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MATHEMATICS

0580/42

Paper 4 (Extended)

October/November 2023

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

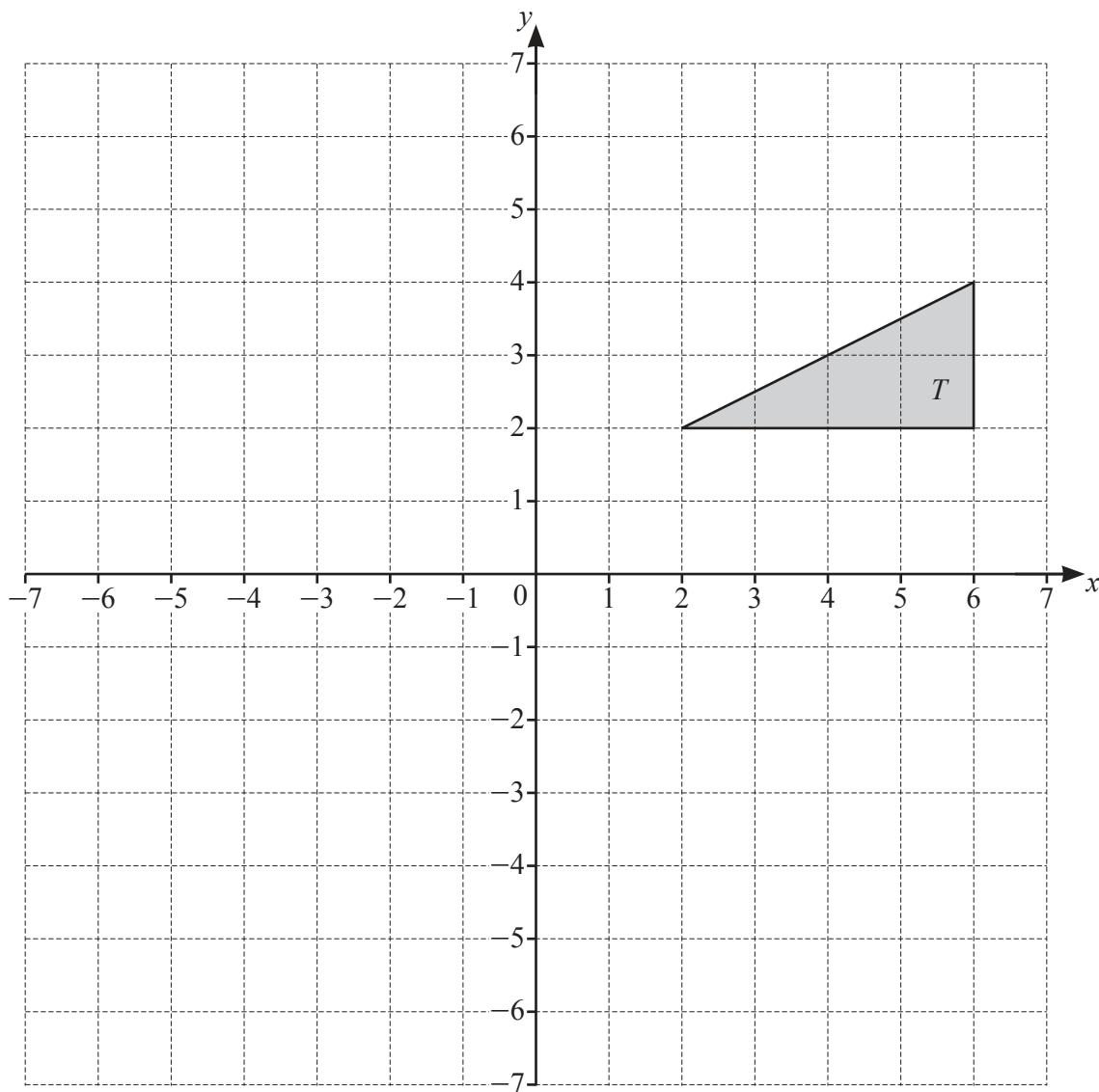
INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre 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 working 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 brackets [].

