



## Cambridge O Level

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**MATHEMATICS (SYLLABUS D)**

**4024/22**

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  $\pi$ , 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. Any blank pages are indicated.

- 1 (a) The price of an electric drill is \$78.  
In a sale, the price is reduced by 15%.

Calculate the sale price.

\$ ..... [2]

- (b) The exchange rate between dollars (\$) and euros (€) is  $\$1 = \text{€}0.85$ .  
Michael changes \$100 to euros.  
He buys a clock costing €58.99.  
He changes the remaining money back to dollars.

Calculate the amount, in dollars, he has left.

\$ ..... [2]

(c)

|  |
|--|
| <p style="text-align: center;"><u>ACE SIMPLE</u></p> <p style="text-align: center;">Simple interest at<br/>2.1% per year</p> |
|--|

|   |
|---|
| <p style="text-align: center;"><u>COOL COMPOUND</u></p> <p style="text-align: center;">Compound interest at<br/>2% per year</p> |
|---|

Pietro invests \$3500 in the Ace Simple account for 4 years.  
Eliana invests \$3500 in the Cool Compound account for 4 years.

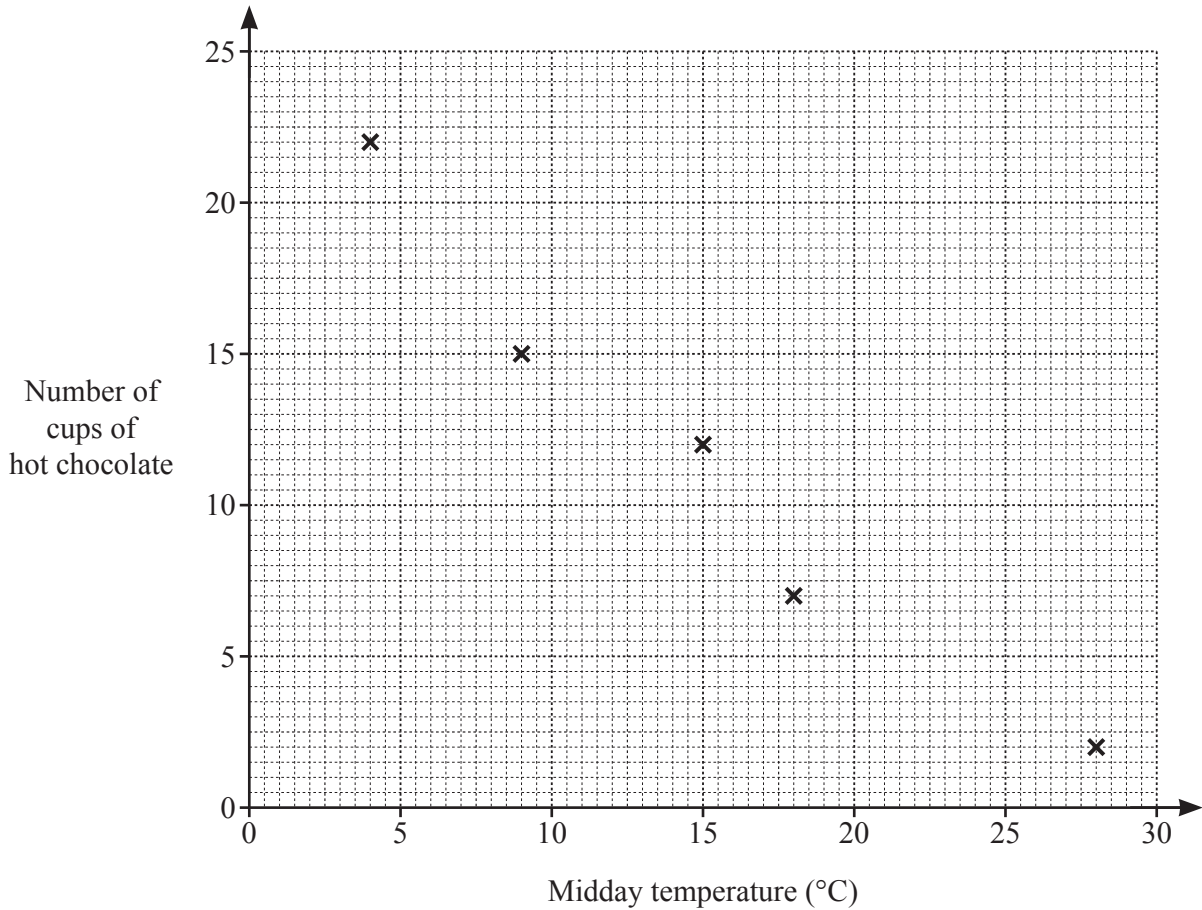
At the end of the 4 years, who has more money in their account and by how much?

