



# Cambridge IGCSE™

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**MATHEMATICS (US)**

**0444/04**

Paper 4 (Extended)

**For examination from 2020**

SPECIMEN PAPER

**2 hours 30 minutes**

You must answer on the question paper.

You will need: Geometrical instruments

## INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, center number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary work clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For  $\pi$ , use either your calculator value or 3.142.

## INFORMATION

- The total mark for this paper is 130.
- The number of marks for each question or part question is shown in parentheses [ ].

This document has **18** pages. Blank pages are indicated.

## Formula List

For the equation

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Lateral surface area,  $A$ , of cylinder of radius  $r$ , height  $h$ .

$$A = 2\pi rh$$

Lateral surface area,  $A$ , of cone of radius  $r$ , sloping edge  $l$ .

$$A = \pi rl$$

Surface area,  $A$ , of sphere of radius  $r$ .

$$A = 4\pi r^2$$

Volume,  $V$ , of pyramid, base area  $A$ , height  $h$ .

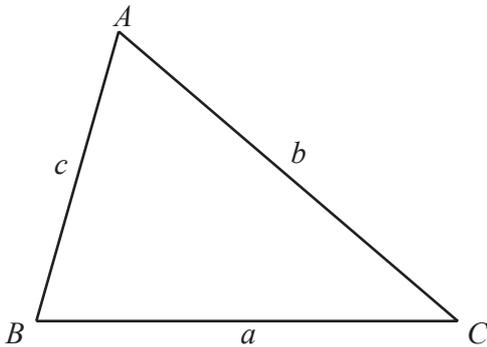
$$V = \frac{1}{3}Ah$$

Volume,  $V$ , of cone of radius  $r$ , height  $h$ .

$$V = \frac{1}{3}\pi r^2 h$$

Volume,  $V$ , of sphere of radius  $r$ .

$$V = \frac{4}{3}\pi r^3$$



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\text{Area} = \frac{1}{2}bc \sin A$$

- 1 Marlene, Carolina, and Pedro receive \$800 from their grandmother in the ratio

$$\text{Marlene} : \text{Carolina} : \text{Pedro} = 7 : 5 : 4.$$

- (a) Calculate how much money each receives.

Marlene \$ .....

Carolina \$ .....

Pedro \$ ..... [3]

- (b) Marlene spends  $\frac{2}{7}$  of her money and then invests the rest for two years at a rate of 5% per year **simple** interest.

How much money does Marlene have at the end of the two years?

\$ ..... [3]

- (c) Carolina spends all of her money on a computer and two years later sells it at a loss of 20%.

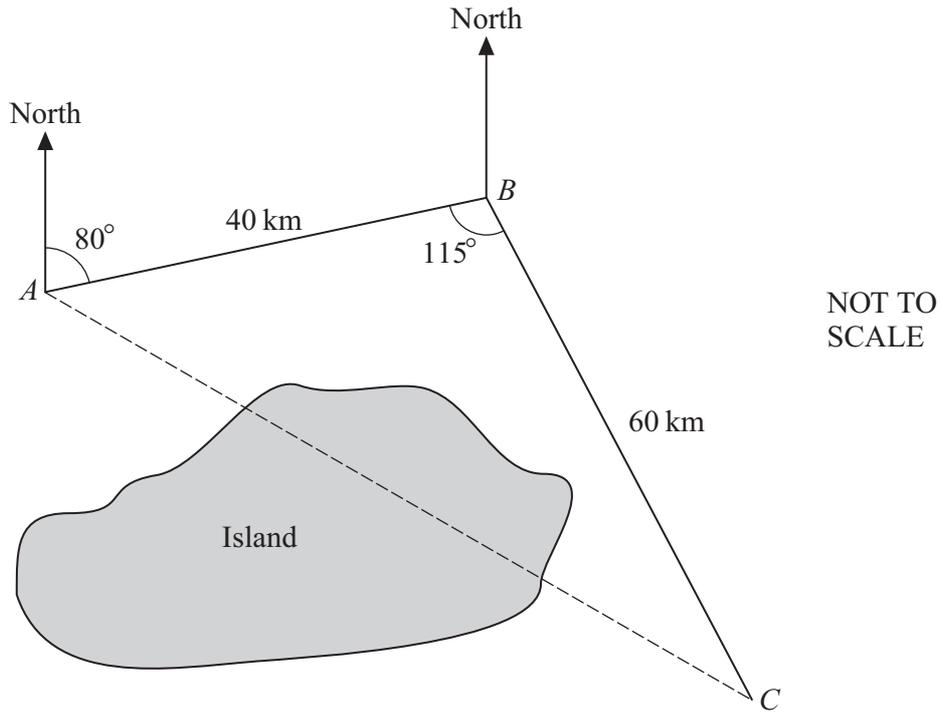
How much money does Carolina have at the end of the two years?