This document has **20** pages. Any blank pages are indicated.



(a) (i) Translate triangle T by the vector $\begin{pmatrix} -7 \\ 1 \end{pmatrix}$. Label the image K . [2]

(ii) Describe fully the **single** transformation that maps triangle K onto triangle T .

.....

.....

[1]

(b) Reflect triangle T in the line $y = 4$. [2]

(c) Rotate triangle T through 90° clockwise about $(0, 0)$. [2]

(d) (i) Enlarge triangle T by scale factor $-\frac{1}{2}$, centre $(0, 0)$. Label the image P . [2]

(ii) Describe fully the **single** transformation that maps triangle P onto triangle T .

.....

.....

[2]

2 (a) Daisy records her 50 homework marks.
The table shows the results.

Homework mark	15	16	17	18	19	20
Frequency	1	3	19	11	10	6

(i) Write down the range.

..... [1]

(ii) Write down the mode.

..... [1]

(iii) Find the median.

..... [1]

(iv) Calculate the mean.

..... [3]

(b) 21 33 20 25 21 34 22 21 20 30 18

The list shows Ed's scores in 11 tests.

(i) Complete the stem-and-leaf diagram to show this information.

1	
2	
3	

Key: 2|5 represents 25

[2]

(ii) Find the median.

..... [1]

(iii) Find the interquartile range.

..... [2]

3 (a) The value of Priya's car decreases by 10% every year.
The value today is \$7695.

(i) Calculate the value of the car after one year.

\$ [2]

(ii) Calculate the value of the car one year ago.

\$ [2]

(b) Ali invests \$600 at a rate of 2% per year simple interest.

Calculate the value of Ali's investment at the end of 5 years.

\$ [3]

(c) Sara invests \$500 at a rate of $r\%$ per year compound interest.
At the end of 12 years, the value of Sara's investment is \$601.35, correct to the nearest cent.

Find the value of r .

$r =$ [3]

(d) The mass of a radioactive substance decreases exponentially at a rate of 3% each day.

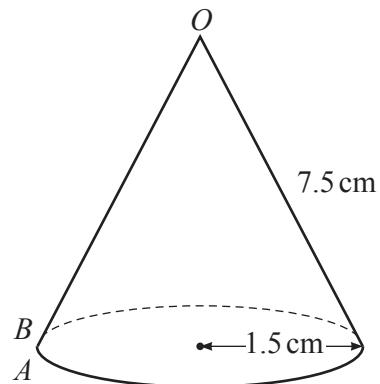
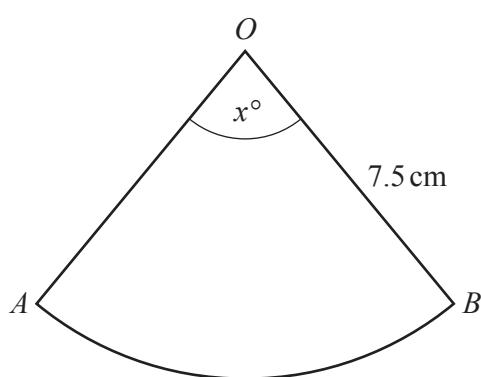
(i) Find the overall percentage decrease at the end of 10 days.

..... % [2]

(ii) Find the number of whole days it takes until the mass of this substance is one half of its original amount.

..... [3]

4 (a)

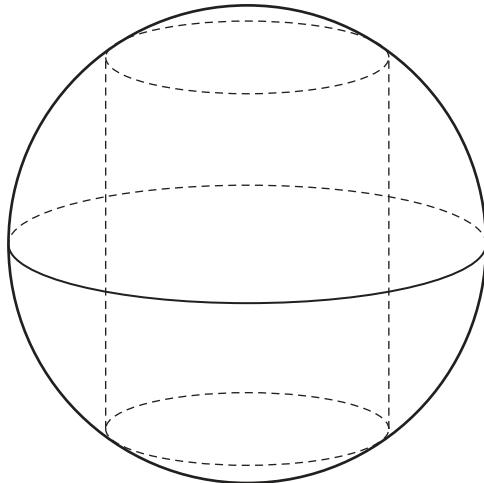
NOT TO
SCALE

The diagram shows a sector of a circle that is made into a cone by joining OA to OB .
 The sector angle is x° and the radius of the sector is 7.5 cm.
 The base radius of the cone is 1.5 cm.

