Cambridge IGCSE

Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

8650279967

MATHEMATICS **0580/43**

Paper 4 (Extended) **October/November 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 **19** printed pages and **1** blank page.

DC (NH/JG) 118014/2

CAMBRIDGE International Examinations

[Turn over

1 **(a)** A jigsaw puzzle has edge pieces and inside pieces.
The ratio edge pieces : inside pieces = 3 : 22.

(i) There are 924 inside pieces.

Calculate the total number of pieces in the puzzle.

22parts = 924

$\frac{924}{22} \times 25$

1050 ..... [2]

(ii) Find the percentage of the total number of pieces that are edge pieces.

$\frac{1050 - 924}{1050} \times 100$

12 ..... % [1]

(iii) Anjum and Betty spent a total of 9 hours completing the puzzle.
The ratio Anjum's time : Betty's time = 7 : 5.

Work out how much time Anjum spent on the puzzle.

$\frac{9}{7+5} = \frac{9}{12} = \frac{3}{4}$

$\frac{3}{4} \times 7 = 5.25$

5.25 ..... hours [2]

(b) The price of the puzzle was \$15.99 in a sale.
This was 35% less than the original price.

Calculate the original price of the puzzle.

100% − 35% = 65%

65% = 15.99

$\frac{15.99}{65} \times 100$

\$ 24.60 ..... [3]

(c) Betty takes a photograph of the completed puzzle.
The photograph and the completed puzzle are mathematically similar.

The area of the photograph is 875 cm^2 and the area of the puzzle is 2835 cm^2.
The length of the photograph is 35 cm.

Work out the length of the puzzle.

$\frac{2835}{875} = 3.24$

$35 \times \sqrt{3.24}$

63 ..... cm [3]

(d) **(i)** The area of another puzzle is 6610 cm^2.

÷100

cm → m

$cm^2 \xrightarrow{(\div 100)^2} m^2$.

Change 6610 cm^2 into m^2.

$6610 \div (100)^2$

0.661 ..... m^2 [1]

(ii) The cost price of this puzzle is $12.50 .
The selling price is $18.50 .

Calculate the percentage profit.

$\left(\frac{18.50 - 12.50}{12.50}\right) \times 100$

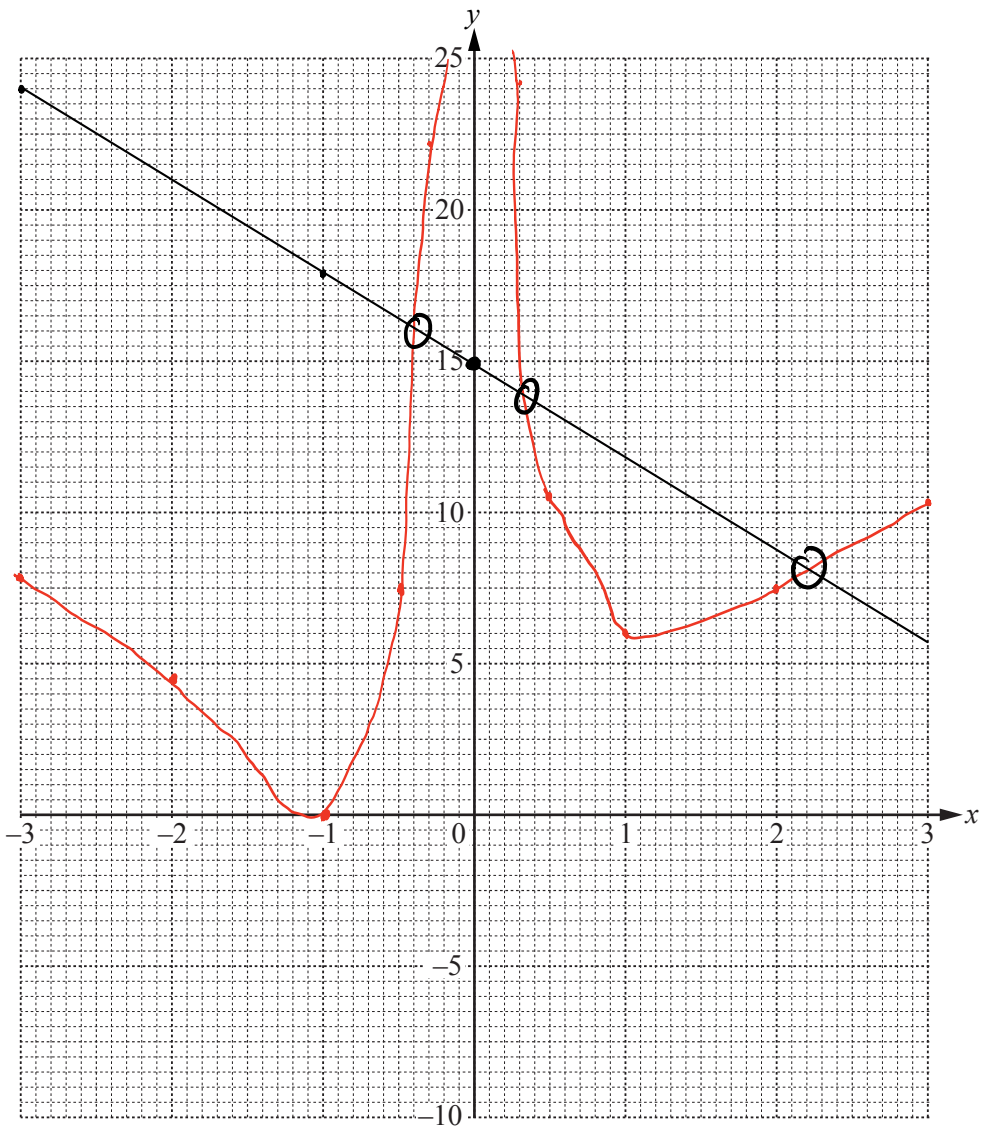
48 ..... % [3]

