OCR
Oxford Cambridge and RSA

H

GCSE (9–1) Mathematics

J560/05 Paper 5 (Higher Tier)

Thursday 8 June 2017 – Morning

Time allowed: 1 hour 30 minutes

7349119029

You may use:
- Geometrical instruments
- Tracing paper

Do not use:
- A calculator

J560/05

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Read each question carefully before you start to write your answer.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **100**
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **16** pages.

Answer **all** the questions.

1 Work out $\frac{2}{15} \times \frac{15}{22}$.

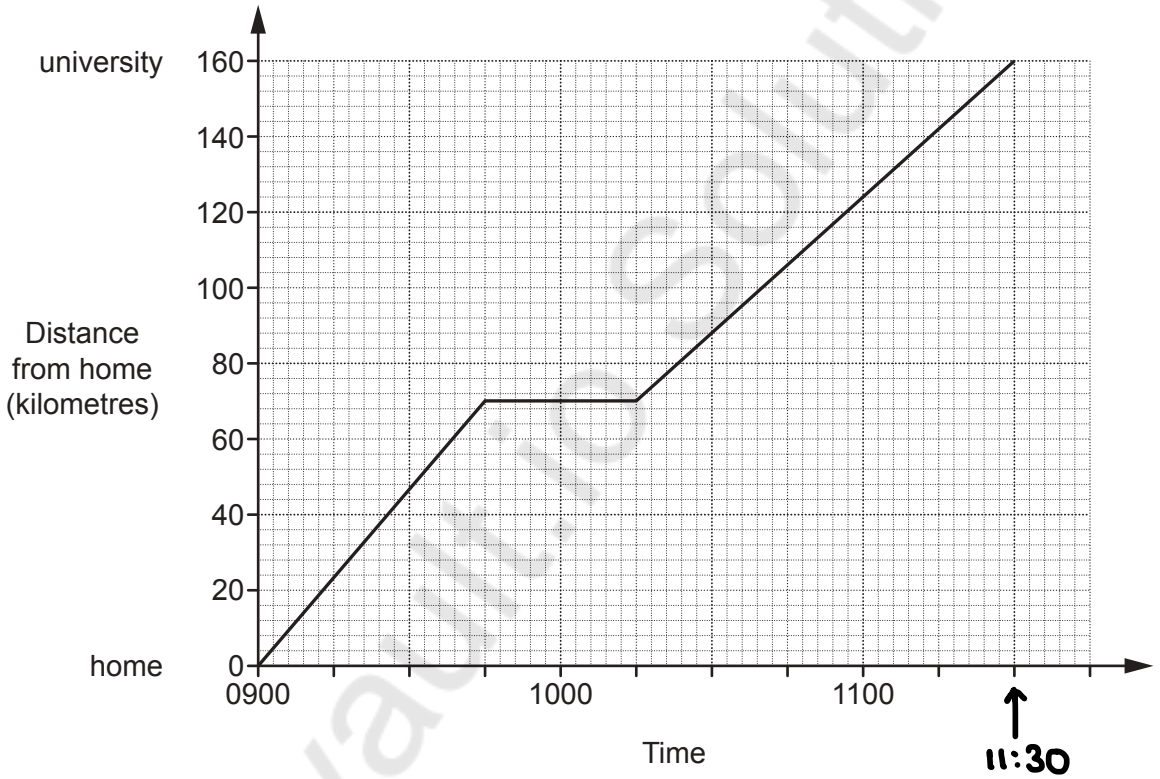
Give your answer in its lowest terms.

$\frac{1}{1} \times \frac{1}{11}$

$\frac{1}{11}$

..... **[2]**

2 The graph shows Mia's journey from her home to university.



60 mins ÷ 4 = 15 mins

Calculate Mia's average speed for the whole journey.

D
S T

$S = \frac{D}{T}$

D = 160 km

T = 2.5 h

$S = \frac{160}{2.5} \times 2 = \frac{320}{5} = 64$

64 km/h **[3]**

$5\overline{)320}$ = 64

3 Last year, Katie earned £16 200.
Her total loan repayments were £6400.

Katie estimates that the ratio of her loan repayments to her earnings is approximately 3 : 8.

Is she correct?
Show your reasoning.