\$ ..... [2]

- (d) Pedro spends some of his money and at the end of the two years he has \$100.

Write down and simplify the ratio of the amounts of money Maria, Carolina, and Pedro have at the end of the two years.

\$..... : \$..... : \$..... [2]



To avoid an island, a ship travels 40 kilometers from  $A$  to  $B$  and then 60 kilometers from  $B$  to  $C$ .

The bearing of  $B$  from  $A$  is  $080^\circ$  and angle  $ABC$  is  $115^\circ$ .

- (a) The ship leaves  $A$  at 11.55.  
It travels at an average speed of 35 km/h.

Calculate, correct to the nearest minute, the time it arrives at  $C$ .

..... [3]

- (b) Find the bearing of

- (i)  $A$  from  $B$ ,

..... [1]

- (ii)  $C$  from  $B$ .

..... [1]

(c) Calculate the straight line distance  $AC$ .

..... km [4]

(d) Calculate angle  $BAC$ .

..... [3]

(e) Calculate how far  $C$  is **east** of  $A$ .

..... km [3]

3  $f(x) = x^2 - 4x + 3$  and  $g(x) = 2x - 1$ .

(a) Solve  $f(x) = 0$ .

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [2]

(b) Find  $g^{-1}(x)$ .

$\dots\dots\dots$  [2]

(c) Solve  $f(x) = g(x)$ , giving your answers correct to 2 decimal places.  
You must show each step of your working.

$x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [5]

(d) Find the value of  $g(f(-2))$ .

$\dots\dots\dots$  [2]

(e) Find  $f(g(x))$ .  
Give your answer in its simplest form.

$\dots\dots\dots$  [3]

- 4 (a) A solid metal sphere has a radius of 3.5 cm.  
One cubic centimeter of the metal has a mass of 5.6 grams.

Calculate

- (i) the surface area of the sphere,

..... cm<sup>2</sup> [2]

- (ii) the volume of the sphere,

..... cm<sup>3</sup> [2]

- (iii) the mass of the sphere.

..... g [2]

(b)

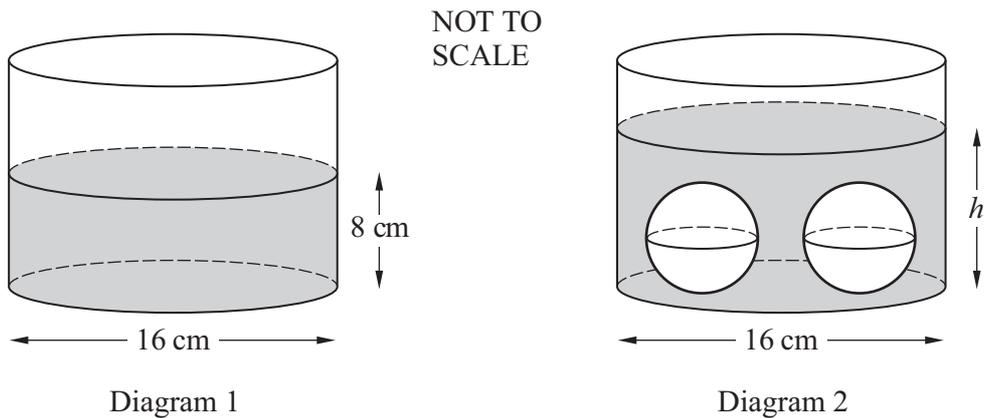


Diagram 1 shows a cylinder with a **diameter** of 16 cm.

It contains water to a depth of 8 cm.

Two spheres identical to the sphere in **part (a)** are placed in the water. This is shown in Diagram 2.

Calculate  $h$ , the new depth of water in the cylinder.

