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0580/43

May/June 2016

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Electronic calculator
Tracing paper (optional).

Geometrical instruments

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown below that question.

Electronic calculators should be used.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 130.

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **15** printed pages and **1** blank page.

1 A football club sells tickets at different prices dependent on age group.

(a) (i) At one game, the club sold tickets in the ratio

$$\text{under 18} : 18 \text{ to } 60 : \text{over } 60 = 2 : 7 : 3.$$

There were 6100 tickets sold for people aged under 18.

Calculate the **total** number of tickets sold for the game.

$$2 \text{ parts} = 6100 \rightarrow 1 \text{ part} = 3050$$

$$3050 \times 12$$

$$36600 \dots\dots\dots [3]$$

(ii) Calculate the percentage of tickets sold for people aged under 18.

$$\frac{6100}{36600} \times 100$$

$$16.7 \dots\dots\dots \% [1]$$

(b) The table shows the football ticket prices for the different age groups.

Age	Price
Under 18	\$15
18 to 60	\$35
Over 60	\$18

At a **different** game there were 42 600 tickets sold.

- 14% were sold to people aged under 18
- $\frac{2}{3}$ of the tickets were sold to people aged 18 to 60
- The remainder were sold to people aged over 60

Calculate the total amount the football club receives from ticket sales for this game.

$$42600 \times 0.14 = 5964$$

$$5964 \times 15 = \underline{89460}$$

$$\frac{2}{3} \times 42600 = 28400$$

$$28400 \times 35 = \underline{994000}$$

$$42600 - 28400 = 5964$$

$$= 8236$$

$$8236 \times 18 = \underline{148248}$$

$$89460 + 994000 + 148248$$

$$\text{\$ } 1231708 \dots\dots\dots [5]$$

- (c) In a sale, the football club shop reduced the price of the football shirts to \$23.80 .
An error was made when working out this sale price.
The price was reduced by 30% instead of 20%.

Calculate the correct sale price for the football shirt.

$$70\% = 23.80$$

$$\frac{23.80}{70} \times 80 = 27.2$$

$$\$ \underline{27.20} \quad [5]$$

- 2 (a) Solve the inequality.

$$5x - 3 > 9$$

$$5x > 12$$

$$x > 2.4$$

$$\text{or}$$

$$x > \frac{12}{5} \quad [2]$$

- (b) Factorise completely.

(i) $xy - 18 + 3y - 6x$

$$xy + 3y - 18 - 6x$$

$$y(x+3) - 6(x+3)$$

$$(x+3)(y-6) \quad [2]$$

(ii) $8x^2 - 72y^2$

$$8(x^2 - 9y^2)$$

$$8(x+3y)(x-3y)$$

$$8(x+3y)(x-3y) \quad [3]$$

- (c) Make r the subject of the formula.

