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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 π , 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 .

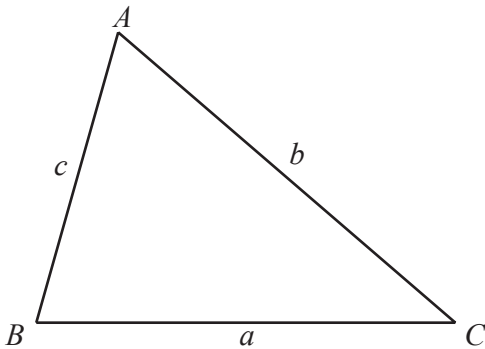
$$V = \frac{1}{3}Ah$$

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%.

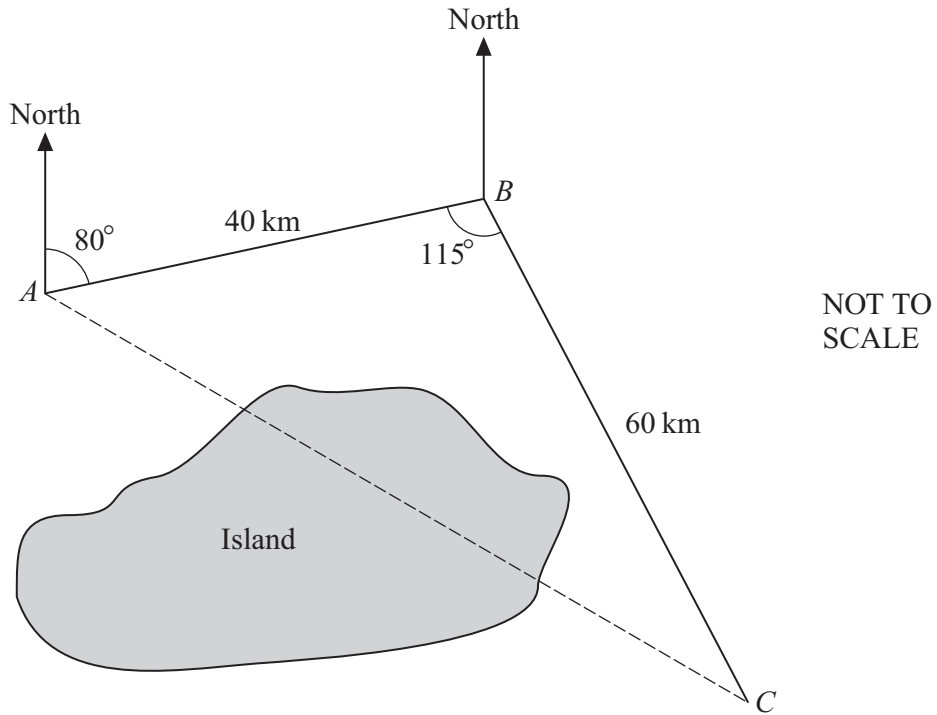
How much money does Carolina have at the end of the two years?

\$ [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° and angle ABC is 115° .

- (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,

..... cm² [2]

- (ii) the volume of the sphere,

..... cm³ [2]

- (iii) the mass of the sphere.

..... g [2]

(b)

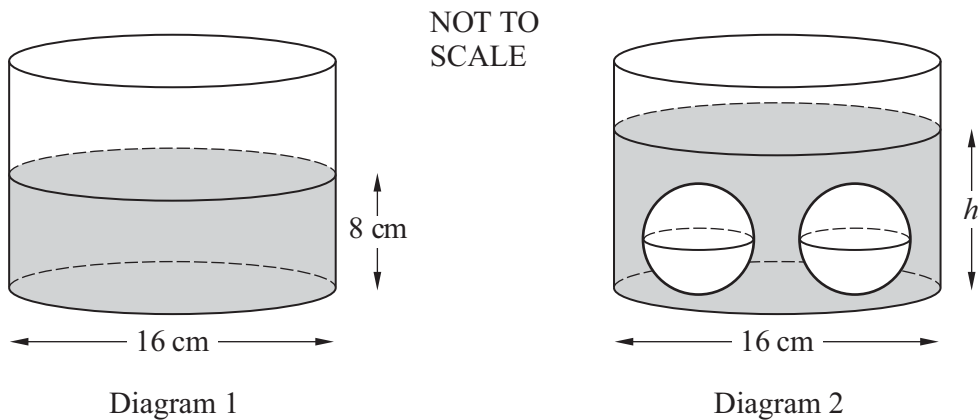


Diagram 1 shows a cylinder with a **diameter** of 16 cm.