..... cm [4]

5  $f(x) = 3x - \frac{1}{x^2} + 3, x \neq 0$

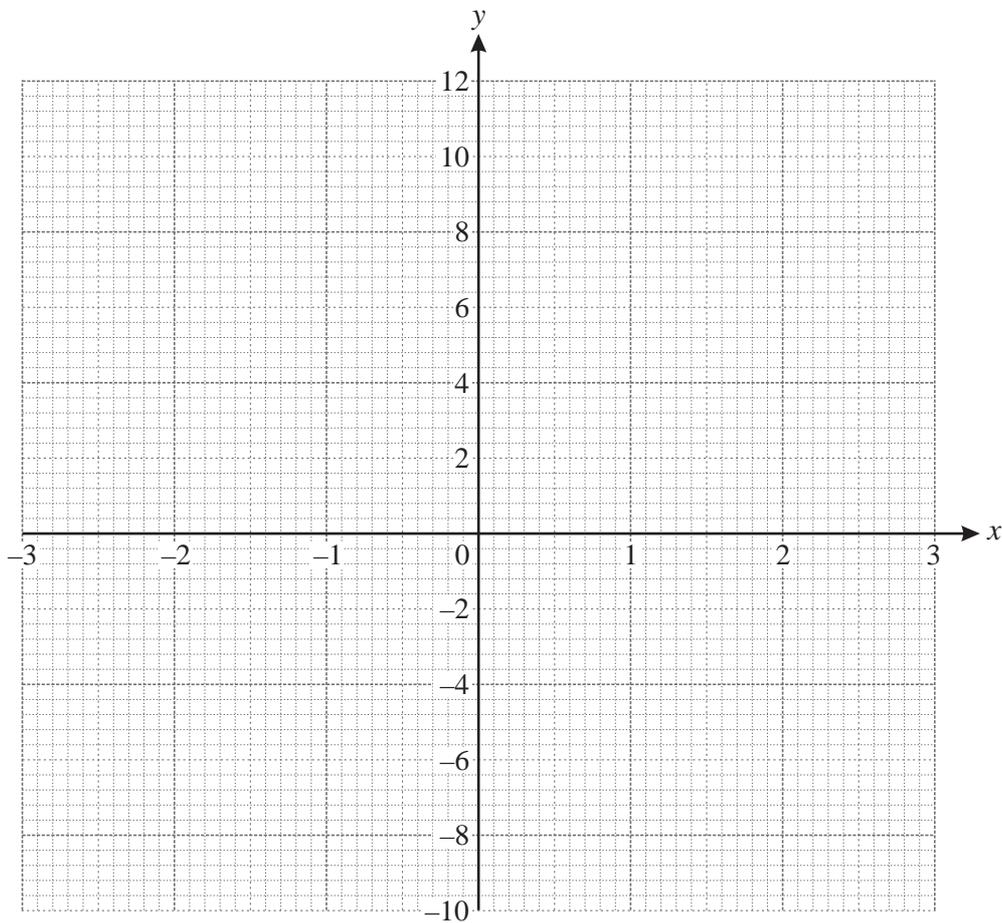
(a) The table shows some values of  $f(x)$ .

$x$	-3	-2.5	-2	-1.5	-1	-0.5	-0.4	-0.3	0.3	0.4	0.5	1	1.5	2	2.5	3
$f(x)$	$p$	-4.7	-3.3	-1.9	-1	-2.5	-4.5	-9.0	-7.2	-2.1	0.5	$q$	7.1	8.8	10.3	$r$

Find the values of  $p$ ,  $q$ , and  $r$ .

$p = \dots\dots\dots, q = \dots\dots\dots, r = \dots\dots\dots$  [3]

(b) Draw the graph of  $y = f(x)$  for  $-3 \leq x \leq -0.3$  and  $0.3 \leq x \leq 3$ .



[5]

(c) Use your graph to solve the equations

(i)  $3x - \frac{1}{x^2} + 3 = 0,$

..... [1]

(ii)  $3x - \frac{1}{x^2} + 7 = 0.$

..... [3]

(d)  $g(x) = 3x + 3$

On the grid on page 8, draw the graph of  $y = g(x)$  for  $-3 \leq x \leq 3$ . [2]

(e) (i) Describe briefly what happens to the graphs of  $y = f(x)$  and  $y = g(x)$  for large positive or large negative values of  $x$ .

.....  
 ..... [1]

(ii) Estimate the slope of  $y = f(x)$  when  $x = 100$ .

..... [1]

6 Hank invests \$100 at a rate of 4% per year **compound** interest.

(a) How many dollars will Hank have after 2 years?

..... [2]

(b) After  $x$  years, Hank will have  $y$  dollars.