$$p+5 = \frac{1-2r}{r}$$

$$r(p+5) = 1-2r$$

$$pr + 5r = 1-2r$$

$$2r + pr + 5r = 1$$

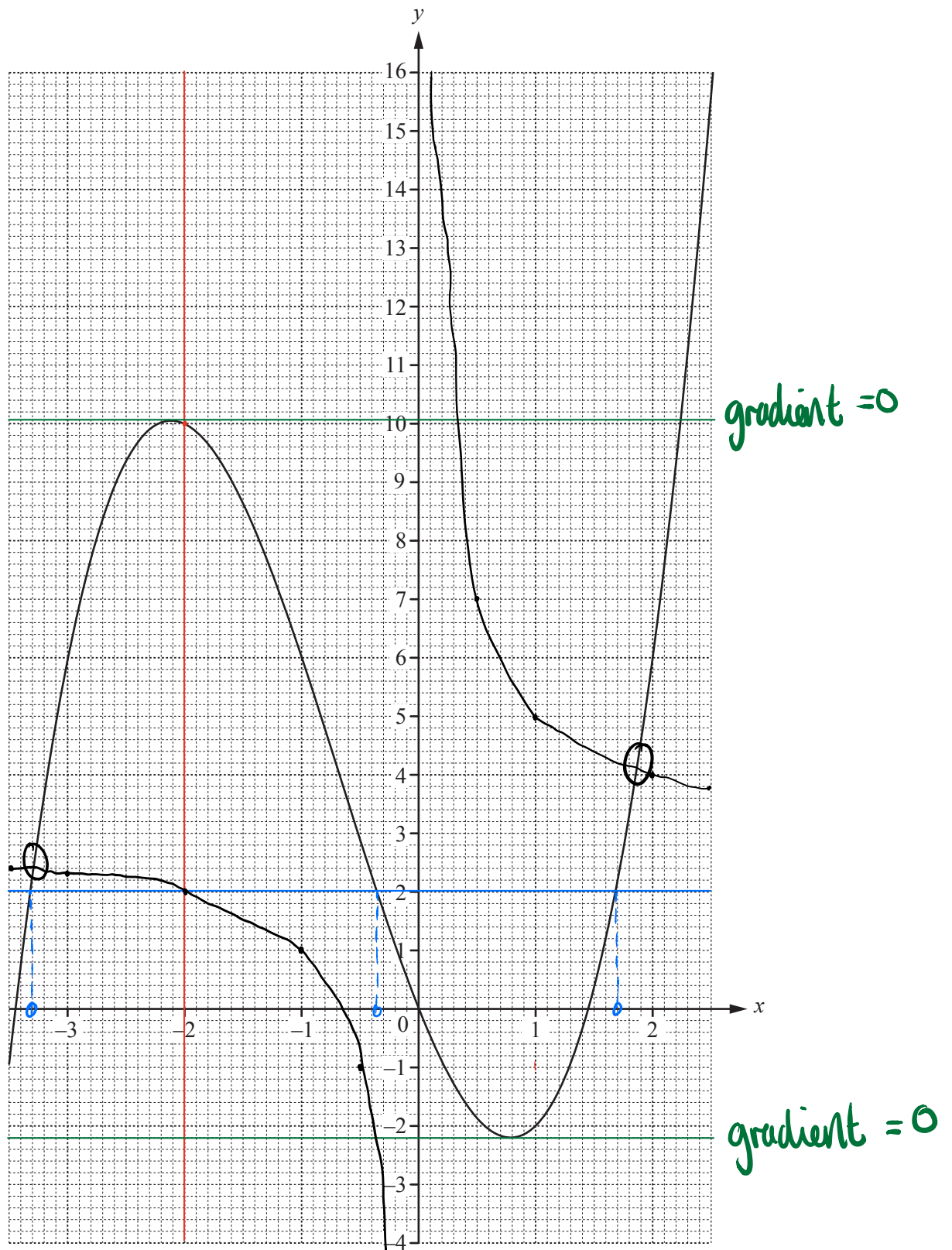
$$7r + pr = 1$$

$$r(7+p) = 1$$

$$r = \frac{1}{7+p}$$

$$r = \frac{1}{p+7} \quad [4]$$

- 3 The diagram shows the graph of $y = f(x)$ for $-3.5 \leq x \leq 2.5$.



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

$$x = -2$$

.....10..... [1]

- (ii) Solve the equation
- $f(x) = 2$
- .

$$y = 2$$

 $x = -3.3$ or $x = -0.35$ or $x = 1.7$ [3]

- (iii) Two tangents, each with gradient 0, can be drawn to the graph of
- $y = f(x)$
- .

Write down the equation of each tangent.

 $y = 10 \text{ to } 10.1$
 $y = -2.3 \text{ to } -2.1$ [2]

- (b) (i) Complete the table for
- $g(x) = \frac{2}{x} + 3$
- for
- $-3.5 \leq x \leq -0.5$
- and
- $0.5 \leq x \leq 2.5$
- .

x	-3.5	-3	-2	-1	-0.5		0.5	1	2	2.5
$g(x)$	2.4	2.3	2	1	-1		7	5	4	3.8

[3]

- (ii) On the grid opposite, draw the graph of
- $y = g(x)$
- .

[4]

- (iii) Use your graph to solve the equation
- $f(x) = g(x)$
- .

 $x = -3.4 \text{ to } -3.2$ or $x = 1.8 \text{ to } 1.9$ [2]

- (c) Find
- $gf(-2)$
- .

$$f(-2) = 10$$
$$g(10) = \frac{2}{10} + 3 = 3.2$$

.....3.2..... [2]

- (d) Find
- $g^{-1}(5)$
- .

$$y = 5$$
$$5 = \frac{2}{x} + 3$$

$$2 = \frac{2}{x} \rightarrow x = \frac{2}{2} = 1$$

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

- 4 Coins are put into a machine to pay for parking cars.
The probability that the machine rejects a coin is 0.05.

