Cambridge O Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

MATHEMATICS (SYLLABUS D) **3171/22**

Paper 2 **May/June 2021**

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 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages.

1 (a) One day, 12 employees in an office recorded the distance they drove to work and the time it took.
The table shows the distances, in kilometres, and the times, in minutes.

Distance (km)	40	23	37	18	25	45	35	20	32	35	22	39
Time (minutes)	59	35	49	28	29	54	40	29	40	48	33	46

(i) On the grid, complete the scatter diagram.
The first six points have been plotted for you.
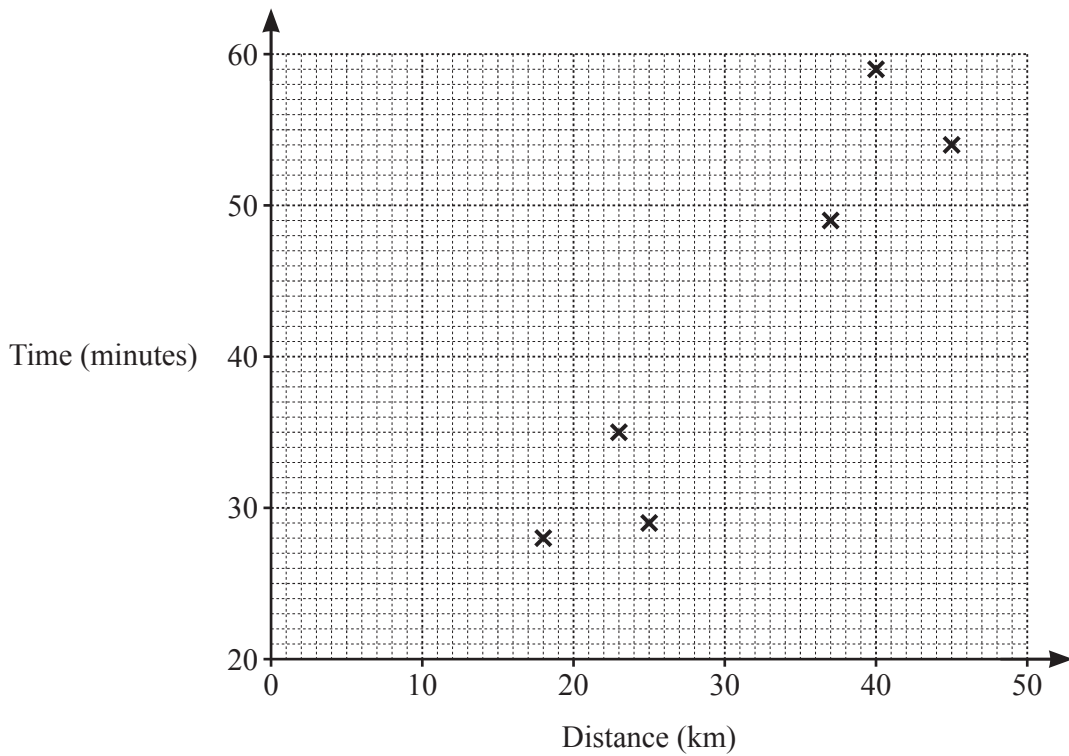
[2]

(ii) What type of correlation does the scatter diagram show?

.... [1]

(iii) Draw a line of best fit on the scatter diagram. [1]

(iv) Another employee drove a distance of 30 km to work.

Use your line of best fit to estimate how many minutes they took.

.... minutes [1]

(b) There are 150 employees at the company.
The table shows the distances, in kilometres, each employee travels to work.

Distance (d km)	$0 < d \leqslant 10$	$10 < d \leqslant 20$	$20 < d \leqslant 25$	$25 < d \leqslant 30$	$30 < d \leqslant 60$
Frequency	25	28	42	36	19

(i) Calculate the percentage of employees who travel **more than** 25 km to work.

.... % [2]

(ii) Calculate an estimate of the mean distance.

.... km [3]

2 **(a)** Zara works for 5 days each week.
    Each day she works from 08 00 until 12 30 and from 13 15 until 17 00.
    She is paid $15.40 per hour.