He knows a formula to calculate  $y$ .

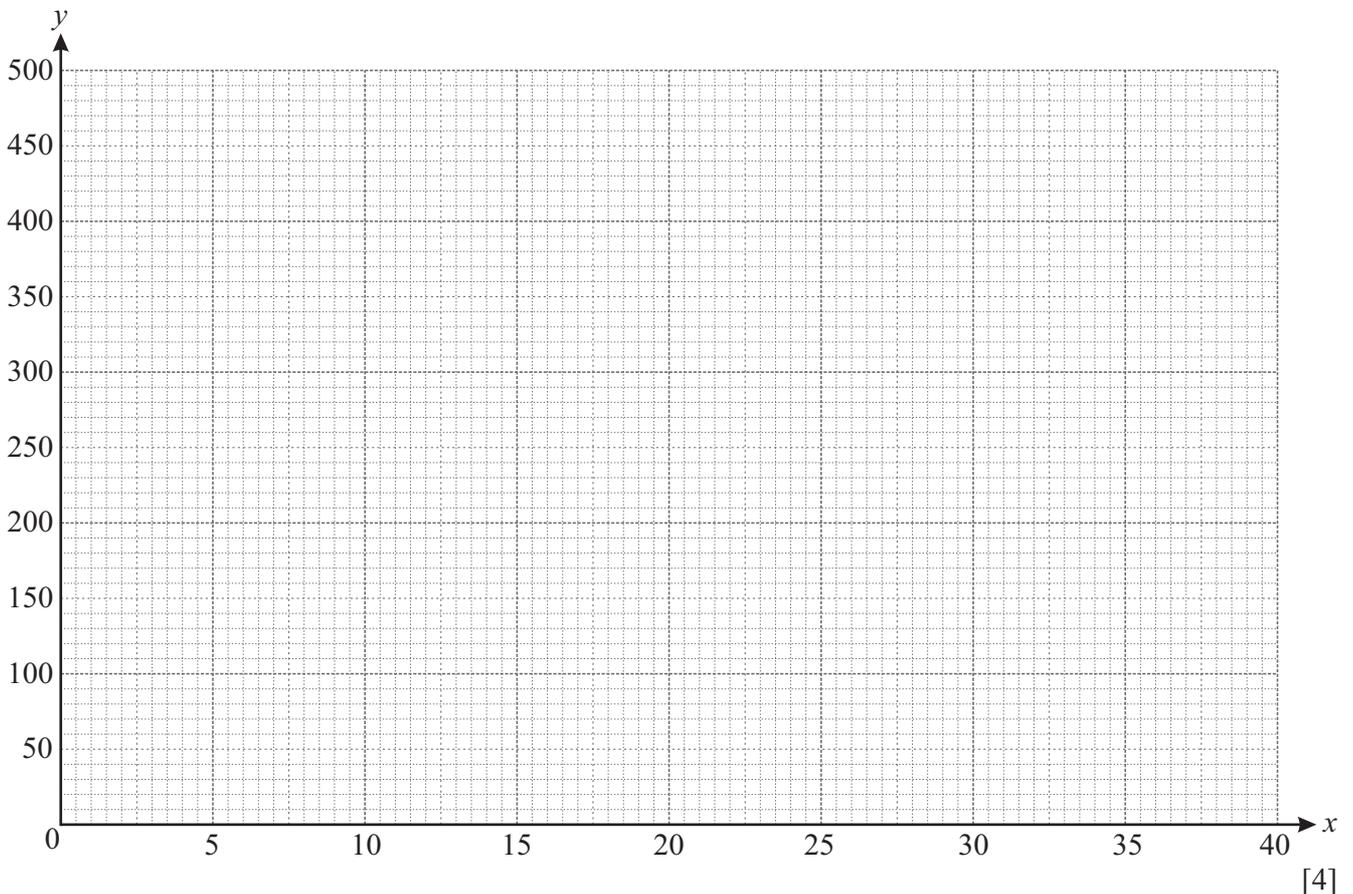
The formula is  $y = 100 \times 1.04^x$

$x$ (Years)	0	10	20	30	40
$y$ (Dollars)	100	$p$	219	$q$	480

Use this formula to calculate the value of  $p$  and the value of  $q$  in the table.

$p = \dots\dots\dots$ ,  $q = \dots\dots\dots$  [2]

(c) Plot the five points in the table on the grid and draw a smooth curve through them.