(a) Adhira puts 2 coins into the machine.

(i) Calculate the probability that the machine rejects **both** coins.

$$0.05 \times 0.05$$

$$\frac{1}{400} \dots [2]$$

(ii) Calculate the probability that the machine accepts at **least one** coin.

or
or

$$\left. \begin{array}{l} R A \\ A R \\ A A \end{array} \right\} (0.95 \times 0.05) + (0.95 \times 0.05) + (0.95 \times 0.95)$$

$$\frac{399}{400} \dots [1]$$

(b) Raj puts 4 coins into the machine.

Calculate the probability that the machine rejects **exactly one** coin.

$$\left. \begin{array}{l} R A A A \\ A R A A \\ A A R A \\ A A A R \end{array} \right\} = (0.95)^3 \times 0.05 \times 4 = 0.171475$$

$$0.171 \dots [3]$$

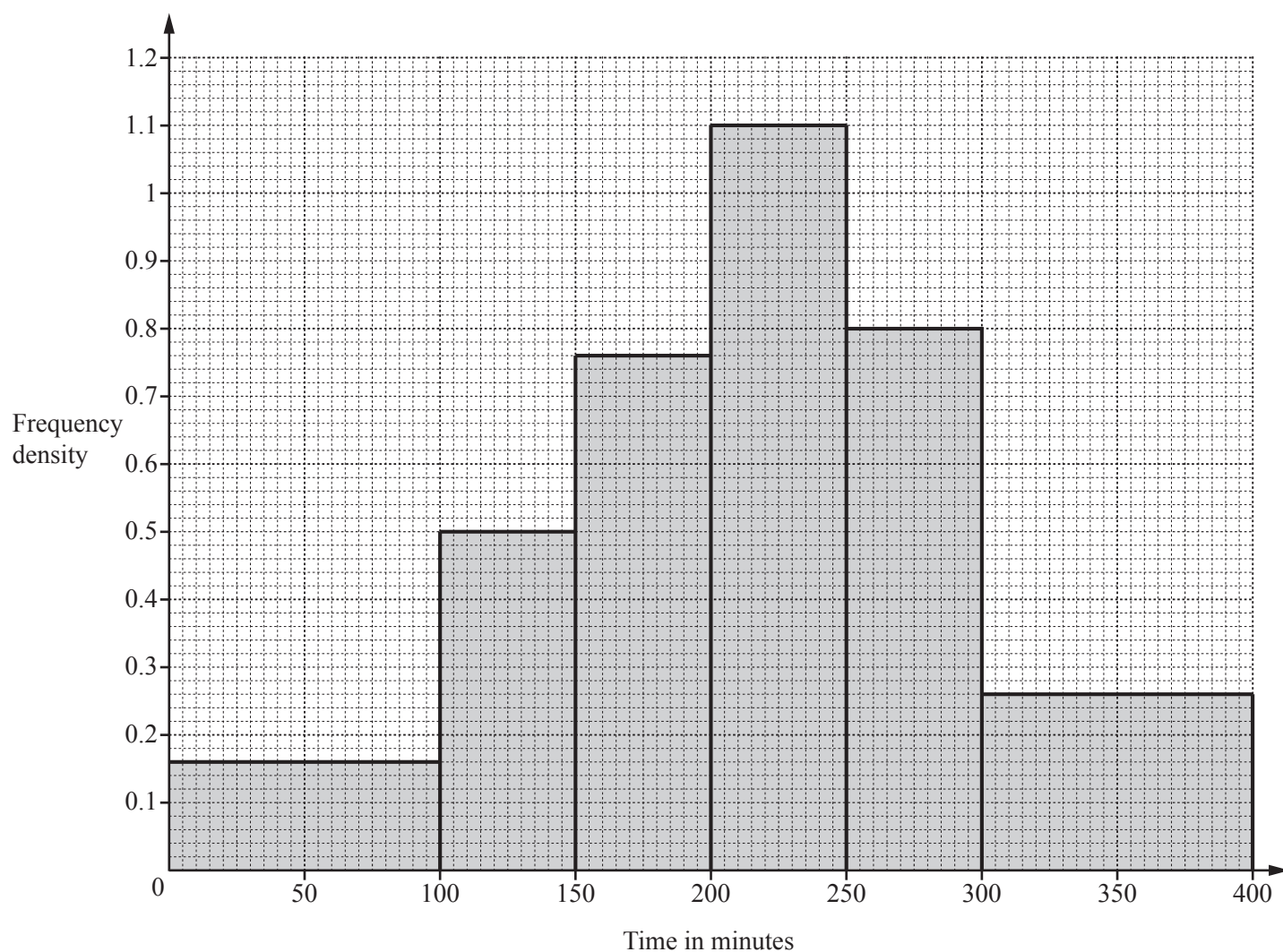
(c) The table shows the amount of money, \$a, received for parking each day for 200 days.