6400 : 16200
÷100 ÷100
64 : 162
÷2 ÷2
32 : 81
~ 30 : 80
÷10 ÷10
3 : 8

Yes ..... [3]

4 Rashid invests money into an account which pays a fixed rate of compound interest each year.
The value, £V, of his investment after t years is given by the formula

$$V = 1250 \times 1.03^t.$$

(a) How much money did Rashid invest?

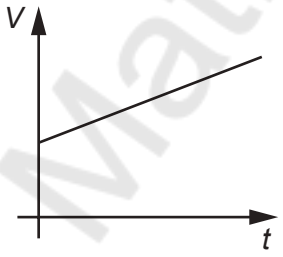
(a) £ 1250 ..... [1]

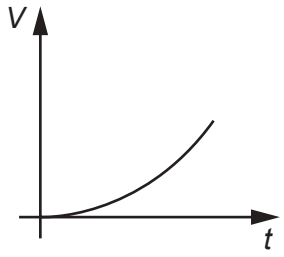
(b) What rate of compound interest is paid each year?

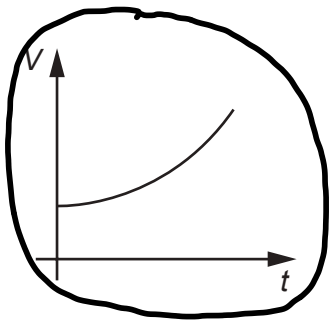
1.03 × 100 = 103%
−100%
3%

(b) 3 ..... % [1]

(c) Circle the graph that best represents the growth in Rashid's account.







[1]

5 **(a)** Rearrange the equation to make x the subject.

$y = 7x - 3$

$+3 \quad +3$

$y + 3 = 7x$

$\div 7 \quad \div 7$

$\frac{y+3}{7} = x$

(a) $x =$ $\frac{y+3}{7}$ [2]

(b) Factorise.

(i) $x^2 - xy$

HCF of x^2 and xy = x

$x \times x = x^2$

$x \times -y = -xy$

$x(x - y)$

(b)(i) $x(x-y)$ [1]

(ii) $x^2 + 8x + 12$

$(x + 6)(x + 2)$

$+6 \times +2 = 12$

$+6 + +2 = 8$

(ii) $(x+6)(x+2)$ [2]

6 Jenny played four games of golf.
For these games her modal score was 76 and her mean score was 75.
Her range of scores was 10.

What were her scores for the four games?

L 76 76 H

Range

$H - L = 10$

Mean

$\frac{L + 76 + 76 + H}{4} = 75$ (×4 ×4)

$152 + L + H = 300$

$-152 \quad -152$

$L + H = 148$

$L + H = 148$

$H - L = 10$

$24 = 158$

$\div 2 \quad \div 2$

$H = 79$

$L + H = 148$

$L + 79 = 148$

$L = 69$

69 76 76 79 [4]

7 The population of a village is in the following ratios.

- men : children = 11 : 3
- women : children = 5 : 2

(a) Find the ratio men : women.
Give your answer in its simplest form.

m : C
11 : 3
x 2
22 : 6

w : C
5 : 2
x 3
15 : 6

m : w : C
22 : 15 : 6 → m : w
22 : 15

(a) 22 : 15 [2]

(b) There are 36 children in the village.

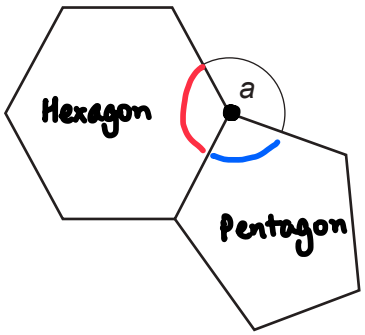
Find the total population of the village.

m : w : C
22 : 15 : 6
x6 x6 x6
132 : 90 : 36

Total = 132 + 90 + 36 = 258

(b) 258 [3]

8 Imran joins two tiles together as shown below.
One tile is a regular hexagon and the other tile is a regular pentagon.



Not to scale

(a) Show that angle *a* is 132°.

Hexagon
Exterior angle = 360 ÷ 6
= 60°
Interior angle = 180° - 60°
= 120°

Pentagon
Exterior angle = 360 ÷ 5
= 72°
Interior angle = 180° - 72°
= 108°

Angle a = 360° - (120° + 108°)
= 360° - 228°
= 132°

[3]

(b) Imran thinks that another tile in the shape of a regular polygon will fit **exactly** into angle *a*.