[4]

(d) Use your graph to estimate

(i) how many dollars Hank will have after 25 years,

\$ ..... [1]

(ii) how many years, correct to the nearest year, it takes for Hank to have \$200.

..... [1]

(e) Avril invests \$100 at a rate of 7% per year **simple** interest.

(i) Show that after 20 years Avril has \$240.

[2]

(ii) How many dollars will Avril have after 40 years?

\$ ..... [1]

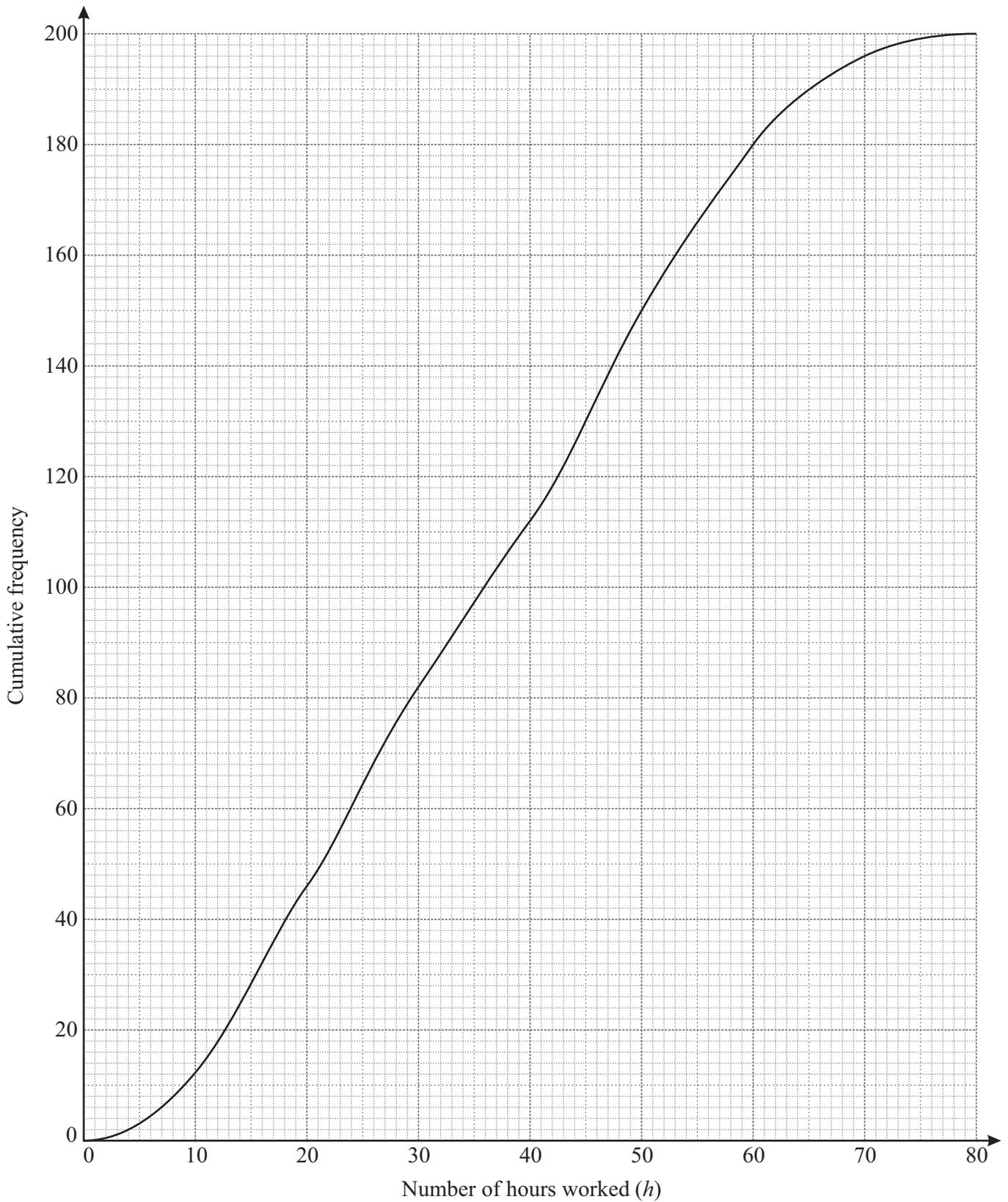
(iii) On the grid on page 10, draw a graph to show how the \$100 which Avril invests will increase during the 40 years. [2]

(f) Avril and Hank start with the same amount.