    Work out how much Zara earns in one week.

    $ .... [3]

(b) Samuel works for 40 hours each week.
    He is paid $13.60 per hour.
    He pays 7.5% of his total earnings in tax.
    The rest of his earnings are paid into his bank account.

    Calculate the amount paid into his bank account each week.

    $ .... [3]

(c) Jacob invests $750 in an account that pays 2.1% per year simple interest.
Mary invests $750 in an account that pays p% per year compound interest.

They each leave the money in their account for 5 years.
At the end of 5 years there is the same amount of money in each account.

Calculate the value of p.
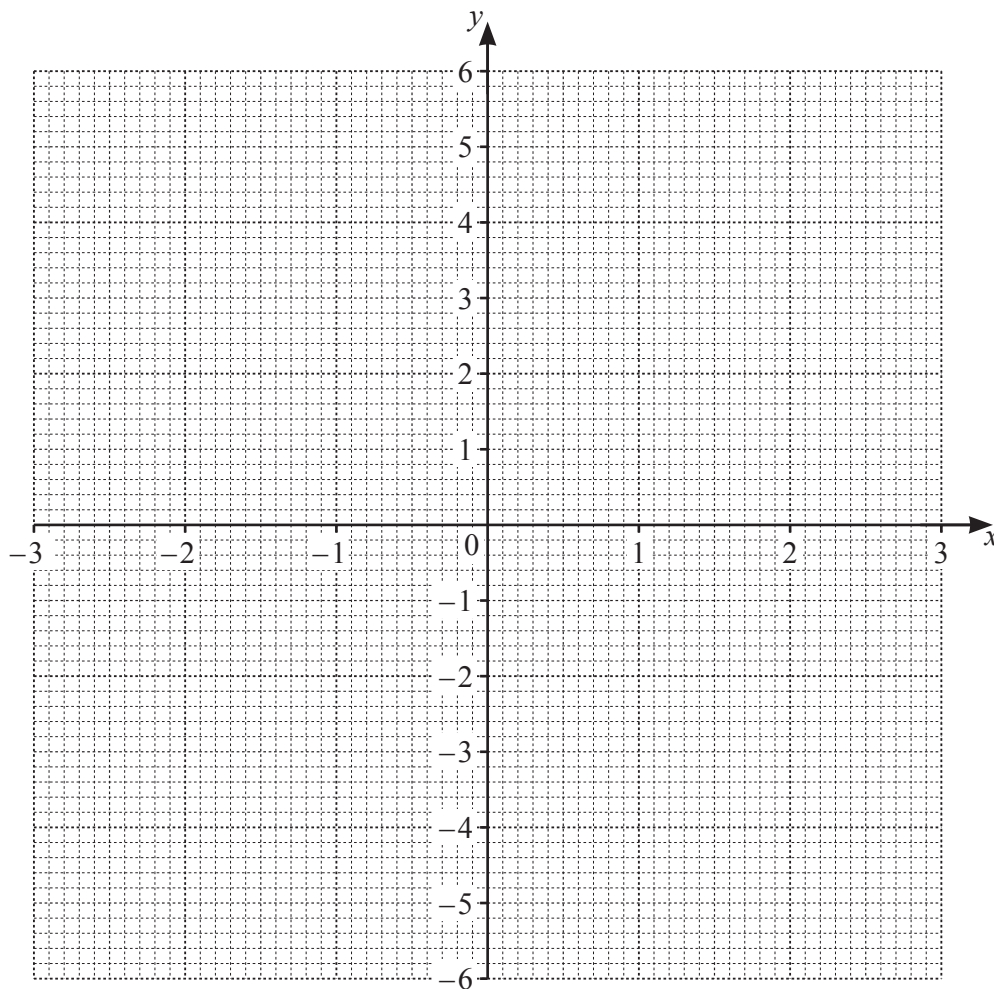Give your answer correct to 2 decimal places.

$p =$ .... [5]

3 **(a)** Complete the table for $y = -\dfrac{x^3}{2} + 3x + 1$.

x	-3	-2	-1.5	-1	0	1	1.5	2	3
y		-1	-1.8	-1.5	1	3.5	3.8	3	-3.5

[1]

(b) Draw the graph of $y = -\dfrac{x^3}{2} + 3x + 1$ for $-3 \leqslant x \leqslant 3$.