2 **(a)** Complete the table for $y = 3x + \frac{2}{x^2} + 1,\ x \neq 0$.

x	–3	–2	–1	–0.5	–0.3		0.3	0.5	1	2	3
y	–7.8	-4.5	0	7.5	22.3		24.1	10.5	6	7.5	10.2

[2]

(b) On the grid, draw the graph of $y = 3x + \frac{2}{x^2} + 1$ for $-3 \leqslant x \leqslant -0.3$ and $0.3 \leqslant x \leqslant 3$.



[5]

(c) Write down the value of the largest integer, k, so that the equation $3x + \frac{2}{x^2} + 1 = k$ has exactly one solution.

$k =$ 5 ..... [1]

(d) (i) By drawing a suitable straight line on the grid, solve $3x+\frac{2}{x^2}+1=15-3x$.

Draw line for $y=15-3x$. } Use Calculator

$(-3, 24)$ $(-2, 21)$ $(-1, 18)$ }

$x =$ -0.4 - -0.31 or $x =$ 0.35 - 0.45 or $x =$ 2.2 - 2.3 [4]

(ii) The equation $3x+\frac{2}{x^2}+1=15-3x$ can be written in the form $ax^3+bx^2+cx+2=0$, where a, b and c are integers.

Find a, b and c.

$x x^2 \left(3x+\frac{2}{x^2}+1\right)=(15-3x)\times x^2$

$3x^3+2+x^2=15x^2-3x^3$

$3x^3+2+x^2-15x^2+3x^3=0$

$6x^3-14x^2+2=0$

$a =$ 6

$b =$ -14

$c =$ 0 [3]

3 **(a)** Solve.

$8x - 5 = 22 - 4x$

$12x = 27$

$x =$ 2.25 [2]

(b) Solve.

$6x \geqslant 2x + 14$

$4x \geqslant 14$

$x \geqslant \frac{14}{4}$

$x \geqslant 3.5$ [2]

(c) Factorise.

$x^2 - 4x - 21$

$(x-7)(x+3)$ [2]

(d) Expand the brackets and simplify.