..... by \$ ..... [4]

- 2 The table shows the midday temperature and the number of cups of hot chocolate Natcha sells on each of ten days.

|                                 |    |    |    |    |    |    |    |    |    |    |
|---------------------------------|----|----|----|----|----|----|----|----|----|----|
| Midday temperature (°C)         | 18 | 9  | 4  | 28 | 15 | 21 | 6  | 5  | 12 | 23 |
| Number of cups of hot chocolate | 7  | 15 | 22 | 2  | 12 | 8  | 17 | 21 | 16 | 6  |

- (a) Complete the scatter diagram.  
The first 5 points have been plotted for you.



[2]

- (b) Describe the relationship between the midday temperature and the number of cups of hot chocolate Natcha sells.

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

- (c) By drawing a line of best fit, estimate the number of cups of hot chocolate sold when the midday temperature is 17°C.

..... [2]

3 (a) Simplify  $4a - b + 6b - 7a$ .

..... [2]

(b) Solve  $\frac{m}{2} - 4 = 5$ .

$m =$  ..... [2]

(c) Rearrange  $u = \frac{t+4}{3}$  to make  $t$  the subject.

$t =$  ..... [2]

(d) Expand  $3y(2y^2 + 5)$ .

..... [2]

- 4 100 adults in a town were surveyed about the number of emails they each received one day. The table shows the results.

|                  |   |    |    |    |    |   |   |   |
|------------------|---|----|----|----|----|---|---|---|
| Number of emails | 1 | 2  | 3  | 4  | 5  | 6 | 7 | 8 |
| Number of adults | 8 | 10 | 22 | 28 | 15 | 9 | 5 | 3 |

- (a) Find the mode.

..... [1]

- (b) Calculate the mean.

..... [2]

- (c) One of these adults is chosen at random.

Find the probability that they received **fewer than** 4 emails that day.  
Give your answer as a fraction in its simplest form.

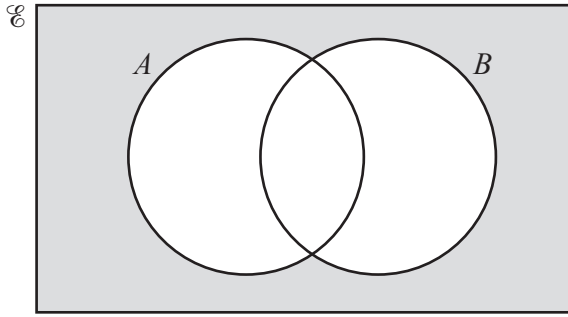
..... [2]

- (d) The town has 18 000 adults.

Use the survey results to estimate the number of adults in the town who received exactly 5 emails that day.

