Solutions

Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3300U40-1

A16-3300U40-1

MATHEMATICS
UNIT 2: CALCULATOR-ALLOWED
INTERMEDIATE TIER

E D C B
30 49 76 106
15+ 25+ 39+ 53+

THURSDAY, 10 NOVEMBER 2016 – MORNING

1 hour 45 minutes

ADDITIONAL MATERIALS

A calculator will be required for this paper.

A ruler, a protractor and a pair of compasses may be required.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

Take π as 3·14 or use the π button on your calculator.

INFORMATION FOR CANDIDATES

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

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

In question **9**, the assessment will take into account the quality of your linguistic and mathematical organisation, communication and accuracy in writing.

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	4	4
2.	3	7
3.	3	10
4.	5	15
5.	3	18
6.	3	21
7.	4	25
8.	2	27
9.	6	33
10.	6	39
11.	7	46
12.	3	49
13.	4	53
14.	6	59
15.	5	64
16.	4	68
17.	5	73
18.	7	80
Total	80	

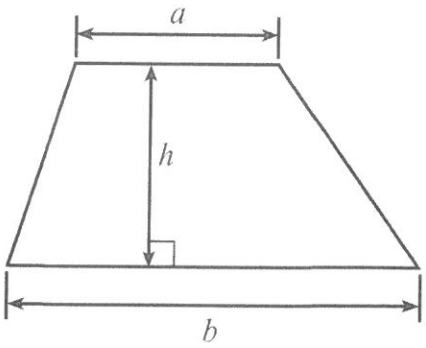
E D C B

3300U401 01

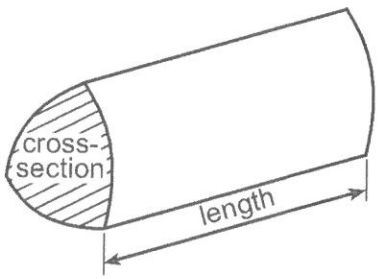
NOV163300U40101

Formula List – Intermediate Tier

Area of trapezium $= \frac{1}{2}(a + b)h$



Volume of prism = area of cross-section × length



Examiner only

1. Using only the numbers in the following list,

57 58 59 60 61 62 63 64 65

write down

(a) a prime number, [1]

59 B1

(b) a cube number, [1]

64 B1

(c) a factor of 186, [1]

B1 62

(d) a multiple of 7·25. [1]

58 B1

3300U401
03

2. Circle the correct answer for each of the following statements.

(a) One angle in a right-angled triangle is 60°.
One of the other angles must be

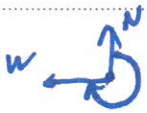
180° (30°) 120° 60° 360°. [1] B1

(b) Three of the angles in a quadrilateral add up to 250°.
The size of the fourth angle is

70° 360° 180° (110°) 125·5°. [1] B1

360 − 250

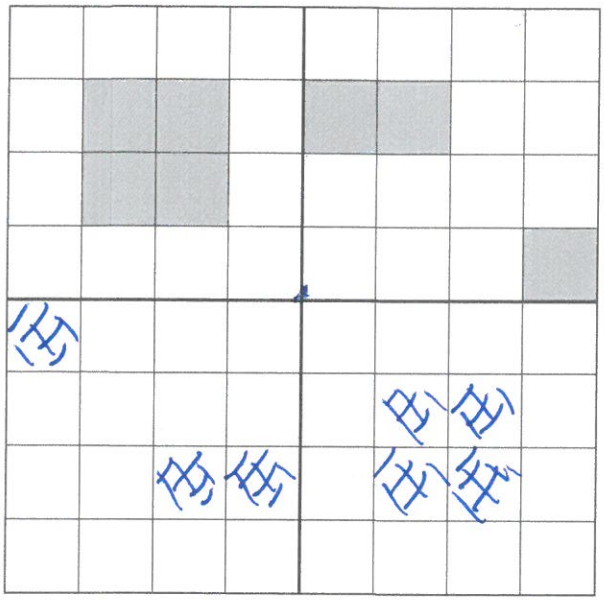
(c) Huw is facing North.
He turns **clockwise** until he is facing West.
He has turned through an angle of