Calculate the value of x .

$$x = \dots \quad [3]$$

(b)

NOT TO
SCALE

The diagram shows a cylinder with radius 8 cm inside a sphere with radius 17 cm.
 Both ends of the cylinder touch the curved surface of the sphere.

(i) Show that the height of the cylinder is 30 cm.

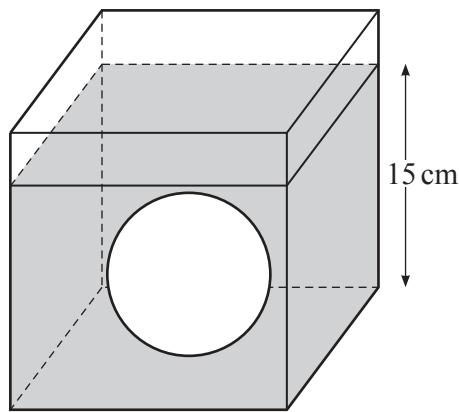
[2]

(ii) Calculate the volume of the cylinder as a percentage of the volume of the sphere.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... % [4]

(c)



NOT TO
SCALE

The diagram shows a solid sphere with radius 6 cm inside a cube with side length 20 cm.
The cube contains water to a depth of 15 cm.
The sphere is removed.

Calculate the new depth of water in the cube.

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

..... cm [3]

5 (a) In a shop the cost of a fiction book is $\$x$ and the cost of a reference book is $\$(x+2)$.
The cost of 11 fiction books is the same as the cost of 10 reference books.

Find the value of x .

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

(b) In another shop, the cost of a fiction book is $\$y$ and the cost of a reference book is $\$(y+2)$.
Maria spends $\$95$ on fiction books and $\$147$ on reference books.
She buys a total of 12 books.

(i) Show that $6y^2 - 109y - 95 = 0$.

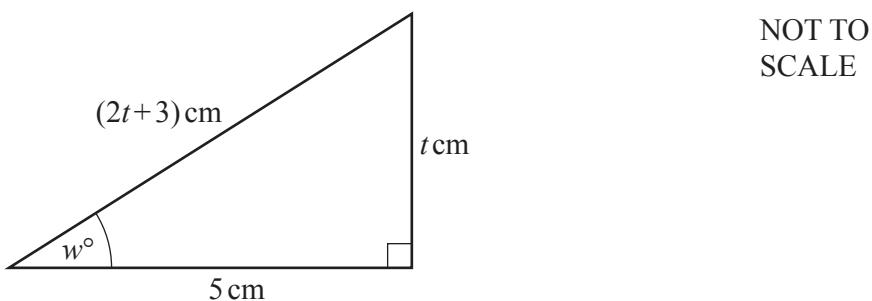
[4]

(ii) Factorise $6y^2 - 109y - 95$.

$$\dots \quad [2]$$

(iii) Find the value of y .

$$y = \dots \quad [1]$$

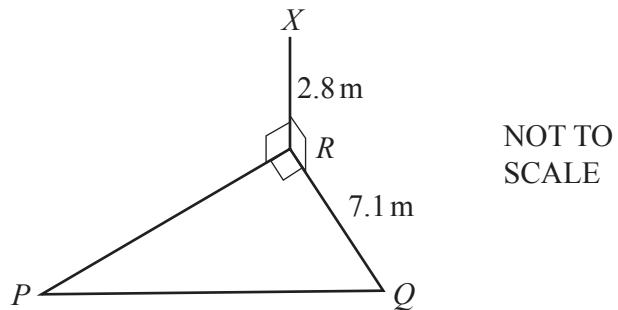


The diagram shows a right-angled triangle.

Find the value of w .

$w = \dots$ [7]

7 (a)



The diagram shows a right-angled triangle PQR on horizontal ground. X is vertically above R and the angle of elevation of X from P is 21° . $XR = 2.8$ m and $RQ = 7.1$ m.