Is Imran correct?
Show your reasoning.

Interior = 132°
Exterior = 180° - 132°
= 48°

$\frac{360}{48} = \frac{90}{12}$ = Not an integer

Number of sides = 360° ÷ 48°
Not an integer

No.

[3]

9 George is the manager of a shoe shop.
He samples 50 of his customers and asks them about the **one** style of shoe they would buy next.
The table shows his results.

Style of shoe	Number of customers
Laced shoes	18
Boots	15
Sandals	8
Trainers	5
Other	4

George buys 1000 pairs of shoes with the number of each style based on his survey results.

How many pairs of sandals should he buy?
Write down any assumption you make about his sample.

$\frac{8}{50} \times 1000 = \frac{800}{5} = 160$

The sample of 50 is representative of the population. [3]

10 **(a)** Solve the inequality.

$3x - 2 > 10$

$+2 \quad +2$

$3x > 12$

$\div 3 \quad \div 3$

$x > 4$

(a) $x > 4$ [2]

(b) Solve.

$6x + 2 = 5 - 4x$

$+4x \quad +4x$

$10x + 2 = 5$

$-2 \quad -2$

$10x = 3$

$\div 10 \quad \div 10$

$x = \frac{3}{10}$

(b) $x = \frac{3}{10}$ [3]

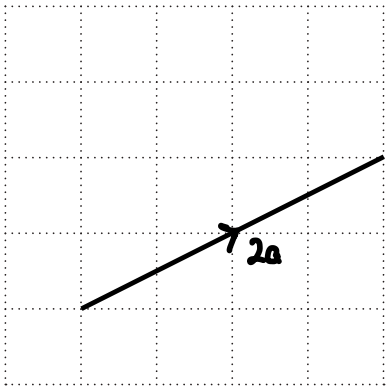
11 Vector $\mathbf{a} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$, vector $\mathbf{b} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$.

(a) On each grid below, draw a vector to represent

(i) 2**a**,

$2\begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$

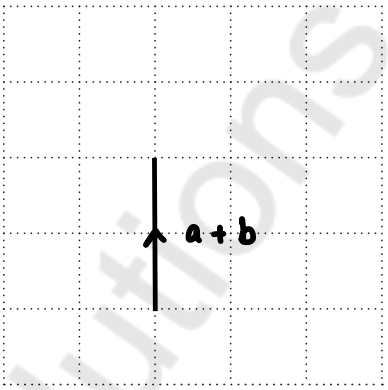
4 right
2 up



(ii) **a** + **b**.

$\begin{pmatrix} 2 \\ 1 \end{pmatrix} + \begin{pmatrix} -2 \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ 2 \end{pmatrix}$

0 left / right
2 up



[2]

(b) Emma says that if she draws vector **a** and vector **b** they will be the same.

Explain why this is incorrect. $\begin{pmatrix} 2 \\ 1 \end{pmatrix}$ right $\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ left

They will be different in direction. **[1]**

(c) $\mathbf{c} = \begin{pmatrix} -12 \\ 0 \end{pmatrix}$.

Find the value k so that $k(\mathbf{a} - \mathbf{b}) = \mathbf{c}$.

$k\left(\begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} -2 \\ 1 \end{pmatrix}\right) = \begin{pmatrix} -12 \\ 0 \end{pmatrix}$

$k\begin{pmatrix} 4 \\ 0 \end{pmatrix} = \begin{pmatrix} -12 \\ 0 \end{pmatrix}$

$-12 \div 4 = -3$

$0 \div 0 = 0$

$k = -3$

(c) $k =$ −3 **[2]**

12 Helen delivers parcels.
On Tuesday, Helen delivered 20% more parcels than on Monday.
On Wednesday, Helen delivered 50% fewer parcels than on Tuesday.
On Wednesday, Helen delivered 72 parcels.

Calculate the number of parcels that Helen delivered on Monday.

Wednesday
50% fewer = 50%

50% = 72
×2 ×2
Tuesday 100% = 144

Tuesday
20% more = 120%

120% = 144
÷12 ÷12
10% = 12
×10 ×10
Monday: 100% = 120

120 ..... [5]

13 **(a)** Write $\frac{7}{9}$ as a recurring decimal.