(270°) 3° 90° 0·75° 9°. [1] B1

Examiner only

3. Shade the least number of squares in the lower two quadrants so that the grid has rotational symmetry of order 2. [3]



B3

Examiner only

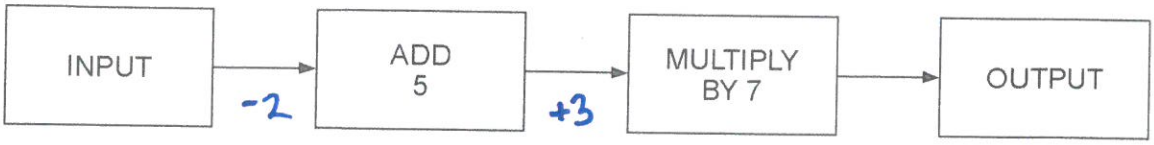
4. *(a)* Solve the equation $3x - 2 = 10$. [2]

$3x = 10+2$

$3x = 12$ B1

$x = \frac{12}{3} = 4$ B1

(b) A number machine is shown below.



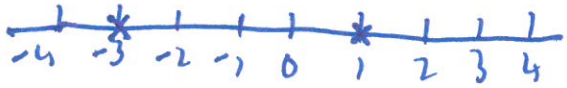
(i) Calculate the OUTPUT when the INPUT is −2. [1]

21 B1

(ii) Write down an expression for the OUTPUT when the INPUT is n. [2]

$(n+5) \times 7$ = output B1 B1

3300U401 05



E ✓

Examiner only

5. Complete each row of the following table.
The first row has been done for you. [3]

Place	Temperature at midday	Change	Temperature at following midday
Holyhead	−1°C	Up 3°C	2°C
Dolgellau	−3°C	up 4°c	1°C
Cardigan	2°C	Down 3°C	-1°c
Newport	-4°c	Up 2°C	−2°C

B1 B1 B1

6.

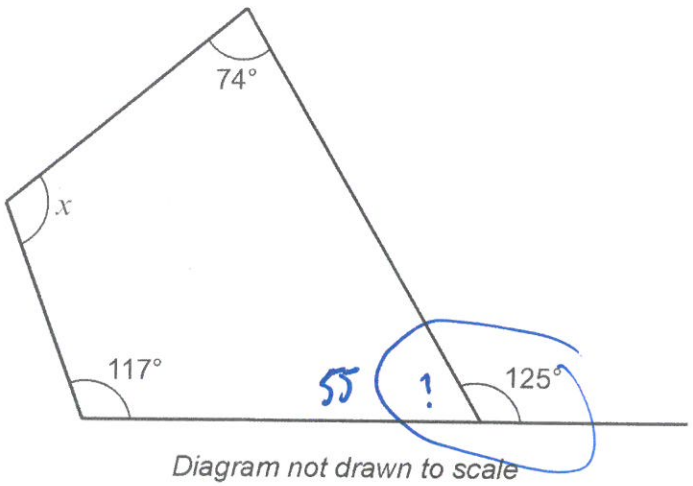


Diagram not drawn to scale

Find the size of angle x. [3]

180 - 125 = 55°

74 + 117 + 55 = 246

B1

M1

x = 360 − 246

A1

x = 114° °

Examiner only

7. **Show clearly** whether the following statement is true or false. [4]

'If you increase a positive number by 10% and then decrease that new value by 10%, you get back to your original number.'

Choose 50

Increase by 10% = 55 M1A1

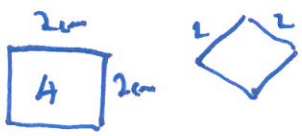
decrease by 10% = 55 × 0.9 = 49.5 M1

NOT back to original number, so FALSE. A1

D ✓

8. Circle either TRUE or FALSE for each statement given below. [2]

STATEMENT		
All equilateral triangles are congruent.	TRUE	FALSE
All squares with equal areas are congruent.	TRUE	FALSE
Circles with equal perimeters are congruent.	TRUE	FALSE
All regular octagons are congruent.	TRUE	FALSE

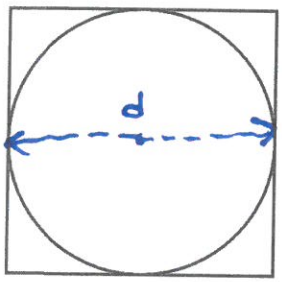


3300U401 07

Examiner only

9. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

A square has a perimeter of 80 cm.
A circle fits exactly inside the square, as shown in the diagram.