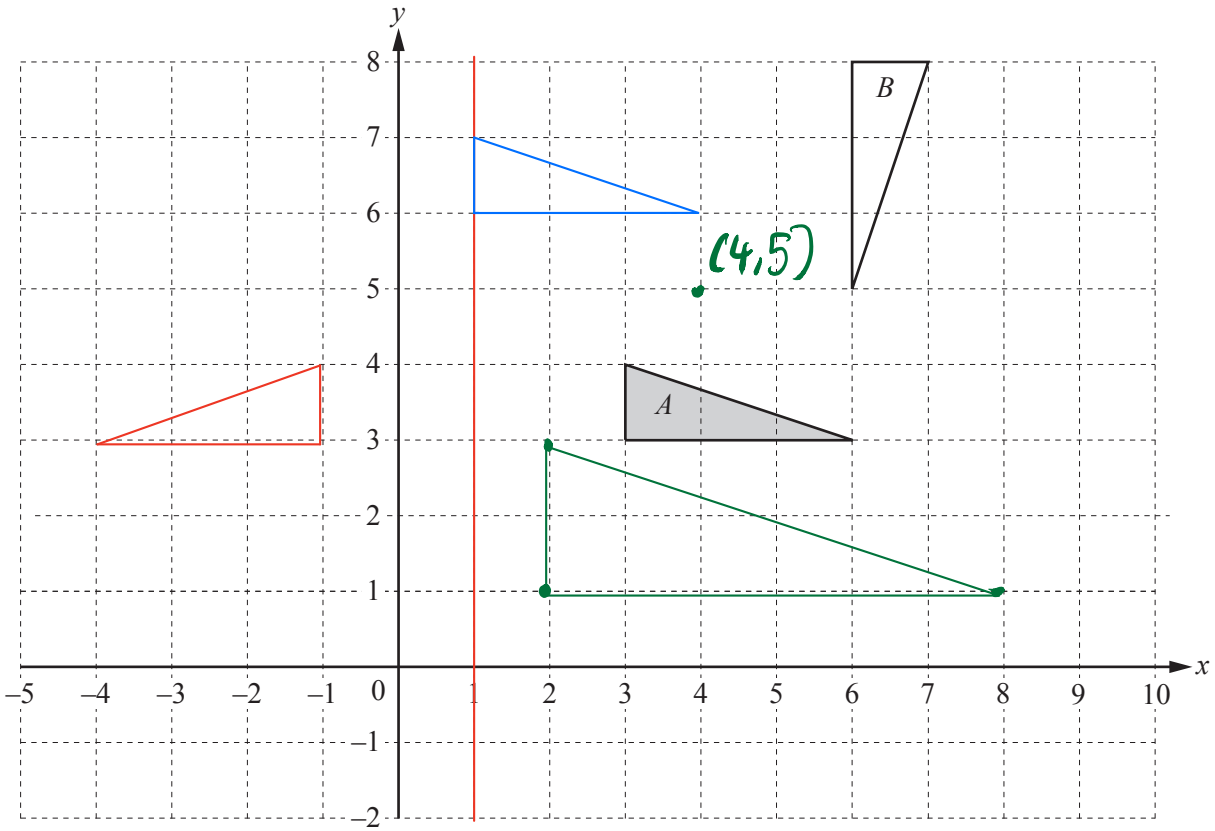
$(3x - 2y)(4x + 3y)$

$12x^2 + 9xy - 8xy - 6y^2$

$12x^2 + xy - 6y^2$ [3]

$12x^2 + xy - 6y^2$

4



(a) Draw the image when triangle A is reflected in the line $x = 1$. [2]

(b) Draw the image when triangle A is translated by the vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$. [2]

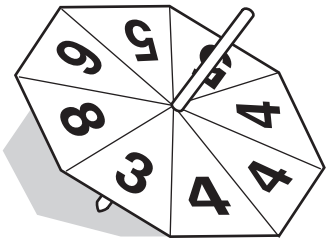
(c) Draw the image when triangle A is enlarged by scale factor 2 with centre (4, 5). [2]

(d) Describe fully the **single** transformation that maps triangle A onto triangle B.

Rotation, 90° clockwise at the center (7,4)

..... [3]

5 Sandra has a fair eight-sided spinner.
The numbers on the spinner are 3, 4, 4, 4, 5, 5, 6 and 8.
Sandra spins the spinner twice and records each number it lands on.



Find the probability that

(a) both numbers are 8,

$\frac{1}{8} \times \frac{1}{8}$

$\frac{1}{64}$ ..... [2]

(b) the two numbers are not both 8,

$1 - \frac{1}{64}$

$\frac{63}{64}$ ..... [1]

(c) one number is odd and one number is even,

$\left(\frac{3}{8} \times \frac{5}{8}\right) + \left(\frac{5}{8} \times \frac{3}{8}\right)$

$\frac{15}{32}$ ..... [2]

(d) the total of the two numbers is at least 13.