[3]

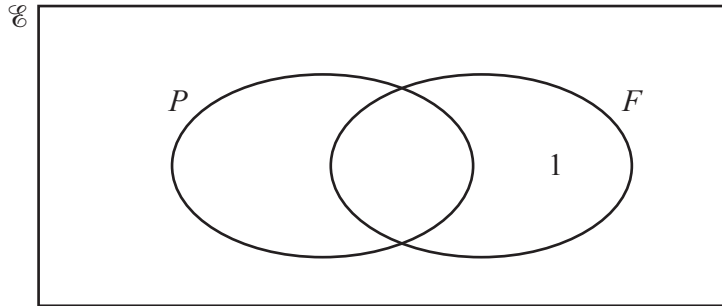**(c)** By drawing a tangent, estimate the gradient of the curve at $x = 2$.

.... [2]

(d) By drawing a suitable line on the grid, estimate the solutions of the equation $\dfrac{x^3}{2} + 1 = 2x$.

$x =$ .... , $x =$ .... , $x =$ .... [4]

4 **(a)** $\mathcal{E} = \{x : x$ is an integer $1 \leqslant x \leqslant 10\}$
$P = \{x : x$ is a prime number$\}$
$F = \{x : x$ is a factor of 18$\}$

(i) Complete the Venn diagram.

[2]

(ii) Write down the elements of $P \cap F$.

.... [1]

(iii) State n$(P' \cup F')$.

.... [1]

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(b)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Tara has these ten number cards.

(i) She takes one of the ten cards at random.

Find the probability that the card shows a square number.

.... [1]

(ii) Tara takes one of the ten cards at random, notes the number and replaces it.
She repeats this.
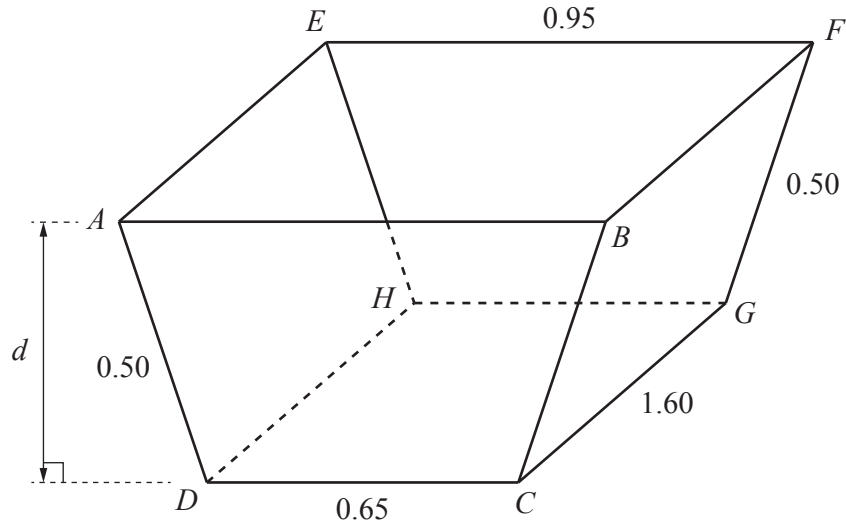
Work out the probability that both cards show multiples of 4.
Give your answer as a fraction in its lowest terms.

.... [2]

(iii) Tara takes two of the ten cards at random, **without** replacement.

Work out the probability that at least one of the cards shows a number greater than 7.