Calculate the circumference of the circle.
Give your answer correct to 1 decimal place.
You must show your working. [4 + 2 OCW]

$C = \pi \times d$

diameter of circle = length of side of square

Square has four equal sides so $4 \times d = 80$

$d = \frac{80}{4} = 20$ M1 A1

So $C = \pi \times 20$ M1

$= 62.8$ cm to 1 dp A1

+2

Examiner only

10. *(a)* Write down the nth term of the following sequence. [2]

1 2 3 4
3, 4, 5, 6, ...
+1 +1 +1

B1

$1n + 2$

B1

(b) The nth term of a different sequence is given by $n^2 + 7$.

(i) Write down the first three terms of this sequence. [2]

$n=1 \quad (1)^2 + 7 = 1 + 7 = 8$

$n=2 \quad (2)^2 + 7 = 4 + 7 = 11$

$n=3 \quad (3)^2 + 7 = 9 + 7 = 16$

B2

1st term = 8 2nd term = 11 3rd term = 16

(ii) Which **term** in this sequence is the first that has a value greater than 85? [2]

$n^2 + 7 > 85$

$n^2 > 85 - 7$

$n^2 > 78$

$n > \sqrt{78}$

$n > 8.8$

B2

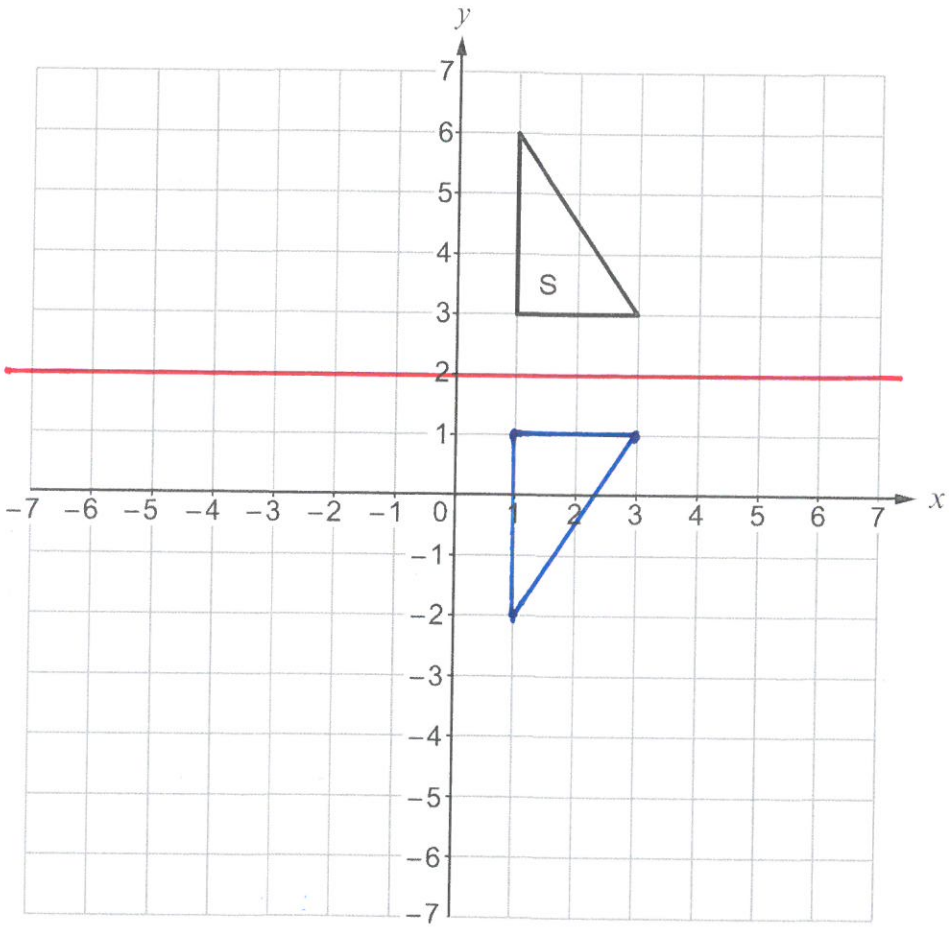
Answer = 9th term.