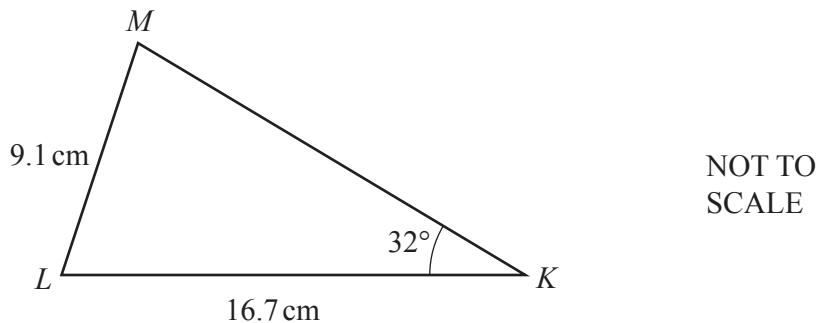
(i) Calculate the angle of elevation of X from Q .

..... [2]

(ii) Calculate PQ .

..... m [3]

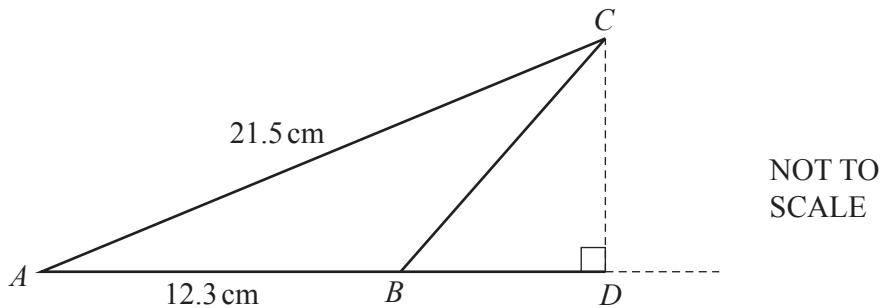
(b)



Calculate the acute angle KML .

Angle KML = [3]

(c)



The area of triangle ABC is 62.89 cm^2 .

(i) Show that angle $BAC = 28.4^\circ$, correct to 1 decimal place.

[2]

(ii) Calculate BC .

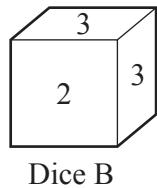
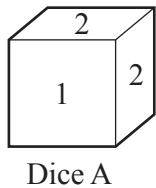
..... cm [3]

(iii) AB is extended to a point D such that angle $BDC = 90^\circ$.

Calculate BD .

..... cm [3]

8



The diagram shows two fair dice.

Dice A is numbered 1, 2, 2, 2, 3, 6.

Dice B is numbered 2, 3, 3, 4, 4, 4.

(a) (i) Dice A is rolled once.

Write down the probability that it lands on the number 6.

..... [1]

(ii) Dice A is rolled 150 times.

Find the number of times it is expected to land on the number 6.

..... [1]

(b) Dice A and Dice B are each rolled once.

(i) Find the probability that the two numbers they land on have a total of 6.

..... [3]

(ii) Find the probability that when the two numbers they land on have a total of 6, both numbers are 3.

..... [2]