Amount (\$a)	$200 < a \leq 250$	$250 < a \leq 300$	$300 < a \leq 350$	$350 < a \leq 400$	$400 < a \leq 450$	$450 < a \leq 500$
Frequency	13	19	27	56	62	23

Calculate an estimate of the mean amount of money received each day.

mid-point x	225	275	325	375	425	475
$F \times x$	2925	5225	8775	21000	26350	10925
Total = 75200						
mean = $\frac{\sum Fx}{\sum F}$	$= \frac{75200}{200}$					
	\$ 376					

(d) The histogram shows the length of time that 200 cars were parked.



(i) Calculate the number of cars that were parked for 100 minutes or less.

$$100 \times 0.16 = 16$$

16

..... [1]

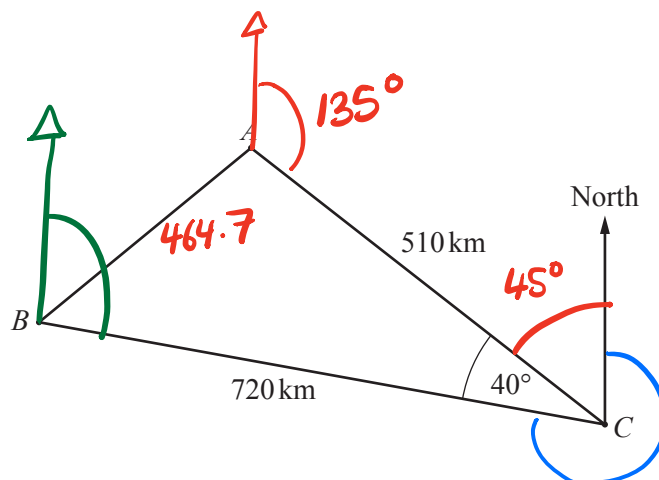
(ii) Calculate the percentage of cars that were parked for more than 250 minutes.

$$\frac{(0.8 \times 50) + (0.26 \times 100)}{200} \times 100$$

200

33

..... % [2]



A plane flies from A to C and then from C to B .
 $AC = 510$ km and $CB = 720$ km.
 The bearing of C from A is 135° and angle $ACB = 40^\circ$.

(a) Find the bearing of

(i) B from C ,

$$360 - 40 - 45$$

$$275$$

..... [2]

(ii) C from B .

$$180 - 40 - 45 = 95$$

$$095$$

..... [2]

(b) Calculate AB and show that it rounds to 464.7 km, correct to 1 decimal place.

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

$$a = (510)^2 + (720)^2 - 2(510)(720)\cos(40)$$

$$a^2 = 215916.961$$

$$a = 464.668572 \quad a = 464.7 \text{ km} \quad [4]$$

(c) Calculate angle ABC .

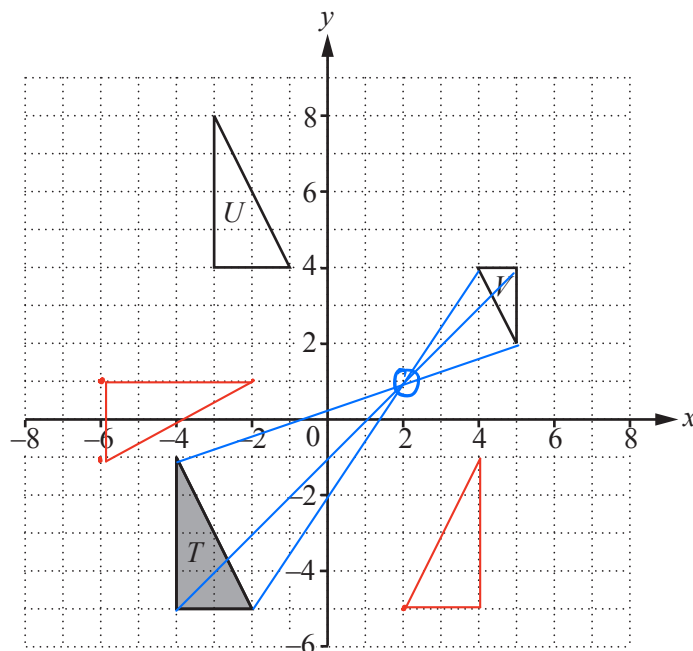
$$\frac{\sin(ABC)}{510} = \frac{\sin(40)}{464.7}$$