3300U401 09

(c) ✓

Examiner only

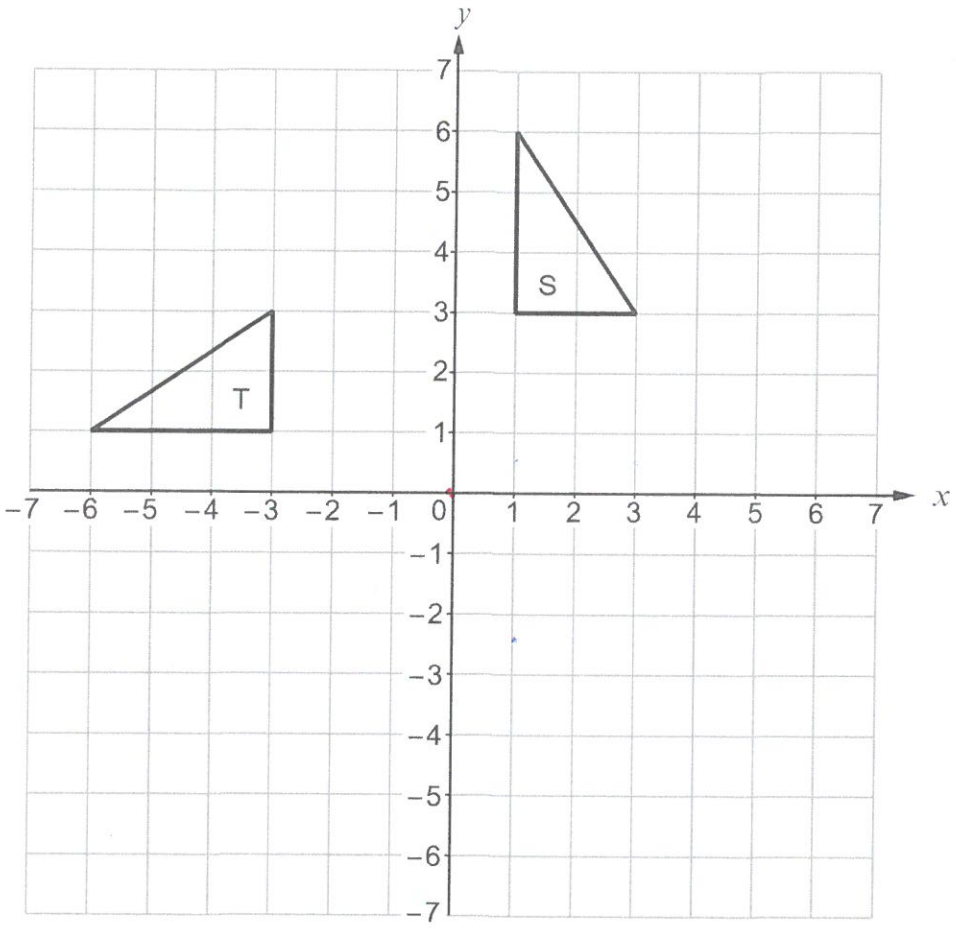
11. *(a)* Reflect the triangle S in the line $y = 2$. [2]



B2

Examiner only

(b) Describe fully a single transformation that transforms triangle S onto triangle T. [3]