..... [2]

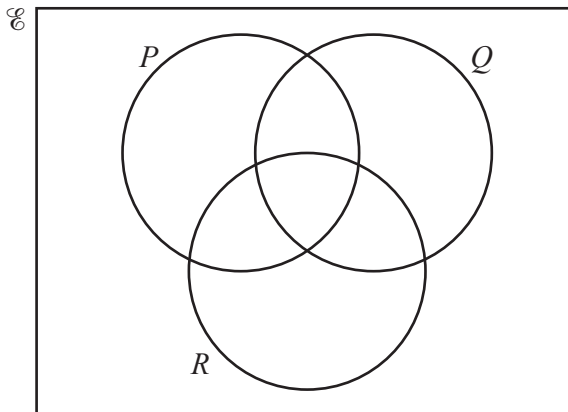
5 (a) Use set notation to describe the subset shaded in the Venn diagram.



..... [1]

- (b)  $U = \{ 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \}$   
 $P = \{ x : x \text{ is a factor of } 36 \}$   
 $Q = \{ x : x \text{ is a multiple of } 4 \}$   
 $R = \{ x : 3 \leq x \leq 6 \}$

(i) Complete the Venn diagram.



[3]

(ii) List the elements of  $P \cap (Q \cup R)'$ .

..... [1]

(iii) Find  $n(P \cup Q)$ .

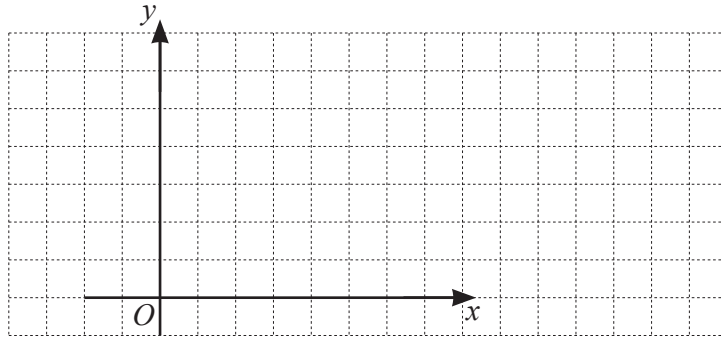
..... [1]

(iv) Use set notation to complete the statement.

..... =  $\emptyset$  [1]

- 6 (a)  $PQR$  is an isosceles triangle with  $PR = QR$ .  
 $P$  is the point  $(1, 5)$  and  $Q$  is the point  $(5, 1)$ .  
 Angle  $PRQ$  is **not** a right angle.

Find the coordinates for one possible position of  $R$ .  
 You may use the grid to help you.



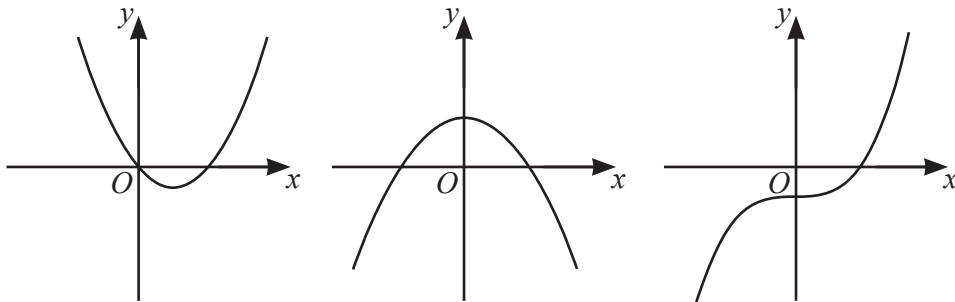
( ..... , ..... ) [2]

- (b) Here are the equations of five curves.

$$y = 2 - x^2 \quad y = x^3 - 2 \quad y = x^2 + 2x - 8 \quad y = x^3 - 3x \quad y = x^2 - 3x$$

Sketches of three of these curves are drawn below.

Write the correct equation underneath each sketch.



.....

.....

.....

[3]



(c)  $A$  is the point  $(-1, -5)$  and  $B$  is the point  $(3, 3)$ .

Find the equation of the line perpendicular to  $AB$  which passes through the midpoint of  $AB$ .

..... [5]

7 (a) A rectangular field measures 30 m by 45 m.