Use your graphs to find after how many years Hank will **start** to have more than Avril.

..... [1]

- 7 200 people record the number of hours they work in a week.  
The cumulative frequency graph shows this information.



(a) Use the graph to find an estimate of

(i) the median,

..... h [1]

(ii) the upper quartile,

..... h [1]

(iii) the interquartile range,

..... h [1]

(iv) the number of people who work more than 60 hours in a week.

..... [2]

(b) Vernon uses the graph to make the following frequency table.

Hours worked ( $h$ )	$0 < h \leq 10$	$10 < h \leq 20$	$20 < h \leq 30$	$30 < h \leq 40$	$40 < h \leq 50$	$50 < h \leq 60$	$60 < h \leq 70$	$70 < h \leq 80$
Frequency	12	34	36	30	38	30	.....	.....

(i) Use the graph to complete the table.

[2]

(ii) Calculate an estimate of the mean number of hours worked in a week.

..... h [4]

(c) Maria uses the graph to make a different frequency table.

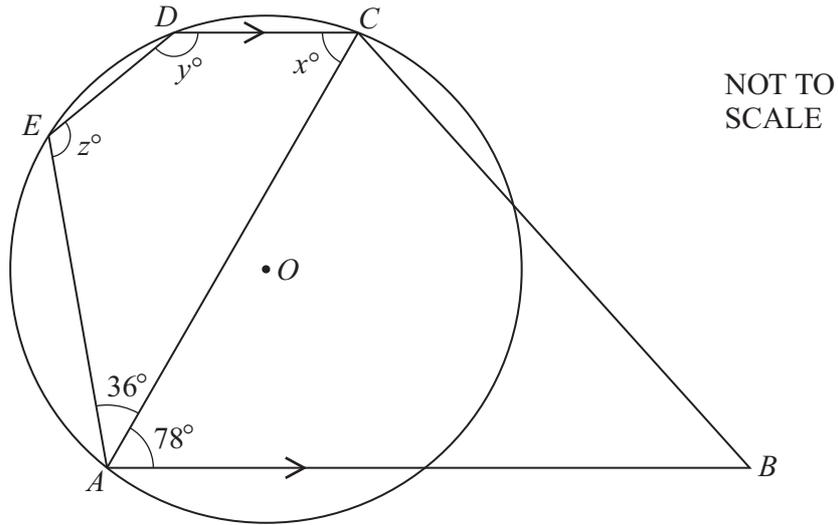
Hours worked ( $h$ )	$0 < h \leq 30$	$30 < h \leq 40$	$40 < h \leq 50$	$50 < h \leq 80$
Frequency	82	30	38	50

When she draws a histogram, the height of the column for the interval  $30 < h \leq 40$  is 9 cm.

Calculate the height of each of the other three columns.

..... cm, ..... cm, ..... cm [4]

8 (a)



$ABCDE$  is a pentagon.  
 A circle, center  $O$ , passes through the points  $A$ ,  $C$ ,  $D$ , and  $E$ .  
 Angle  $EAC = 36^\circ$ , angle  $CAB = 78^\circ$ , and  $AB$  is parallel to  $DC$ .

(i) Find the values of  $x$ ,  $y$ , and  $z$ , giving a reason for each.

$x = \dots\dots\dots$

Reason .....

$y = \dots\dots\dots$

Reason .....

$z = \dots\dots\dots$

Reason ..... [6]

(ii) Explain why  $ED$  is **not** parallel to  $AC$ .

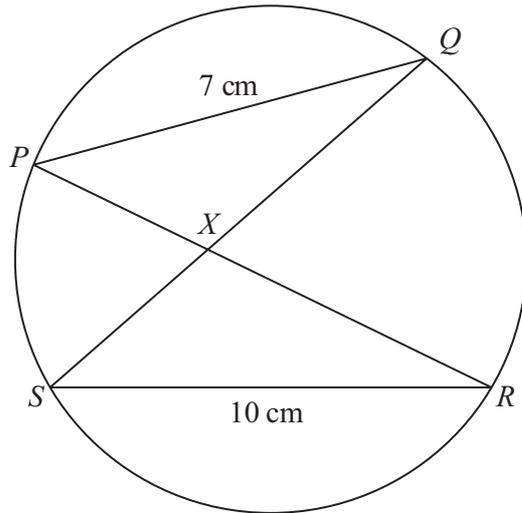
.....