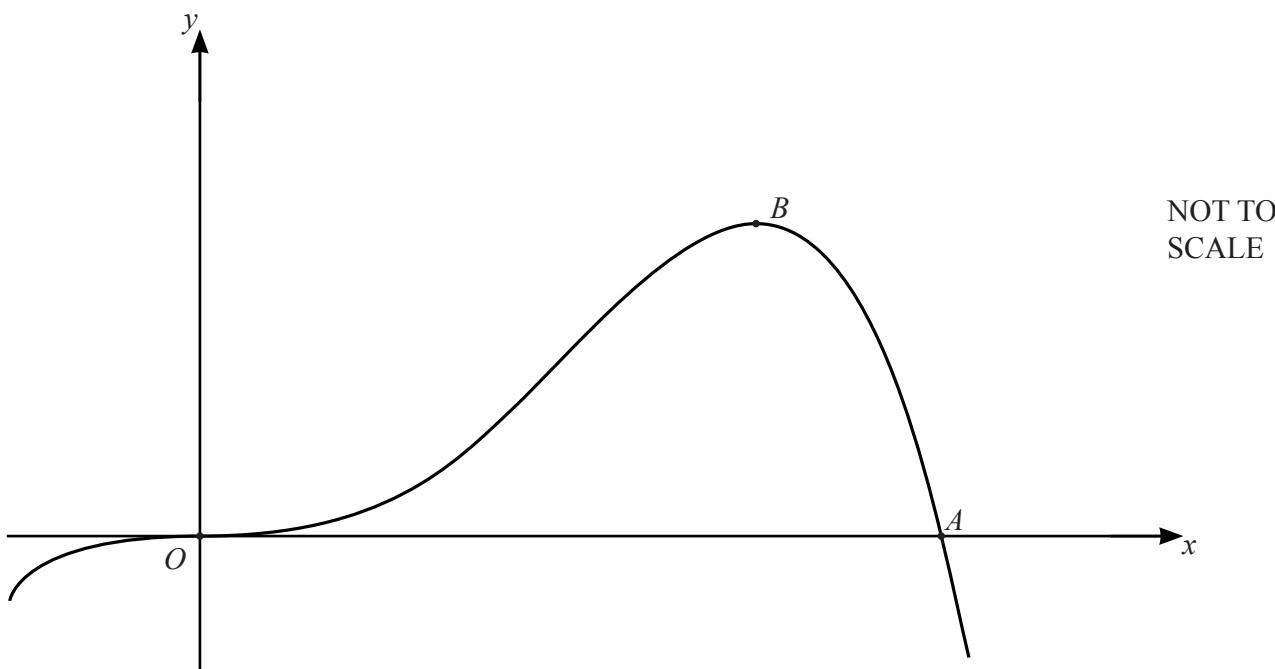
(c) Dice B is rolled n times.

The probability that on the n th roll it first lands on a number 3 is $\frac{32}{729}$.

Find the value of n .

$n = \dots$ [2]

9



The diagram shows a sketch of the graph of $y = 4x^3 - x^4$.
 The graph crosses the x -axis at the origin O and at the point A .
 The point B is a maximum point.

(a) Differentiate $4x^3 - x^4$.

..... [2]

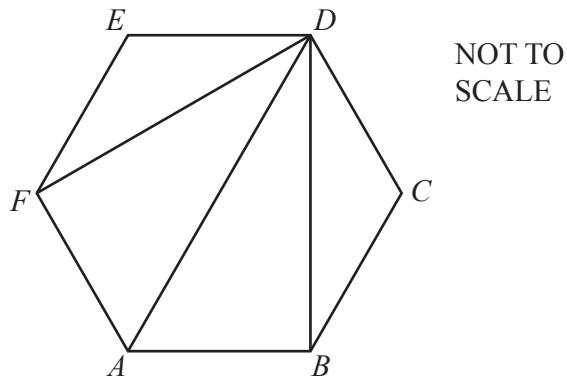
(b) Find the coordinates of B .

(.....,) [3]

(c) Find the gradient of the graph at the point A .

..... [3]

10 (a)



$ABCDEF$ is a regular hexagon.
 DF , DA and DB are diagonals.

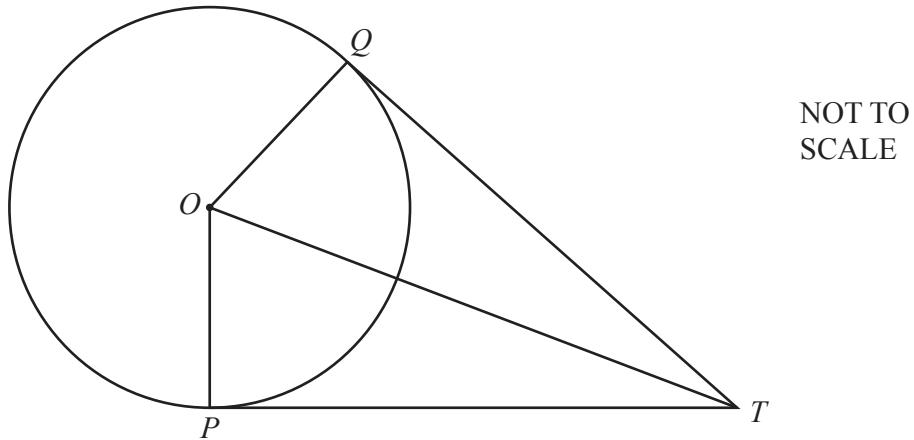
Complete the following statements using three different triangles.