$7 \div 9$

$$9 \overline{)7.^{7}0^{7}0^{7}0} \quad 0.777$$

(a) $0.\dot{7}$ ..... [1]

(b) Sally divided a two-digit number by another two-digit number.
Her answer was 3.18181818..... .

Find two numbers that Sally could have used.

$x = 3.1818...$

$100x = 318.1818...$

$100x - x = 99x$

$318.\dot{1}\dot{8} - 3.\dot{1}\dot{8} = 315$

$99x = 315$
$\div 99 \quad \div 99$

$x = \frac{315}{99} \begin{matrix} \div 3 \\ \div 3 \end{matrix}$

$= \frac{105}{33} \begin{matrix} \div 3 \\ \div 3 \end{matrix}$

$= \frac{35}{11}$

(b) 35 and 11 ..... [3]

14 John has

- 8 different shirts
- 6 different hats
- 4 different scarves.

(a) On Monday, he picks a shirt, a hat and a scarf.

Show that there are 192 different combinations he can pick.

8 x 6 x 4 = 192 ..... **[1]**

(b) John thinks that if he picks **just two** of the three items of clothing there will be more than 192 combinations.

Is he correct?
Show your reasoning.

S & H: 8 x 6 = 48

Sh & Sc: 8 x 4 = 32

H & Sc: 6 x 4 = 24

Total = 48 + 32 + 24 = 104

No, there are 104. .....

..... **[3]**

15 **(a)** Simplify fully.

(i) $\sqrt{50} + \sqrt{2}$

$\sqrt{50} = \sqrt{25} \times \sqrt{2}$

$= 5\sqrt{2}$

$5\sqrt{2} + \sqrt{2} = 6\sqrt{2}$

(a)(i) $6\sqrt{2}$ ..... **[2]**

(ii) $\frac{10}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$

$\frac{10\sqrt{6}}{6} = \frac{5\sqrt{6}}{3}$

(ii) $\frac{5\sqrt{6}}{3}$ ..... **[2]**

(b) There are two errors in Sam's method for finding the value of $64^{-\frac{2}{3}}$ shown below.

Find the cube root of 64 and then multiply by 2. – square
The cube root of 64 is 4 and then 4 x 2 = 8.
The negative power makes the answer negative so answer equals –8.
reciprocal

Describe these errors and then give the correct value of $64^{-\frac{2}{3}}$.

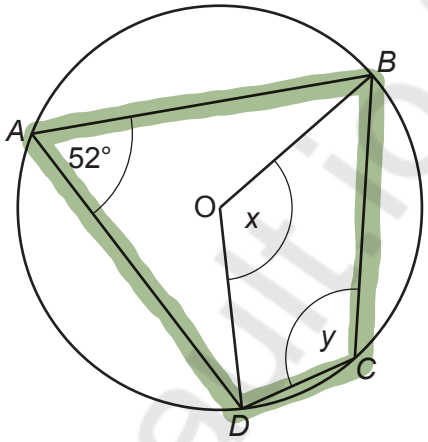
$\sqrt[3]{64} = 4$ $\quad 4^2 = 16$ $\quad \frac{1}{16}$

• We square, not multiply by 2

• We find the reciprocal, not making the answer negative.

Correct value $\frac{1}{16}$ **[3]**

16 A, B, C and D are points on the circumference of a circle, centre O.



Not to scale

Angle BAD = 52°.

(a) Work out angle *x*. $52 \times 2 = 104$
Give a reason for your answer.

x = 104 ° reason angle at centre is twice angle at circumference. **[2]**

(b) Work out angle *y*. $180 - 52 = 128$
Give a reason for your answer.

y = 128 ° reason opposite angles in a cyclic quadrilateral sum to 180°. **[2]**

17 **(a)** Simplify.

$$\frac{x^2 - 16}{x^2 - 3x - 4}$$

$x^2 - 16$ (DOTS)

$(x + 4)(x - 4)$

$x^2 - 3x - 4$

$(x + 1)(x - 4)$

$+1 \times -4 = -4$

$+1 + -4 = -3$

$$\frac{(x+4)(x-4)}{(x+1)(x-4)}$$

$$\frac{x+4}{x+1}$$

(a) ..... **[4]**

(b) $(x+3)(x-4)(x+5)$ is identical to $x^3 + ax^2 - 17x + b$.

