
(3)

(b) Calculate an estimate of the upper quartile.

.....
(3)

Topic 10: Recurring Decimals to Fractions

4. Write $0.\dot{8}\dot{1}$ as a fraction.
Give your answer in its simplest form.

.....
(3)

5. Convert $0.3\dot{4}$ to a fraction.
Give your answer in its simplest form.

.....
(3)

6. Write $0.5\dot{1}\dot{2}$ as a fraction.
Give your answer in its simplest form.

.....
(3)

7. Convert $0.4515151\ldots$ to a fraction.
Give your answer in its simplest form.

.....
(3)

8. Write $1.2\dot{4}$ as a mixed number.
Give your answer in its simplest form.

.....
(3)

9. Write $2.1\dot{6}\dot{5}$ as a mixed number.
Give your answer in its simplest form.

.....
(3)

10. Write the numbers below in order.
Start with the smallest.

$$\frac{11}{23}$$

$$0.\overline{472}$$

$$\frac{5}{11}$$

Topic 11: Iteration

1. The table below shows values of x and y for $y = x^3 - 8x - 10$



x	0	1	2	3	4
y	-10	-17	-18	-7	22

Between which two consecutive integers is there a solution to the equation $x^3 - 8x - 10 = 0$?

Explain your answer.

$x = \dots\dots\dots$ and $x = \dots\dots\dots$

.....
.....

(2)

2. Using $x_{n+1} = 8 - \frac{5}{x_n^2}$



with $x_0 = 1$

find the values of x_1 , x_2 , x_3 and x_4

$x_1 = \dots\dots\dots$

$x_2 = \dots\dots\dots$

$x_3 = \dots\dots\dots$

$x_4 = \dots\dots\dots$

(4)

8. (a) Show that the equation $20 - x^3 - 7x^2 = 0$ can be rearranged to give



$$x = \frac{20}{x^2} - 7$$

(2)

(b) Using $x_{n+1} = \frac{20}{x_n^2} - 7$ with $x_0 = -9$

find the values of x_1 , x_2 and x_3

$x_1 = \dots\dots\dots$

$x_2 = \dots\dots\dots$

$x_3 = \dots\dots\dots$

(3)

(b) Explain what the values of x_1 , x_2 and x_3 represent

.....

.....

.....

(2)

10. (a) Show that the equation $x^4 - 5x + 1 = 0$ has a root between $x = 1.5$ and $x = 2$



(2)

- (b) Use the iteration formula $x_{n+1} = \sqrt[3]{5 - \frac{1}{x_n}}$ three times with $x_0 = 1.5$ to find an estimate for the solution of $x^4 - 5x + 1 = 0$

.....
(3)

11. The equation $x^3 - 2x^2 + 19 = 0$ has a root in the interval $(-3, -2)$



Use an appropriate iteration formula to find an approximate to 2 decimal places for the root of $x^3 - 2x^2 + 19 = 0$ in the interval $(-3, -2)$

Topic 12: Completing the Square

Georgina rewrites the expression $x^2 + px + q$ by completing the square.
He correctly obtains $(x - 5)^2 + 31$

Work out the values of p and q .

$p = \dots\dots\dots$ and $q = \dots\dots\dots$
(3)

Write $x^2 - 3x + 7$ in the form $(x + a)^2 + b$

$\dots\dots\dots$
(3)

7. Express $3x^2 + 18x - 1$ in the form $a(x + b)^2 + c$

.....
(3)

8. Use completing the square to find the minimum point of the curve $y = x^2 - 6x + 1$

.....
(4)

9. Use completing the square to find the minimum point of the curve $y = x^2 + 4x + 7$