(8,8) (8,6) (8,5) (5,8)

Impossible as one 8

$\left(\frac{1}{8} \times \frac{1}{8}\right) + \left(\frac{1}{8} \times \frac{3}{8}\right) + \left(\frac{3}{8} \times \frac{1}{8}\right)$

7/64

..... [3]

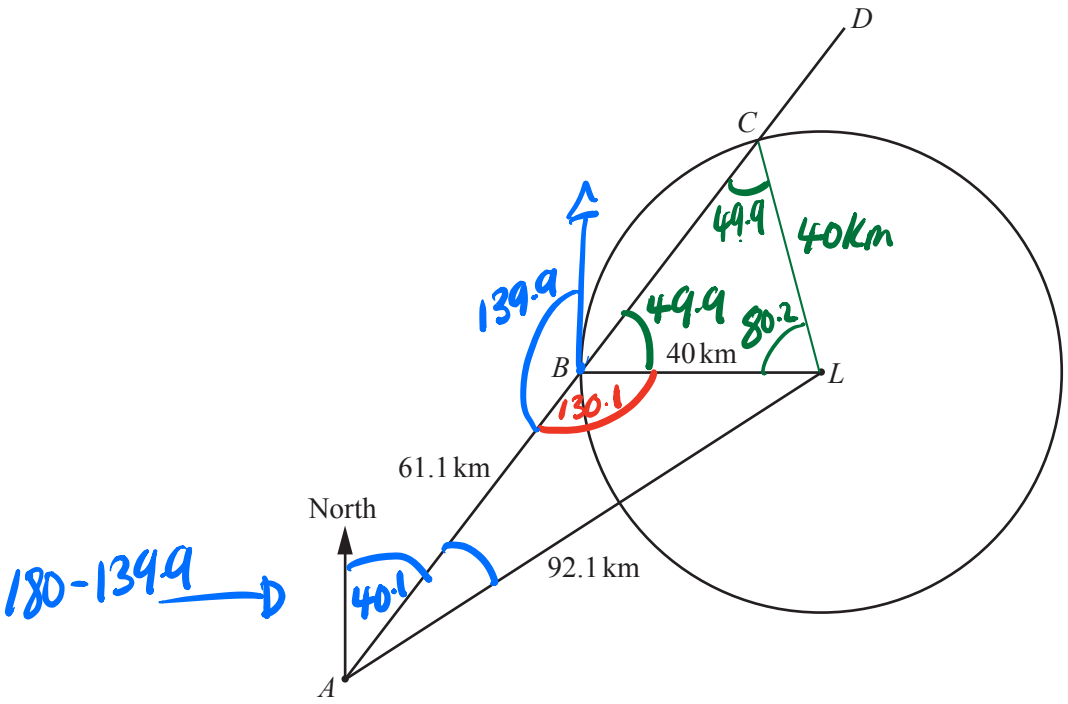
(e) the second number is bigger than the first number.

$\left(\frac{1}{8} \times \frac{7}{8}\right) + \left(\frac{3}{8} \times \frac{4}{8}\right) + \left(\frac{2}{8} \times \frac{2}{8}\right) + \left(\frac{1}{8} \times \frac{1}{8}\right)$

$\frac{3}{8}$

..... [3]

6



The diagram shows the position of a port, A, and a lighthouse, L.
The circle, centre L and radius 40 km, shows the region where the light from the lighthouse can be seen.
The straight line, $ABCD$, represents the course taken by a ship after leaving the port.
When the ship reaches position B it is due west of the lighthouse.

$AL = 92.1$ km, $AB = 61.1$ km and $BL = 40$ km.