$$\sin(ABC) = \frac{510 \times \sin 40}{464.7}$$

$$\sin(ABC) = 0.70544799$$

$$ABC = \sin^{-1}(0.70544799)$$

$$\text{Angle } ABC = 44.9 \quad [3]$$



- (a) (i) Draw the image of triangle T after a reflection in the line $x = 0$. [2]

- (ii) Draw the image of triangle T after a rotation through 90° clockwise about $(-2, -1)$. [2]

- (iii) Describe fully the **single** transformation that maps triangle T onto triangle U .

Translation by vector $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$

[2]

- (iv) Describe fully the **single** transformation that maps triangle T onto triangle V .

Enlargement by scale factor $-\frac{1}{2}$ with center $(2, 1)$

[3]

- (b) (i) Find the matrix that represents the transformation in **part (a)(i)**.

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \quad [2]$$

- (ii) Describe fully the **single** transformation represented by the inverse of the matrix in **part (b)(i)**.

Reflection in the line $x = 0$

[2]

- 7 Alfonso runs 10 km at an average speed of x km/h.
The next day he runs 12 km at an average speed of $(x - 1)$ km/h.

The time taken for the 10 km run is 30 minutes less than the time taken for the 12 km run.

- (a) (i) Write down an equation in x and show that it simplifies to $x^2 - 5x - 20 = 0$.

$$\frac{12}{x-1} - \frac{10}{x} = \frac{1}{2}$$

$$\frac{12x - 10(x-1)}{x(x-1)} = \frac{1}{2}$$

$$2(12x - 10x + 10) = x^2 - x$$

$$4x + 20 = x^2 - x$$

$$x^2 - 5x - 20 = 0$$

[4]

- (ii) Use the quadratic formula to solve the equation $x^2 - 5x - 20 = 0$.
Show your working and give your answers correct to 2 decimal places.

$$x = \frac{5 \pm \sqrt{25 - (4)(1)(-20)}}{2} = \frac{5 \pm \sqrt{105}}{2}$$

$$x = \frac{5 + \sqrt{105}}{2} \quad \text{or} \quad x = \frac{5 - \sqrt{105}}{2}$$

$$x = 7.62 \quad \text{or} \quad x = -2.62 \quad [4]$$

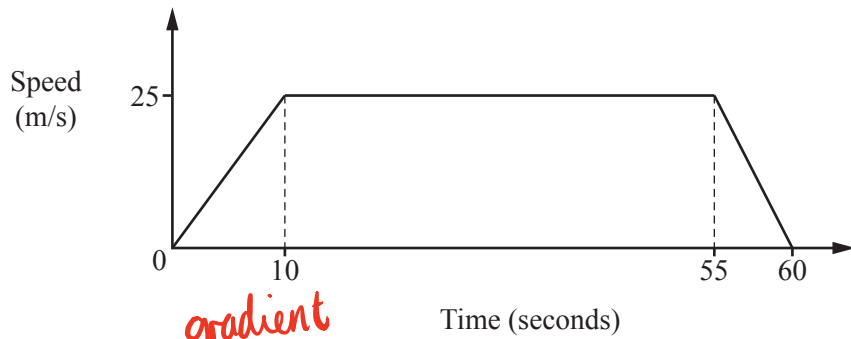
- (iii) Find the time that Alfonso takes to complete the 12 km run.
Give your answer in hours and minutes correct to the nearest minute.



$$\frac{12}{7.62-1} = \frac{600}{331} \text{ h}$$

1 hours 49 minutes [2]

- (b) A cheetah runs for 60 seconds.
The diagram shows the speed-time graph.