.... [3]

5

The diagram shows a water tank in the shape of a prism with an open top.
The cross-section of the tank, *ABCD*, is a trapezium.
The base of the tank, *CDHG*, is a rectangle.
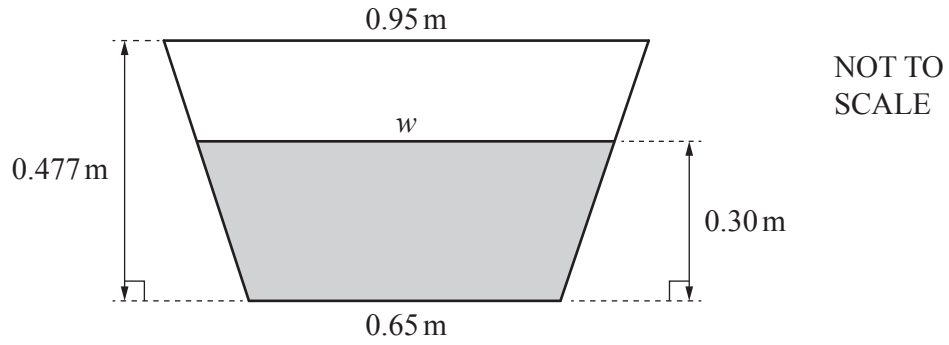All dimensions are in metres and $AD = BC = FG = EH$.

(a) Show that the depth, d m, of the tank is 0.477, correct to 3 significant figures.

[3]

(b) Calculate the surface area of the tank.

.... m² [3]

(c)

The diagram shows the cross-section of this tank.
The tank contains water to a depth of 0.30 m.

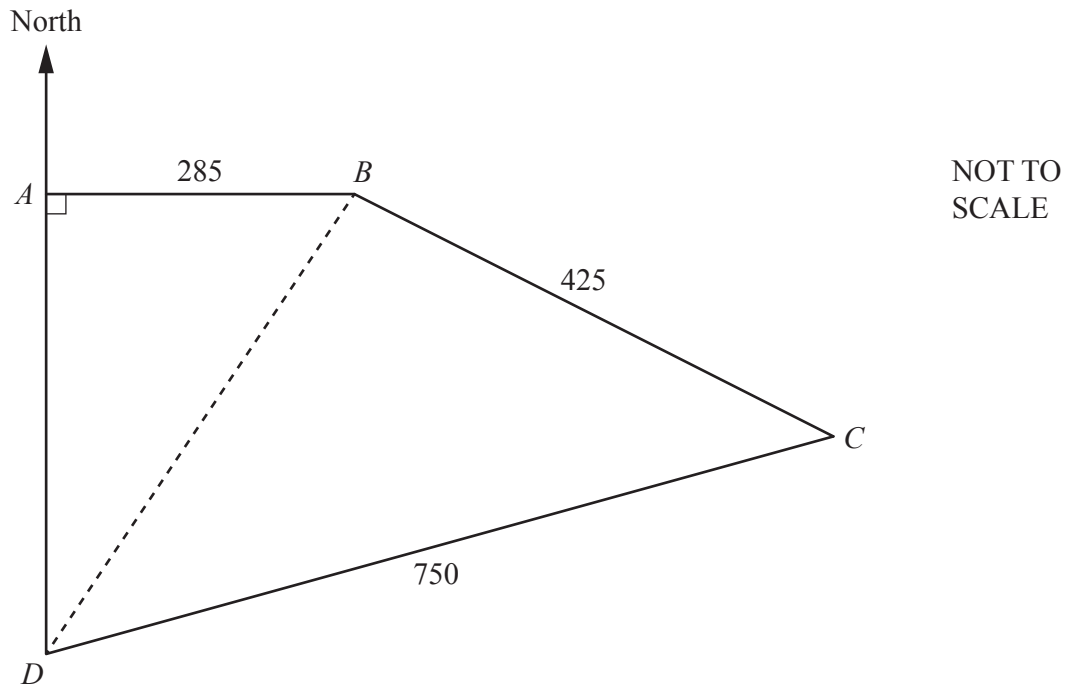**(i)** Show that $w = 0.84$ m, correct to 2 significant figures.

[3]

(ii) Calculate the area of the surface of the water in the tank.

.... m^2 [1]

6

North

The diagram shows a field, *ABCD*.
AB = 285 m, *BC* = 425 m and *CD* = 750 m.

(a) Karim and Nabila are running in the field.

Karim starts running from *B* at the same time as Nabila starts running from *D*.
Nabila runs from *D* to *C* at a speed of 12.2 km/h.
Karim runs from *B* to *C* at a speed of 11.5 km/h.