(a) Use the cosine rule to show that angle $ABL = 130.1°$, correct to 1 decimal place.

$$\cos(ABL) = \frac{b^2+c^2-a^2}{2bc} = \frac{40^2+61.1^2-92.1^2}{2(40)(61.1)}$$

$$\cos(ABL) = \frac{-7873}{12220}$$

$$ABL = \cos^{-1}\left(\frac{-7873}{12220}\right) = 130.1110909$$

$$ABL = 130.1°$$

[4]

(b) Calculate the bearing of the lighthouse, L, from the port, A.

$$\frac{\sin(BAL)}{40} = \frac{\sin(130.1)}{92.1}$$

$$\sin(BAL) = \frac{40 \times \sin(130.1)}{92.1}$$

$BAL = 19.40317629$

$19.40317629 + 40.1$

59.50 ..... [4]

(c) The ship sails at a speed of 28 km/h.

Calculate the length of time for which the light from the lighthouse can be seen from the ship.
Give your answer correct to the nearest minute.

$BC^2 = 40^2 + 40^2 - (2 \times 40 \times 40 \times \cos(80.2))$

$BC^2 = 2655.329603 \rightarrow BC = 51.52989038$

$$\text{Time} = \frac{51.52989038 \text{ km}}{28 \text{ km/h}}$$

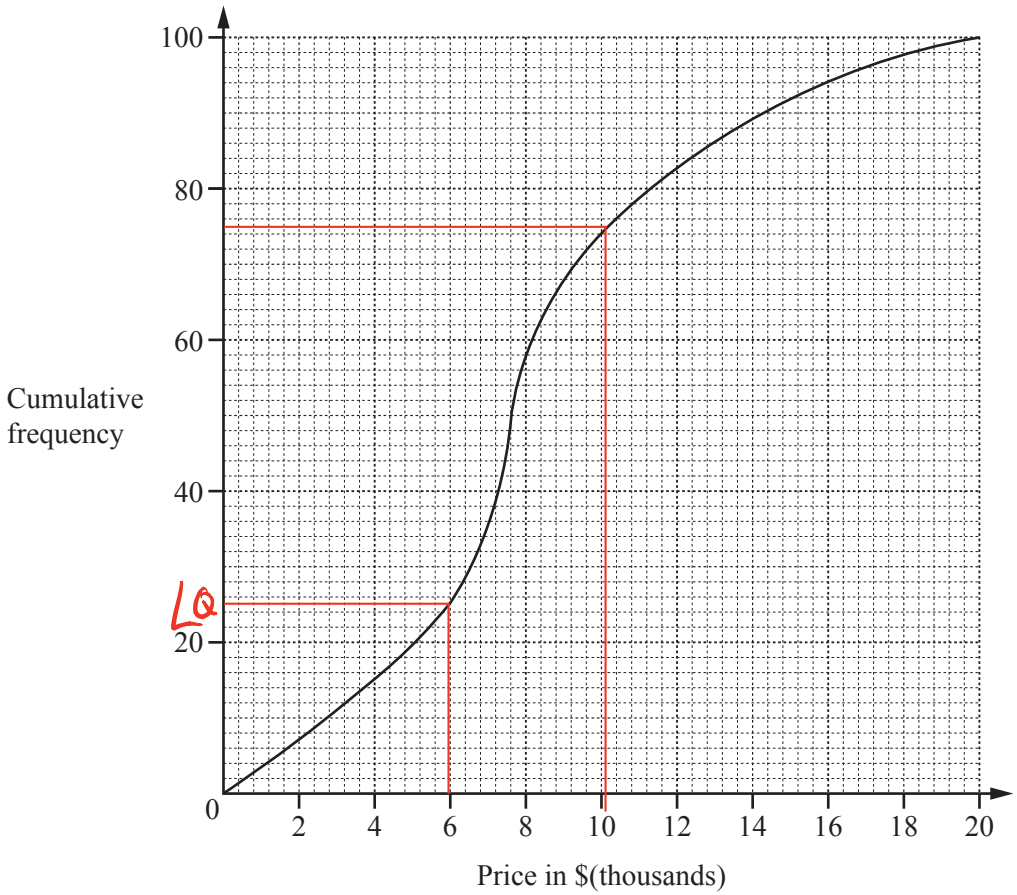
Time = 1.840353228 hours

$\times 60$

Time = 110 mins

1 ..... h 50 ..... min [5]

7 (a) (i)



The cumulative frequency diagram shows information about the prices of 100 cars on Website A.
Use the information to complete this table.

Lower quartile	Median	Upper quartile	Inter-quartile range
$ 6000	$7600	$ 10200	$ 4200

[2]

(ii) This table shows information about the prices of cars on Website B.