NOT TO
SCALE

- (i) Work out the acceleration of the cheetah during the first 10 seconds.

$$\text{acceleration} = \frac{\Delta y}{\Delta x} = \frac{25}{10}$$

2.5 m/s² [1]

- (ii) Calculate the distance travelled by the cheetah.

Area ↓

$$\left(\frac{1}{2} \times 10 \times 25\right) + (45 \times 25) + \left(\frac{1}{2} \times 5 \times 25\right)$$

1312.5 m [3]

8

$$\mathbf{A} = \begin{pmatrix} 2 & 0 \\ -1 & 5 \\ 3 & -4 \end{pmatrix}$$

$$\mathbf{B} = \begin{pmatrix} 1 & 3 \\ -1 & 5 \end{pmatrix}$$

$$\mathbf{C} = \begin{pmatrix} 7 \\ -4 \end{pmatrix}$$

$$\mathbf{D} = (2 \ 5)$$

- (a) Work out each of the following if the answer is possible.
If a calculation is not possible, write "not possible" in the answer space.

(i) \mathbf{BA}

Not Possible

[1]

(ii) $2\mathbf{A}$

$$2 \begin{pmatrix} 2 & 0 \\ -1 & 5 \\ 3 & -4 \end{pmatrix} = \begin{pmatrix} 4 & 0 \\ -2 & 10 \\ 6 & -8 \end{pmatrix}$$

[1]

(iii) \mathbf{CD}

$$\begin{pmatrix} 7 \\ -4 \end{pmatrix} (2 \ 5) = \begin{pmatrix} 14 & 35 \\ -8 & -20 \end{pmatrix}$$

[2]

(iv) \mathbf{DC}

$$(2 \ 5) \begin{pmatrix} 7 \\ -4 \end{pmatrix} = (-6)$$

[2]

(v) \mathbf{B}^2

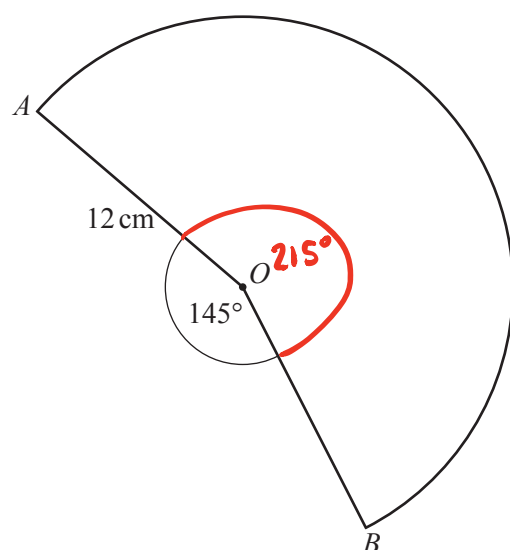
$$\begin{pmatrix} 1 & 3 \\ -1 & 5 \end{pmatrix} \begin{pmatrix} 1 & 3 \\ -1 & 5 \end{pmatrix} = \begin{pmatrix} -2 & 18 \\ -6 & 22 \end{pmatrix}$$

[2]

- (b) Find \mathbf{B}^{-1} , the inverse of \mathbf{B} .

$$\frac{1}{|\mathbf{B}|} = ad - bc = 1 \times 5 - (-1 \times 3) = 8$$

$$\frac{1}{8} \begin{pmatrix} 5 & -3 \\ 1 & 1 \end{pmatrix} \quad \text{or} \quad \begin{pmatrix} 5/8 & -3/8 \\ 1/8 & 1/8 \end{pmatrix} \begin{pmatrix} & \\ & \end{pmatrix} \quad [2]$$



NOT TO
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The diagram shows a sector, centre O , and radius 12 cm.

- (a) Calculate the area of the sector.

$$\frac{215}{360} \times \pi \times (12)^2 = 86\pi$$

$$\underline{270} \dots \text{cm}^2 \quad [3]$$

- (b) The sector is made into a cone by joining OA to OB .

Calculate the volume of the cone.