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

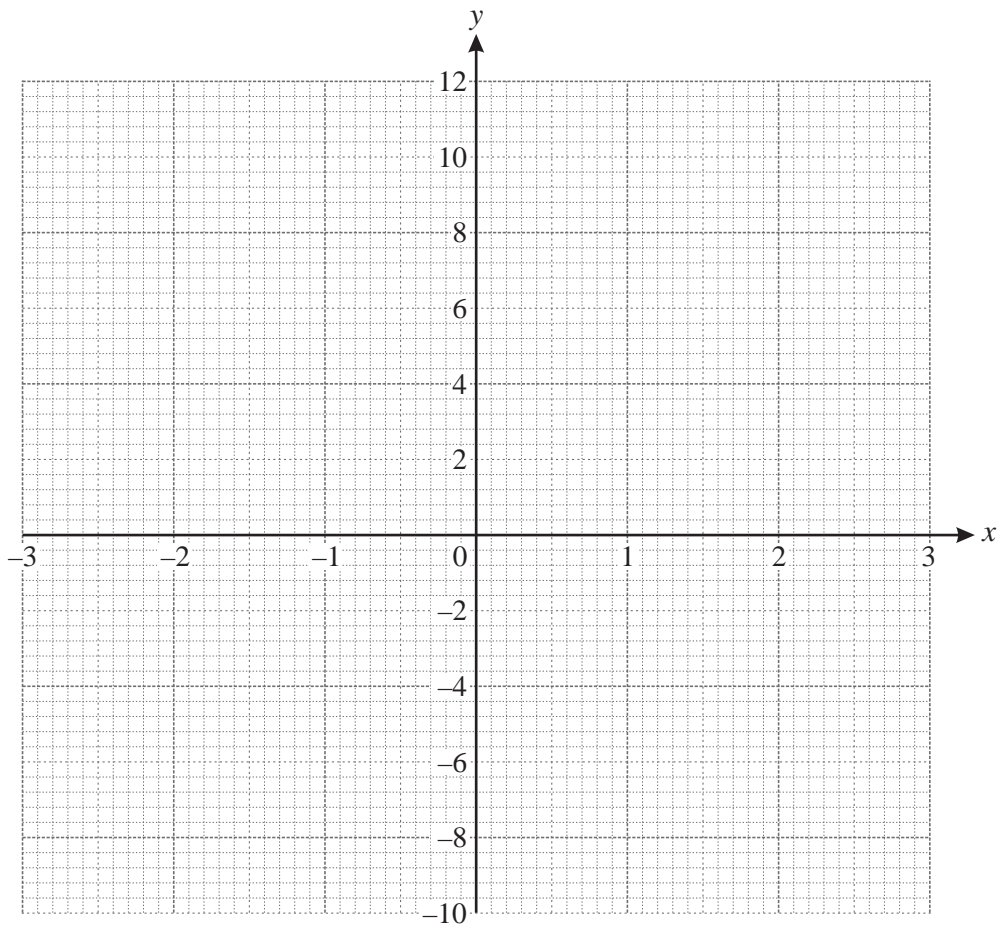
(a) The table shows some values of $f(x)$.

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 .