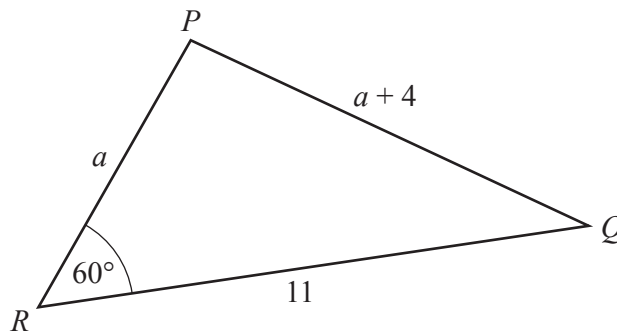
(i) Calculate the perimeter.

..... m [1]

(ii) Calculate the length of a diagonal.

..... m [2]

(b)



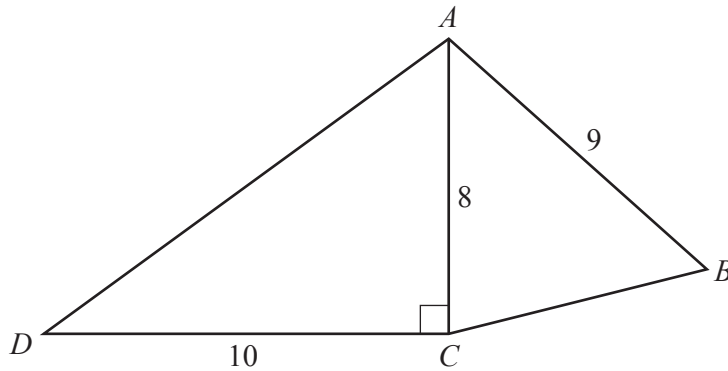
NOT TO SCALE

The diagram shows a sketch of triangle  $PQR$ . All lengths are given in centimetres.

Calculate the length  $a$ .

$a =$  ..... cm [4]

- (c) The diagram shows a sketch of quadrilateral  $ABCD$ .  
All lengths are given in centimetres.



NOT TO  
SCALE

The area of quadrilateral  $ABCD$  is  $70 \text{ cm}^2$ .

Calculate  $\hat{DAB}$ .

$\hat{DAB} = \dots\dots\dots$  [6]

8  $f(x) = 3x - 5$      $g(x) = \frac{4x+4}{3}$

(a) Find  $f(-2)$ .

..... [1]

(b) Find the largest integer satisfying  $f(x) > 3g(x)$ .

..... [3]

(c) Solve  $f(x) = g(3x - 5)$ .

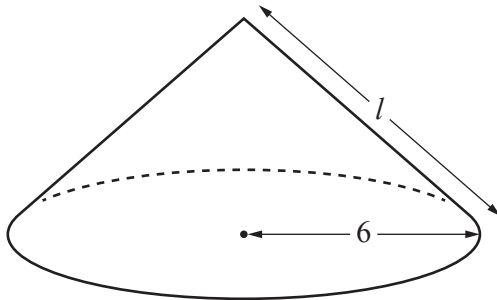
$x =$  ..... [3]

(d) Solve  $g^{-1}(x) = 5$ .

$x =$  ..... [1]

9 [Volume of a cone =  $\frac{1}{3} \pi r^2 h$ ]

[Curved surface area of a cone =  $\pi r l$ ]



A cone has radius 6 cm and slant height  $l$  cm.  
The **total** surface area of the cone is  $84\pi \text{ cm}^2$ .

(a) Show that  $l = 8$ .

[2]

(b) Calculate the volume of the cone.