Triangle DEF is congruent to triangle

Triangle is congruent to triangle

[2]

(b)



P and Q are points on the circle with centre O .
 TP and TQ are tangents to the circle from the point T .

Complete the following statements and reasons.

In triangles OPT and OQT

$OP =$ because each is a radius of the circle

OT is a common side

Angle $OPT =$ angle $= 90^\circ$ because

Triangles OPT and OQT are congruent using the criterion

This proves that the tangents TP and TQ are

[5]

11 $f(x) = 1 - 3x$ $g(x) = (x - 1)^2$ $h(x) = \frac{3}{x}, x \neq 0$

(a) Find $g(3)$.

..... [1]

(b) Find $f(x-2)$, giving your answer in its simplest form.

..... [2]

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

$f^{-1}(x) =$ [2]

(d) $gf(x) - g(x)f(x) = 3x^3 + ax^2 + bx + c$

Find the value of each of a , b and c .

$a =$

$b =$

$c =$ [5]

(e) Find $h(x) - f(x)$, giving your answer as a single fraction in its simplest form.

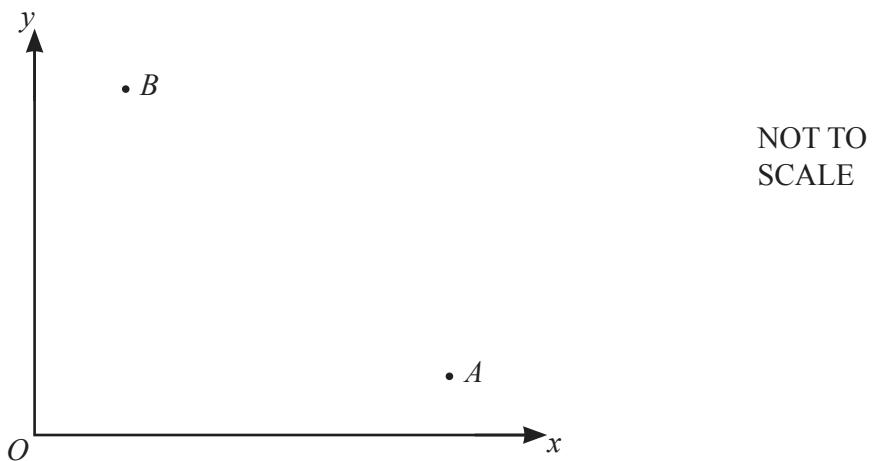
..... [3]

(f) $h(x^n) = 3x^7$

Find the value of n .

$n =$ [1]

12



O is the origin $(0, 0)$, A is the point $(8, 1)$ and B is the point $(2, 5)$.

(a) Write as column vectors.

(i) \overrightarrow{OB}

$$\overrightarrow{OB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} \quad [1]$$

(ii) \overrightarrow{AB}

$$\overrightarrow{AB} = \begin{pmatrix} \quad \\ \quad \end{pmatrix} \quad [1]$$

(b) Find the equation of the line AB .

Give your answer in the form $y = mx + c$.

$$y = \dots \quad [3]$$

(c) Find the equation of the perpendicular bisector of AB .
Give your answer in the form $y = mx + c$.

$y = \dots \dots \dots \dots$ [4]

(d) The line AB meets the y -axis at P .
The perpendicular bisector of AB meets the y -axis at Q .

Find the length of PQ .

$\dots \dots \dots \dots$ [2]

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