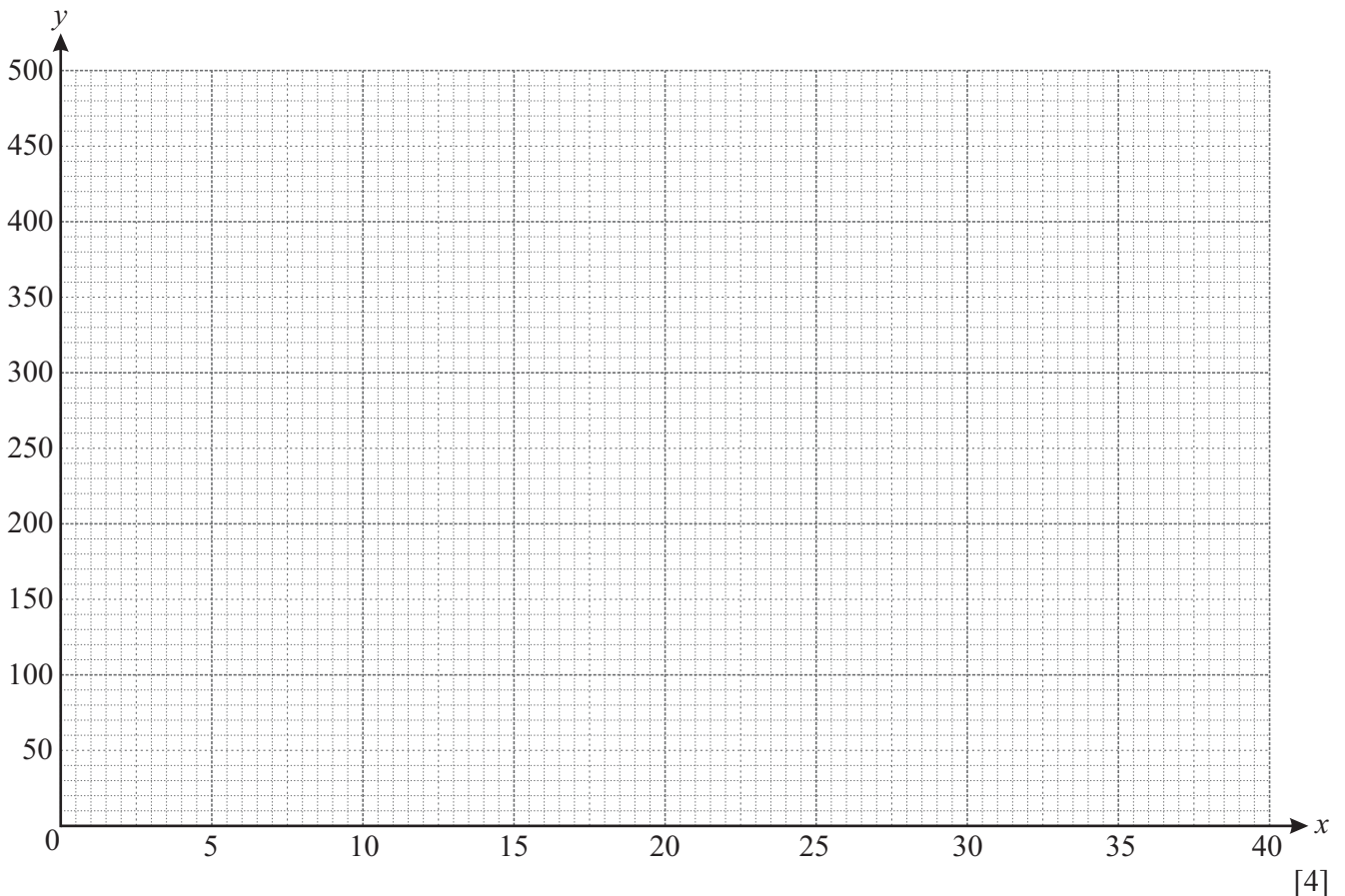
The formula is $y = 100 \times 1.04^x$

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]