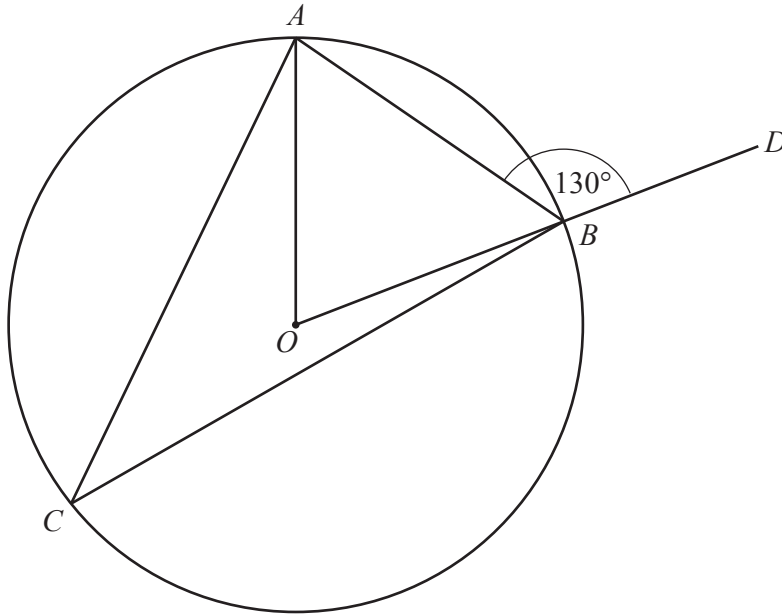
.....  $\text{cm}^3$  [3]

(c) A similar cone has a **total** surface area of  $47.25\pi \text{ cm}^2$ .

Find the radius of this cone.

..... cm [2]

10 (a)



NOT TO SCALE

$A$ ,  $B$  and  $C$  are points on the circumference of a circle, centre  $O$ .  $OBD$  is a straight line and angle  $ABD = 130^\circ$ .

Find angle  $ACB$ , giving a reason for each step of your working.

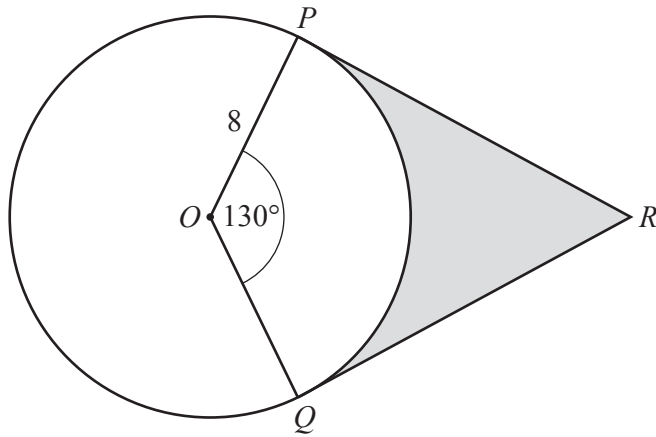
.....

.....

.....

Angle  $ACB = \dots\dots\dots [3]$

(b)



NOT TO  
SCALE

$P$  and  $Q$  are points on the circumference of a different circle, centre  $O$ .  
 $PR$  and  $QR$  are tangents to the circle at  $P$  and  $Q$  respectively.  
 $OP = 8$  cm and  $\widehat{POQ} = 130^\circ$ .

(i) Find  $PR$ .

$PR = \dots\dots\dots$  cm [2]