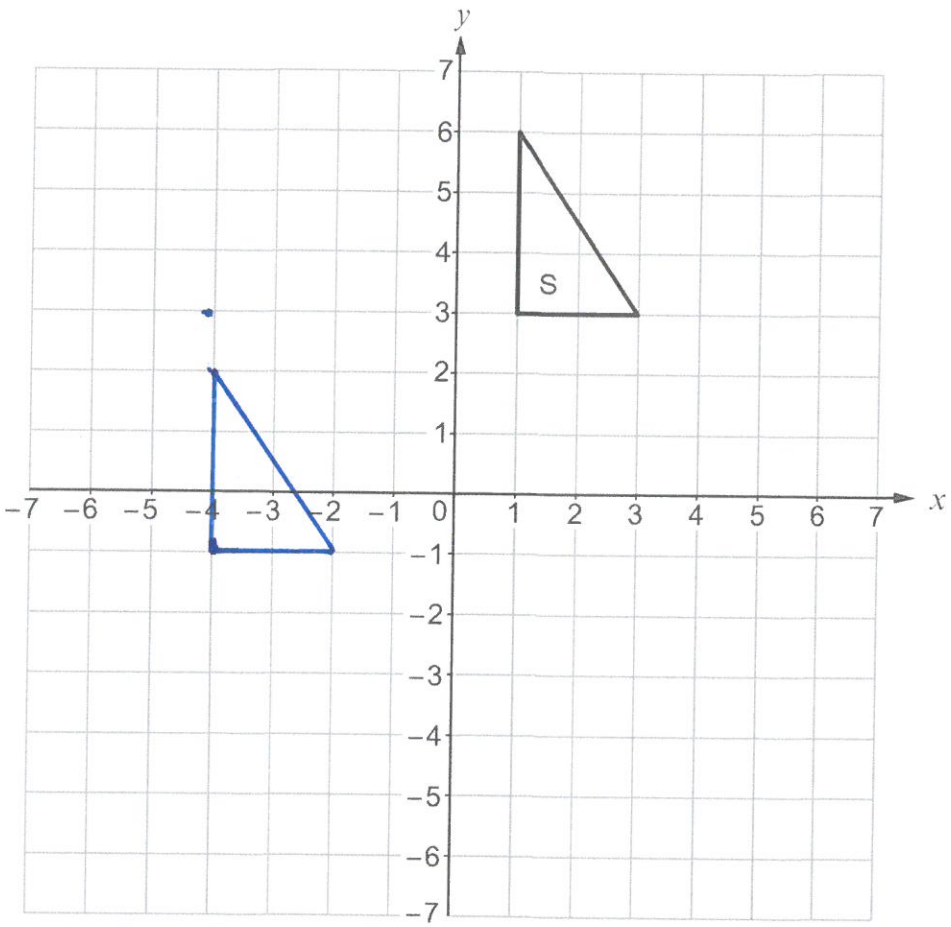
B3

Rotation of 90° anti-clockwise about (0,0)

Examiner only

(c) (i) Translate the triangle S using the column vector $\begin{pmatrix} -5 \\ -4 \end{pmatrix}$ [1]

B1



(ii) Write down the column vector that will reverse the translation in part (i). [1]

$\begin{pmatrix} +5 \\ +4 \end{pmatrix}$

B1

Examiner only

12. Circle the correct answer for each of the following.

(a) $x^3 \times x^6 =$ [1]

x^{36} $x^{0.5}$ x^2 x^9 x^{18}

B1

(b) $(7x - 5y) - (3x + 2y) =$ [1]

$4x - 3y$ $4x - 7y$ $4x + 3y$ $-4x + 7y$ $-4x - 7y$

$7x - 5y - 3x - 2y$

$4x - 7y$

B1

(c) A car travels x miles in 30 minutes.
Its average speed in miles per hour is [1]

$\frac{x}{2}$ $\frac{x}{30}$ $2x$ $\frac{2}{x}$ $30x$

B1

Examiner only

13. A solution to the equation

$$2x^3 - 3x - 17 = 0$$

lies between 2 and 3.

Use the method of trial and improvement to find this solution correct to 1 decimal place.
You must show all your working. [4]

let $x = 2.5$ $\quad 2(2.5)^3 - 3(2.5) - 17 = 6.75$ too big B1

try $x = 2.3$ $\quad 2(2.3)^3 - 3(2.3) - 17 = 0.434$ too big B1

try $x = 2.2$ $\quad 2(2.2)^3 - 3(2.2) - 17 = -2.304$ too small

So $x = 2.2$ or $x = 2.3$ will be our solution to 1 dp.