Find the value of a and the value of b.

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

x	x	+3
x	x^2	$+3x$
−4	$-4x$	−12

$x^2 - x - 12$

$(x^2 - x - 12)(x + 5)$

x	x^2	$-x$	−12
x	x^3	$-x^2$	$-12x$
+5	$+5x^2$	$-5x$	−60

$x^3 + 4x^2 - 17x - 60$

a b

(b) a = 4 .....

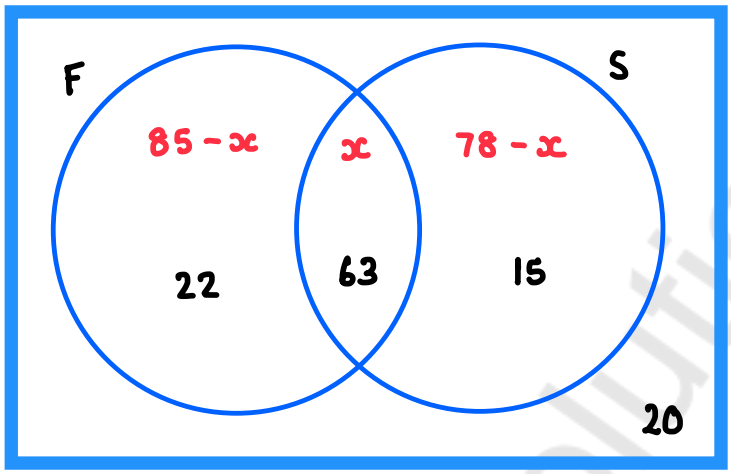
b = −60 ..... **[2]**

18 In a group of 120 adults, 85 watch football, 78 play a sport and 20 do neither.

Find the probability that an adult chosen at random from those who watch football does not play a sport.

85

22



$85 - x + x + 78 - x = 100$

$163 - x = 100$

$-163 \quad -163$

$-x = -63$

$x = 63$

$\frac{22}{85}$

..... **[5]**

Quadratic

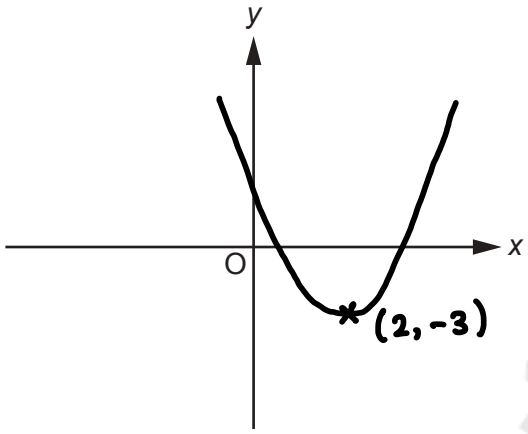
14

19 **(a)** Sketch the graph of $y = (x-2)^2 - 3$.
Show the coordinates of any turning points.

Turning point = (2, -3)

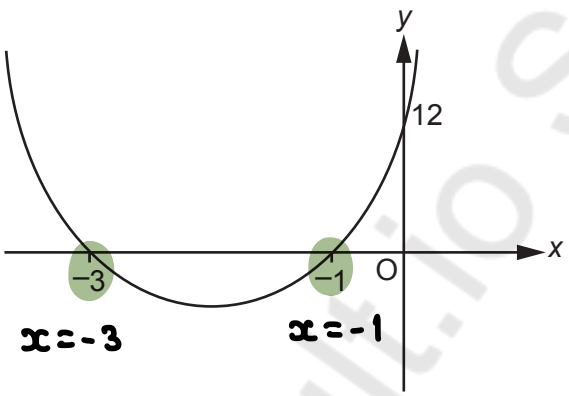
$x - 2 = 0$

$x = 2$ $\quad y = -3$



[3]

(b) The sketch shows part of a graph which has equation $y = ax^2 + bx + c$.



Not to scale

Find the values of a, b and c.