Lower quartile	Median	Upper quartile	Inter-quartile range
$7600	$10 800	$13 600	$6000

Here are two statements comparing the distributions of the prices of cars on Website A and Website B.

For each statement write True or False.
Give a reason for each answer, stating clearly which statistic you use to make your decision.

(a) The prices of cars on Website A are lower than the prices of cars on Website B.

True ..... because ..... The median price is lower ..... [1]

(b) A greater percentage of cars have a price more than \$13 600 on Website A compared to Website B.

False because A's upper quartile = 10200 which is lower than 13600 [1]

(b) The table shows the prices of cars on Website B.

Price (\$$P$)	Number of cars	mid-point (x)	$F \times x$
$0 < P \leqslant 6000$	9	× 3000	27000
$6000 < P \leqslant 8000$	29	× 7000	203000
$8000 < P \leqslant 10000$	20	× 9000	180000
$10000 < P \leqslant 12000$	14	× 11000	154000
$12000 < P \leqslant 14000$	21	× 13000	273000
$14000 < P \leqslant 22000$	27	× 18000	486000

Calculate an estimate of the mean price of the 120 cars.

Total $Fx = 1323000$

$$\text{Mean} = \frac{1323000}{120}$$

\$ 11025 [4]

(c) The price of a car is \$8760.
Bryan pays a deposit of 25% of this price and then 24 equal monthly payments.
After 24 months, he will have paid a total of \$9948.

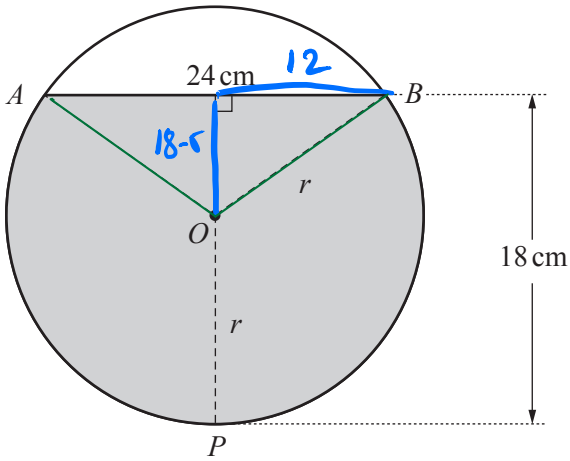
Calculate the cost of one monthly payment.

$0.25 \times 8760 = 2190$

$$\frac{9948 - 2190}{24}$$

\$ 323.25 [3]

8



NOT TO SCALE

The diagram shows the cross section of a cylinder, centre O, radius r, lying on its side.
The cylinder contains water to a depth of 18 cm.
The width, AB, of the surface of the water is 24 cm.

(a) Use an algebraic method to show that $r = 13$ cm.

$r^2 - (18-r)^2 = 12^2$

$r^2 - 324 + 36r - r^2 = 144$

$36r = 468$

$r = \frac{468}{36} = 13\text{cm}$

[4]

(b) Show that angle $AOB = 134.8°$, correct to 1 decimal place.

$\sin x = \frac{12}{13}$

angle $AOB = 2 \times \sin^{-1}\left(\frac{12}{13}\right)$

angle $AOB = 134.760270$ [2]

(c) **(i)** Calculate the area of the major sector $OAPB$.

$\frac{360 - 134.8}{360} \times \pi \times (13)^2$

332

.....cm^2 [3]

(ii) Calculate the area of the shaded segment APB.

$332 + (\frac{1}{2} \times 13 \times 13 \times \sin(134.8))$

392 ..... cm^2 [3]

(iii) The length of the cylinder is 40 cm.

Calculate the volume of water in the cylinder.

392×40

15680 ..... cm^3 [1]

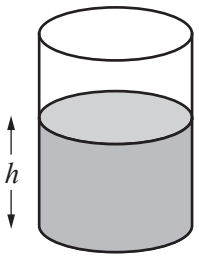
(d) The cylinder is turned so that it stands on one of its circular ends.
In this position, the depth of the water is h.

Find h.