Work out how much time Karim waits at *C* before Nabila arrives.
Give your answer in minutes and seconds, correct to the nearest second.

.... minutes .... seconds [4]

13

(b) *B* is due east of *A* and *D* is due south of *A*.
B is on a bearing of 035° from *D*.

    (i) Calculate *AD*.

.... m [2]

    (ii) Calculate the bearing of *C* from *D*.

.... [5]

7 **(a)** Here are the first four terms of a sequence.

$$1 \qquad 7 \qquad 13 \qquad 19$$

(i) Find an expression for the nth term of this sequence.

.... [2]

(ii) Lee says that there are no even numbers in the sequence.

Use the expression for the nth term to explain why he is correct.

....

.... [1]

(b) Here are the first four terms of a different sequence.

$$\frac{2}{9} \qquad \frac{4}{16} \qquad \frac{8}{25} \qquad \frac{16}{36}$$

Find an expression for the nth term of this sequence.

.... [3]

(c) The *n*th term of another sequence is given by $u_n = 3n^2 - 6n + 5$.
The first term in the sequence with a value greater than 2000 is u_k.

Find the value of *k*.

$k =$ .... [4]

8 **(a)** *A* is the point (−2, 1) and *B* is the point (3, 3).

(i) Find the length of line *AB*.

.... [2]

(ii) *ABCD* is a square with sides *AB, BC, CD* and *DA*.
Point *C* is below the *x*-axis.

Find the coordinates of point *C*.

C = (.................. , ...) [2]

(b) *P* is the point $(-7, 8)$ and *Q* is the point $(9, 4)$.

    (i) Find the coordinates of the midpoint of line *PQ*.

$(\text{..................} , \text{..................})$ [1]

    (ii) Find the equation of the perpendicular bisector of *PQ*.

.... [4]

9
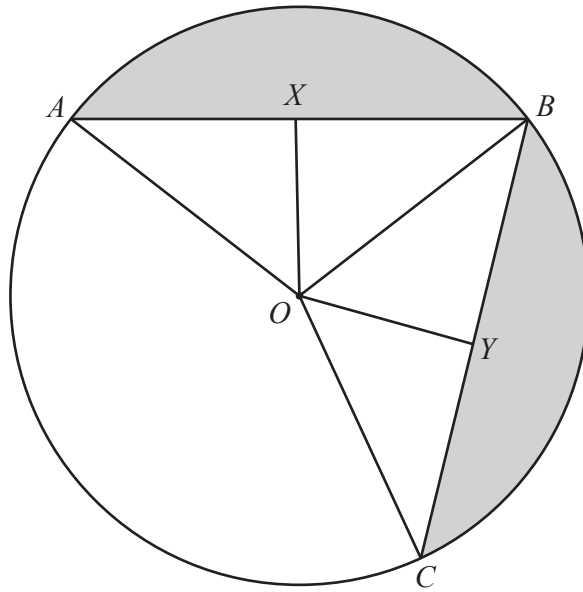
NOT TO SCALE

A, *B* and *C* are points on the circle, centre *O*.
X is the midpoint of *AB* and *Y* is the midpoint of *BC*.
AB = *BC*.

(a) Show that triangle *AOX* is congruent to triangle *BOY*.
Give a reason for each statement you make.

....

....

....

.... [3]

(b) The circle has radius 4 cm and $AB = 7$ cm.

    (i) Calculate angle BOA.

Angle $BOA =$ .... [3]

    (ii) Calculate the shaded area.

.... cm^2 [4]

Question 10 is printed on the next page.

10 (a) Farah and Abid each play a number game.
They both start with the same number.

Farah subtracts 4 from the starting number and multiplies the result by 11.
Abid multiplies the starting number by 5 and adds 1.
Farah and Abid both end up with the same answer.

Form an equation and solve it to find their starting number.

.... [3]

(b) Rearrange the formula $a = \dfrac{b(4-c)}{c+1}$ to make c the subject.

$c =$ .... [3]

(c) Express as a single fraction in its simplest form $\dfrac{5}{3x-2} - \dfrac{4}{1-x}$.

.... [3]