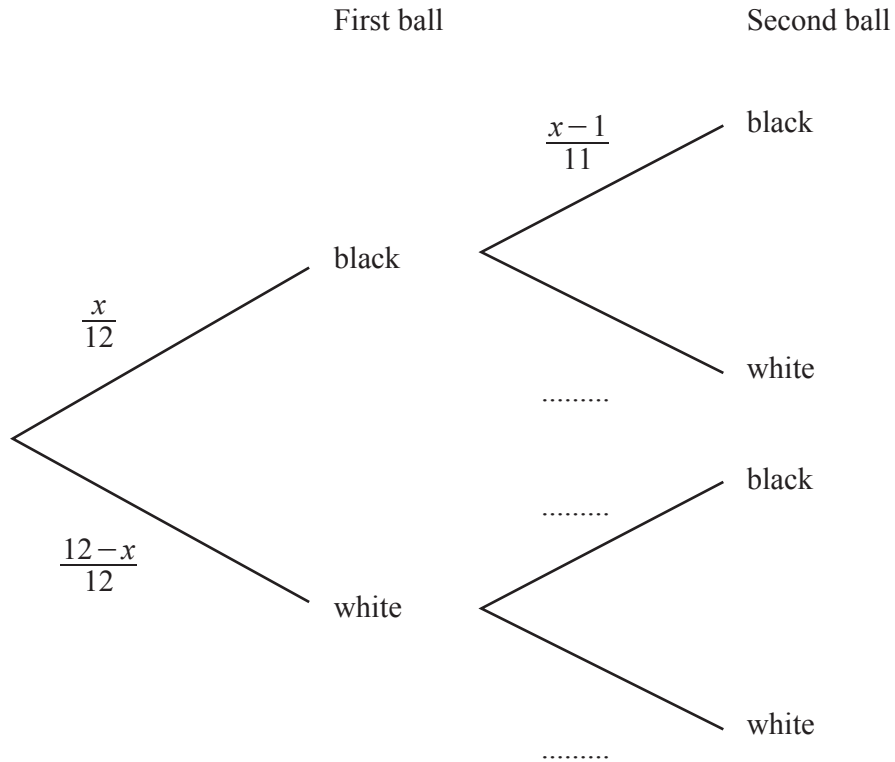
(ii) Calculate the percentage of quadrilateral  $OPRQ$  that is shaded.

$\dots\dots\dots$  % [4]

- 11 A bag contains 12 balls.  
There are  $x$  black balls in the bag and the other balls are white.

Two balls are taken at random from the bag without replacement.

- (a) Complete the tree diagram.



[2]

- (b) Find an expression for the probability of taking one ball of each colour.  
Write your answer as a single fraction in terms of  $x$ .

..... [3]



- (c) The probability that both balls are black is  $\frac{14}{33}$ .

Form an equation in  $x$  and solve it to find the number of black balls in the bag.  
Show your working.

..... [4]

12 (a)  $A$  is the point  $(2, 3)$  and  $B$  is the point  $(3, -5)$ .

(i) Find  $\vec{AB}$ .

$$\vec{AB} = \begin{pmatrix} \phantom{0} \\ \phantom{0} \end{pmatrix} \quad [2]$$

(ii)  $\vec{BC} = \begin{pmatrix} -4 \\ 3 \end{pmatrix}$

Find the coordinates of  $C$ .

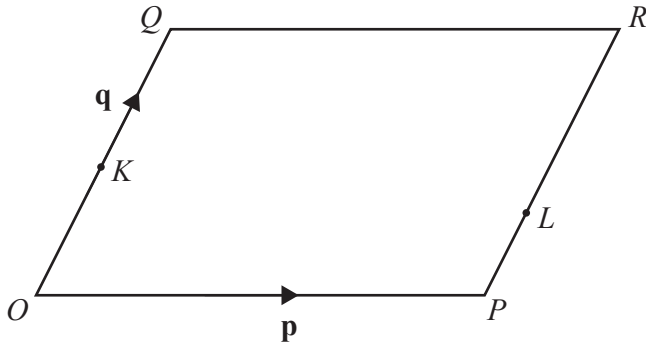
(....., ..... ) [1]

(iii)  $|\vec{AD}| = \sqrt{74}$  and  $D = (-3, n)$ .

Find the possible values of  $n$ .

$n = \dots\dots\dots$  or  $n = \dots\dots\dots$  [3]

(b)

NOT TO  
SCALE

$OQRP$  is a parallelogram.

$\vec{OP} = \mathbf{p}$  and  $\vec{OQ} = \mathbf{q}$ .

$K$  is the midpoint of  $OQ$  and  $L$  is a point on  $PR$ .

$\vec{KL} = \mathbf{p} - \frac{1}{10}\mathbf{q}$ .

Find  $PL : LR$ .

..... : ..... [3]

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