$\pi \times 13^2 \times h = 15680$

$h = \frac{15680}{169\pi}$

$h = 29.533113027$



NOT TO SCALE

$h =$ 29.5 ..... cm [2]

9 **(a)** $\mathbf{m} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\mathbf{n} = \begin{pmatrix} -2 \\ 3 \end{pmatrix}$

(i) Work out $2\mathbf{m} - 3\mathbf{n}$.

$\begin{pmatrix} 6 \\ 4 \end{pmatrix} - \begin{pmatrix} -6 \\ 9 \end{pmatrix}$

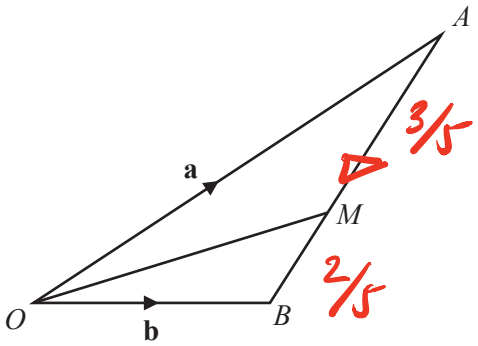
$\begin{pmatrix} 12 \\ -5 \end{pmatrix}$ [2]

(ii) Calculate $|2\mathbf{m} - 3\mathbf{n}|$.

$\sqrt{12^2 + (-5)^2}$.

13 ..... [2]

(b) **(i)**



NOT TO SCALE

In the diagram, O is the origin, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.
The point M lies on AB such that $AM : MB = 3 : 2$.

Find, in terms of **a** and **b**, in its simplest form

(a) $\overrightarrow{AB}$,

$\overrightarrow{AB} =$ $-a + b$ ..... [1]

(b) $\overrightarrow{AM}$,

$\overrightarrow{AM} =$ $\frac{3}{5}(-a + b)$ ..... [1]

(c) the position vector of M.

$\overrightarrow{OM} = a + \frac{3}{5}(-a+b)$

$\frac{2}{5}a + \frac{3}{5}b$ ..... [2]

(ii) OM is extended to the point C.
The position vector of C is $\mathbf{a} + k\mathbf{b}$.

Find the value of k.

$\overrightarrow{OC} = 1a + kb$

$\overrightarrow{OM} = \frac{2}{5}a + \frac{3}{5}b$

$SF = \frac{5}{2}$

So $k = \frac{3}{5} \times \frac{5}{2} = \frac{3}{2}$

$k =$ $\frac{3}{2}$ ..... [1]

10 **(a)** Complete the table for the four sequences A, B, C and D.

	Sequence				Next term	*n*th term
A	2	5	8	11	14	$3n - 1$
B	20	14	8	2	-4	$26 - 6n$
C	1	4	9	16	25	n^2
D	0	2	6	12	20	$n^2 - n$

[10]

(b) The sum of the first n terms of a sequence is $\frac{n(3n+1)}{2}$.

(i) When the sum of the first n terms is 155, show that $3n^2 + n - 310 = 0$.

$\frac{n(3n+1)}{2} = 155$

$3n^2 + n = 310$

$3n^2 + n - 310 = 0$

[2]

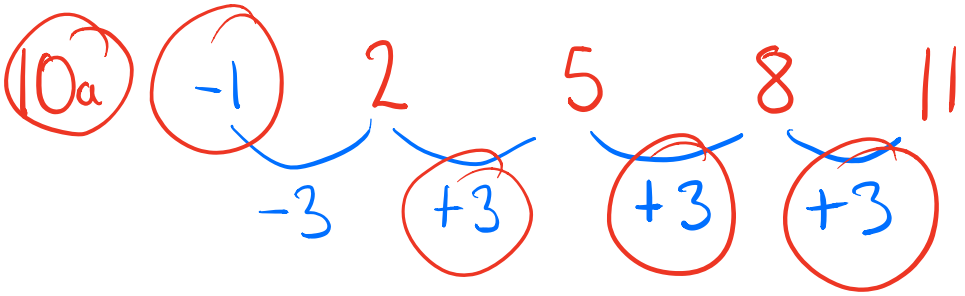
(ii) Solve $3n^2 + n - 310 = 0$.