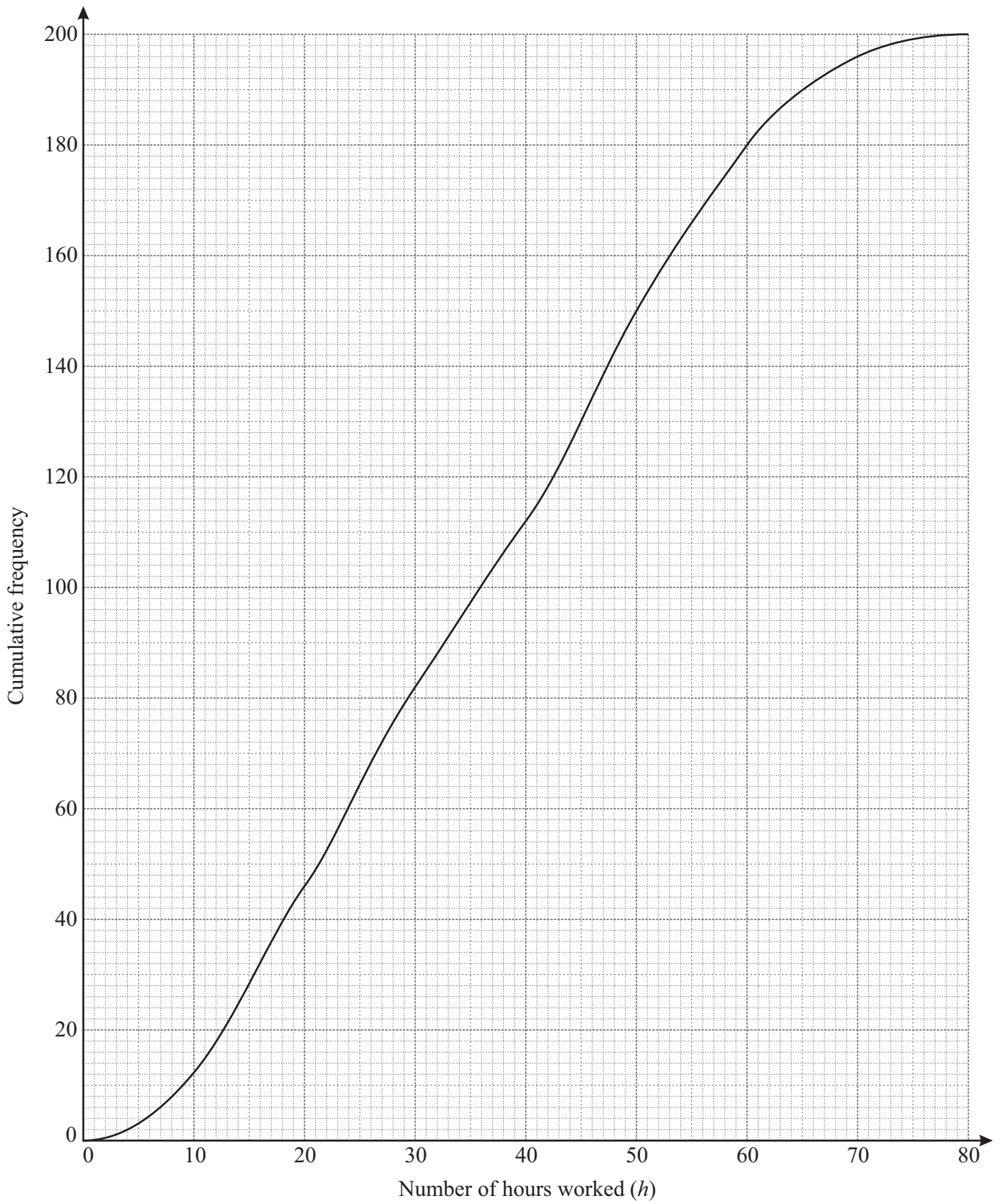
(iii) On the grid on page 10, draw a graph to show how the \$100 which Avril invests will increase during the 40 years. [2]

(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.