..... [1]

(iii) Find angle  $EOC$ .

Angle  $EOC = \dots\dots\dots$  [1]

(b)



NOT TO SCALE

$P, Q, R$  and  $S$  lie on a circle.  
 $PQ = 7$  cm and  $SR = 10$  cm.  
 $PR$  and  $QS$  intersect at  $X$ .  
 The area of triangle  $SRX = 20$  cm<sup>2</sup>.

(i) Write down the geometrical word which completes the following statement.

Triangle  $PQX$  is ..... to triangle  $SRX$ . [1]

(ii) Calculate the area of triangle  $PQX$ .

..... cm<sup>2</sup> [2]

(iii) Calculate the length of the perpendicular height from  $X$  to  $RS$ .

..... cm [2]



Diagram 1

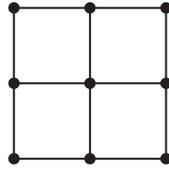


Diagram 2

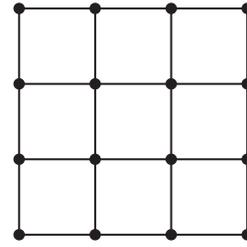


Diagram 3

The first three diagrams in a sequence are shown.

The diagrams are made up of dots and lines. Each line is one centimeter long.

(a) Make a sketch of the next diagram in the sequence.

[1]

(b) The table shows some information about the diagrams.

Diagram	1	2	3	4	...	$n$
Area	1	4	9	16	...	$x$
Number of dots	4	9	16	$p$	...	$y$
Number of one centimeter lines	4	12	24	$q$	...	$z$

(i) Write down the value of  $p$  and the value of  $q$ .

$p = \dots\dots\dots, q = \dots\dots\dots$  [2]

(ii) Write down each of  $x, y,$  and  $z$  in terms of  $n$ .

$x = \dots\dots\dots$

$y = \dots\dots\dots$

$z = \dots\dots\dots$  [4]

- (c) The **total** number of one-centimeter lines in the first  $n$  diagrams is given by the expression

$$\frac{2}{3}n^3 + fn^2 + gn.$$

- (i) Use  $n = 1$  in this expression to show that  $f + g = \frac{10}{3}$ .

[1]

- (ii) Use  $n = 2$  in this expression to show that  $4f + 2g = \frac{32}{3}$ .

[2]

- (iii) Find the value of  $f$  and the value of  $g$ .

$$f = \dots\dots\dots$$

$$g = \dots\dots\dots [3]$$

- (iv) Find the total number of one-centimeter lines in the first 10 diagrams.

..... [1]

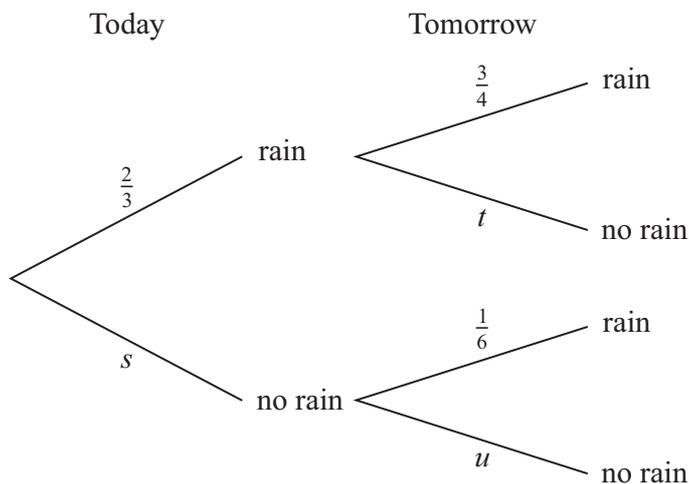
10 Give your answers to this question as fractions.

The probability that it rains today is  $\frac{2}{3}$ .

If it rains today, the probability that it will rain tomorrow is  $\frac{3}{4}$ .

If it does not rain today, the probability that it will rain tomorrow is  $\frac{1}{6}$ .

The tree diagram shows this information.



(a) Write down, as fractions, the values of  $s$ ,  $t$  and  $u$ .

$s = \dots\dots\dots, t = \dots\dots\dots, u = \dots\dots\dots$  [3]

(b) Calculate the probability that it rains on both days.

$\dots\dots\dots$  [2]

(c) Calculate the probability that it will **not** rain tomorrow.

$\dots\dots\dots$  [2]

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