$\frac{-1 \pm \sqrt{1^2 - (4)(3)(-310)}}{6} = \frac{-1 \pm \sqrt{3721}}{6} = x$

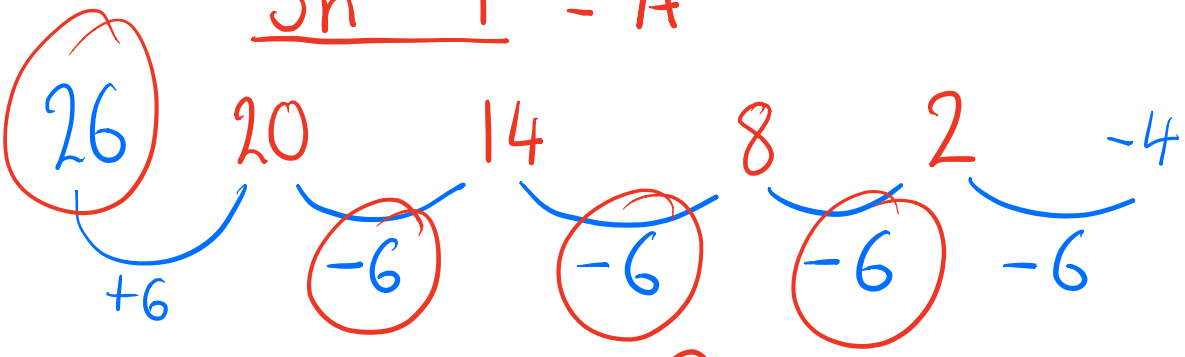
$n =$ 10 or $n =$ $\frac{-31}{3}$ [3]

(iii) Complete the statement.

The sum of the first 10 terms of this sequence is 155. [1]



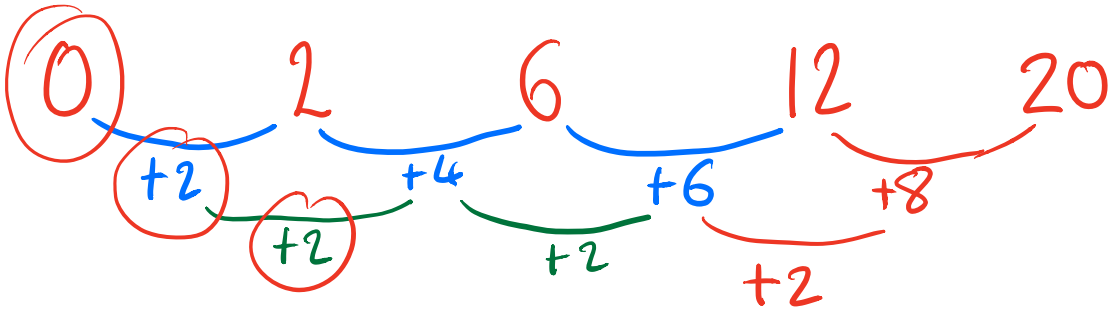
$3n - 1 = A$



$26 - 6n = B$

	1	4	9	16	25
$n =$	1	2	3	4	5
$n^2 =$	1	4	9	16	25

Sequence = $n^2 = C$



$2a = 2$

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

$3a + b = 2$

$a = 1$

$3(1) + b = 2$

$b = 2 - 3 = -1$

$a + b + c = 0$

$a = 1$ and $b = -1$

hence $c = 0$

$an^2 + bn + c$

$a = 1$

$b = -1$

$c = 0$

hence $1n^2 - 1n + 0 =$ Sequence C

$n^2 - n =$ Sequence C

11 Solve.

$$\frac{2}{x+3}+\frac{1}{12}=\frac{3}{2x-1}$$

$\times 12$ $\times 12$

$$\frac{24}{x+3}-\frac{36}{2x-1}=-1$$

$$\frac{24(2x-1)-36(x+3)}{(x+3)(2x-1)}=-1$$

$$48x-24-36x-108=-1(x+3)(2x-1)$$

$$12x-132=-2x^2+x-6x+3$$

$$12x-132=-2x^2-5x+3$$

$$2x^2+17x-135=0$$

$$\frac{-17\pm\sqrt{(17)^2-4(2)(-135)}}{4}=x$$

$$\frac{-17\pm 37}{4}=x$$

so $x=\frac{20}{4}$ or $x=\frac{-54}{4}$

$x =$ 5 or $x =$ −13.5 [7]

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