[The volume, V , of a cone with base radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

$h = ?$
 $r = ?$

Arc length = Circumference

$$\text{Arc length} = \frac{215}{360} \times 2 \times \pi \times 12 = \frac{43}{3}\pi$$

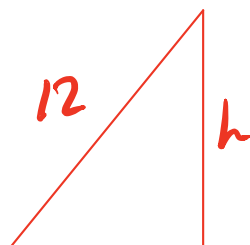
$$2\pi r = \frac{43}{3}\pi \rightarrow r = \frac{43}{6}$$

Volume

$$\frac{1}{3} \times \pi \times \left(\frac{43}{6}\right)^2 \times 9.62$$

$$= 517.6779859$$

$$\underline{518} \dots \text{cm}^3 \quad [6]$$



$$\sqrt{12^2 - \left(\frac{43}{6}\right)^2} = h = 9.624909812$$

10

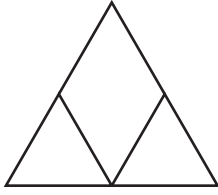


Diagram 1

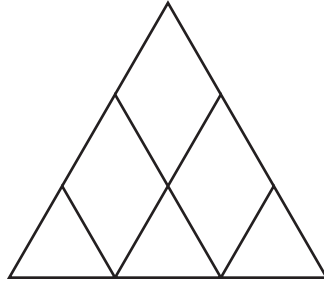


Diagram 2

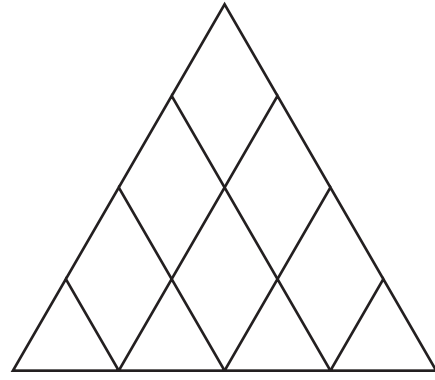


Diagram 3

Each diagram is made from tiles in the shape of equilateral triangles and rhombuses.
The length of a side of each tile is 1 unit.

(a) Complete the table below for this sequence of diagrams.

Diagram	1	2	3	4	5
Number of equilateral triangle shaped tiles	2	3	4	5	6
Number of rhombus shaped tiles	1	3	6	10	15
Total number of tiles	3	6	10	15	21
Number of 1 unit lengths	8	15	24	35	48

[6]

(b) (i) The number of 1 unit lengths in Diagram n is $n^2 + 4n + p$.

Find the value of p .

$$a = 1 \quad b = 4 \quad c = p$$

$$a + b + c = 8$$

$$1 + 4 + p = 8$$

$$p = \underline{3} \quad [2]$$

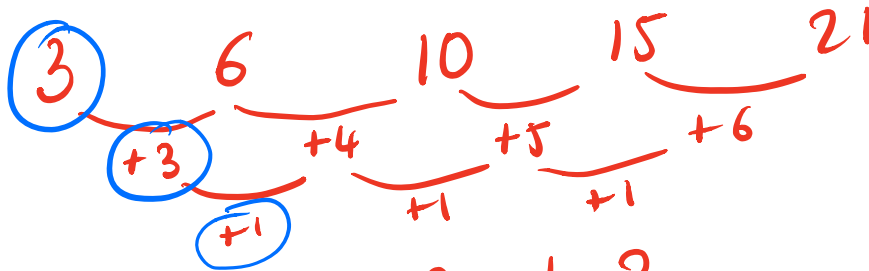
(ii) Calculate the number of 1 unit lengths in Diagram 10.

$$(10)^2 + 4(10) + 3$$

$$\underline{143} \quad [1]$$

- (c) The total number of tiles in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b .



$$2a = 1$$

$$a = \frac{1}{2}$$

$$3a + b = 3$$

$$1.5 + b = 3$$

$$b = 1.5$$

$$a = \underline{0.5}$$

$$b = \underline{1.5} \quad [5]$$

- (d) Part of the Louvre museum in Paris is in the shape of a square-based pyramid made from glass tiles. Each of the triangular faces of the pyramid is represented by Diagram 17 in the sequence.

- (i) Calculate the total number of glass tiles on one triangular face of this pyramid.

$$\frac{1}{2}(17^2) + \frac{3}{2}(17) + 1$$

$$\underline{171} \quad [2]$$

- (ii) 11 tiles are removed from one of the triangular faces to create an entrance into the pyramid.

Calculate the total number of glass tiles used to construct this pyramid.

$$(171 \times 4) - 11$$

$$\underline{673} \quad [1]$$

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