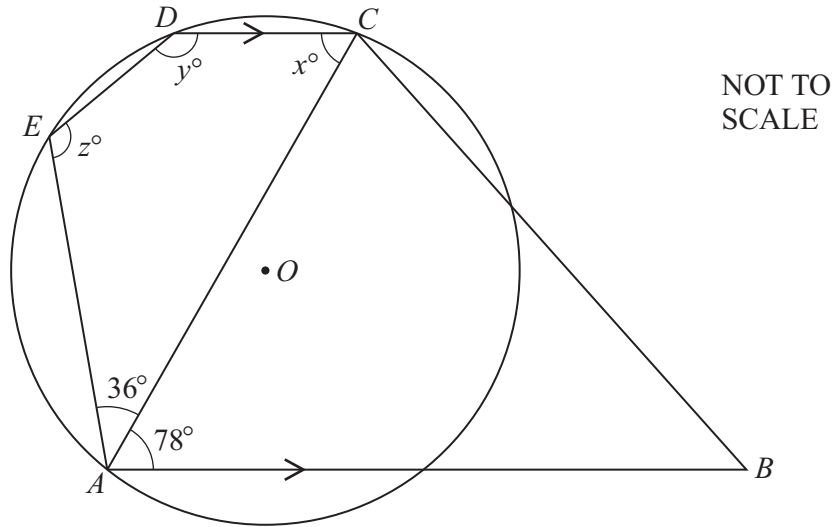
Hours worked (h)	$0 < h \leq 30$	$30 < h \leq 40$	$40 < h \leq 50$	$50 < h \leq 80$
Frequency	82	30	38	50

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 $\dots\dots\dots$

$y = \dots\dots\dots$

Reason $\dots\dots\dots$

$z = \dots\dots\dots$

Reason $\dots\dots\dots$ [6]

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

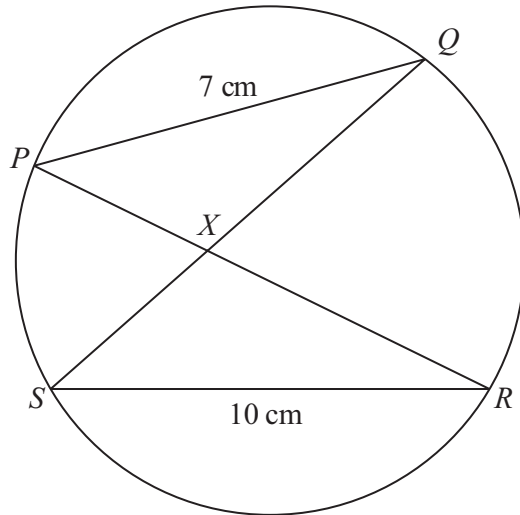
$\dots\dots\dots$

$\dots\dots\dots$ [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 $SRX = 20$ cm².

(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 .

..... cm² [2]

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

..... cm [2]



Diagram 1

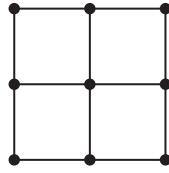


Diagram 2

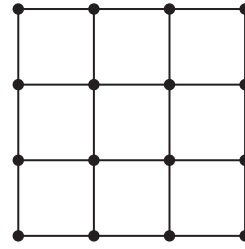


Diagram 3

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]

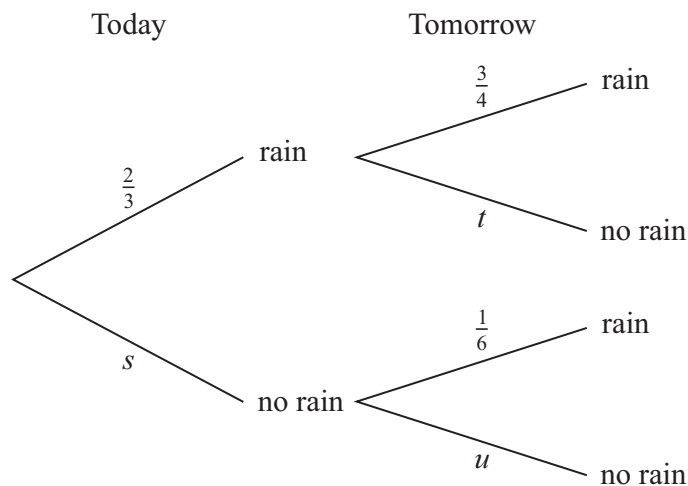
10 Give your answers to this question as fractions.

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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