$y = ax^2 + bx + 12$

when $x = 0$, $y = 12$ [y-intercept]

$x = -3 \quad x = -1$

$(x+3)(x+1) = 0$

$x^2 + x + 3x + 3$

$x^2 + 4x + 3$

$\times 4 \quad \times 4 \quad \times 4$

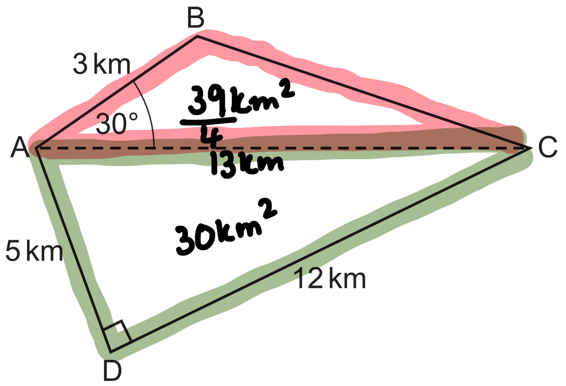
$4x^2 + 16x + 12$

(b) $a =$ 4

$b =$ 16

$c =$ 12 **[5]**

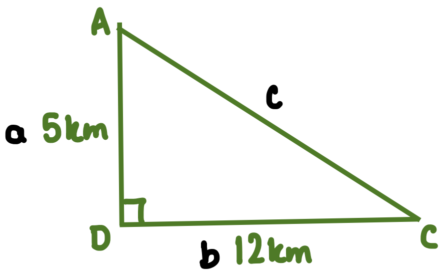
20 The diagram shows some land in the shape of a quadrilateral, ABCD.



AB = 3 km, AD = 5 km, CD = 12 km and angle BAC = 30°.

The land is sold for £10 million per square kilometre.

Calculate the total cost of the land.



$\text{Area} = \frac{1}{2}bh$

$= \frac{1}{2} 5 \times 12$

$= 30 \text{ km}^2$

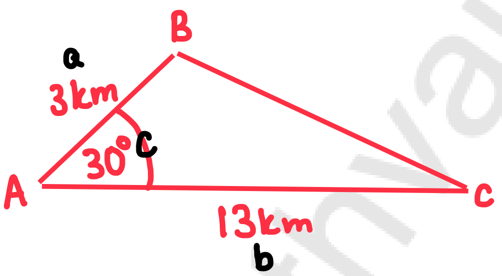
$a^2 + b^2 = c^2$

$5^2 + 12^2 = AC^2$

$\sqrt{5^2 + 12^2} = AC$

$\sqrt{169} = AC$

$13\text{ km} = AC$



$\text{Area} = \frac{1}{2} ab \sin C$

$= \frac{1}{2} \times 3 \times 13 \times \sin 30$

$= \frac{1}{2} \times 39 \times \frac{1}{2}$

$= \frac{39}{4} \text{ km}^2$

	0°	30°	45°	60°	90°
sin	0	1	2	3	4
cos	4	3	2	1	0

(all $\sqrt{\ }$ over 2)

$\sin 30 = \frac{\sqrt{1}}{2} = \frac{1}{2}$

$\text{Total area} = 30 + \frac{39}{4}$

$= \frac{120}{4} + \frac{39}{4}$

$= \frac{159}{4} \text{ km}^2$

$\text{Total cost} = \frac{159}{4} \times 10 = \frac{1590}{4}$

$4 \overline{)1590.0} = 397.5$

£ ....397.5.......... million **[7]**

21 n is an integer.

(a) Explain why $2n + 1$ is an odd number.

2n is even and adding 1 gives an odd number.

[1]

(b) Prove that the difference between the squares of two **consecutive** odd numbers is a multiple of 8.

↳ large - small

↳ one after the other
e.g. 1, 2, 3, 4, 5
+2 +2

$2n+1$, $2n+1+2 = 2n+3$

$2n+1$ and $2n+3$

$(2n+3)^2 - (2n+1)^2$

$(2n+3)(2n+3) = 4n^2 + 6n + 6n + 9 = 4n^2 + 12n + 9$

$(2n+1)(2n+1) = 4n^2 + 2n + 2n + 1 = 4n^2 + 4n + 1$

$8n + 8$

$8n + 8 = 8(n+1)$ ∴ multiple of 8.

[5]

END OF QUESTION PAPER