Test using $x = 2.25$ M1

$2(2.25)^3 - 3(2.25) - 17 = -0.96875$ too small

$\therefore x = 2.3$ to 1 dp. A1

(B)✓

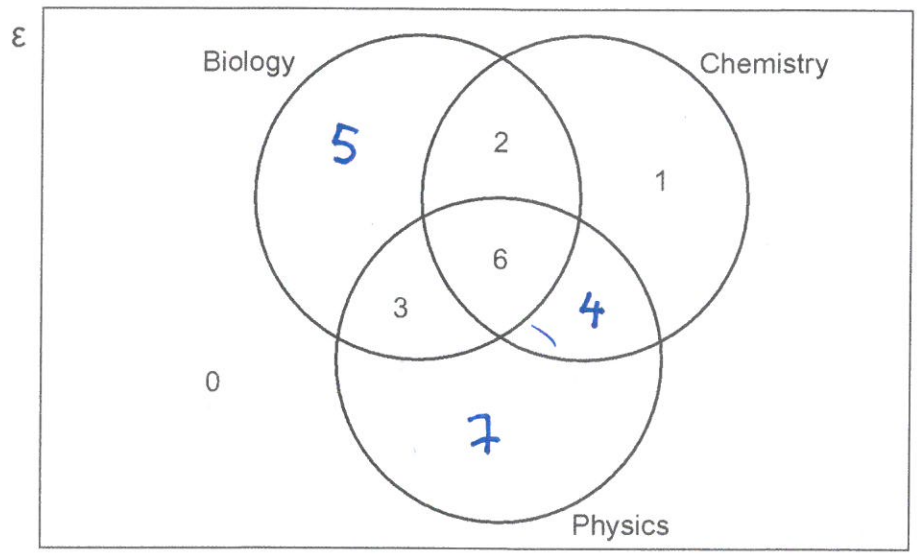
Examiner only

14. At a college, a total of 28 students study one or more of the science subjects: Biology, Chemistry and Physics.
The 28 students form the universal set, ε.
Some parts of the Venn diagram below have already been completed.

It is also known that:

- 5 students study only Biology
- 13 students study Chemistry

(a) Complete the Venn diagram. [3]



B1 B1 B1

(b) How many students study Biology and Chemistry but not Physics? [1]

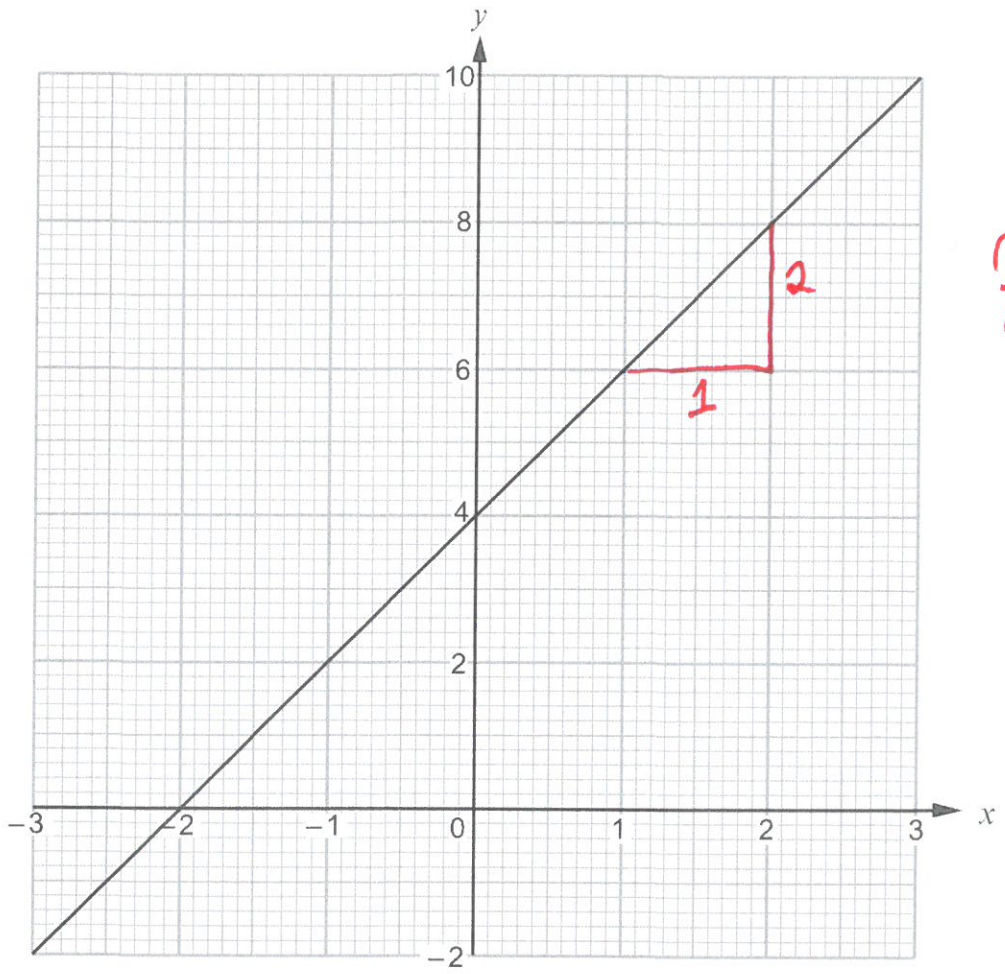
2 B1

(c) One of the students is chosen at random.
What is the probability that this student studies Biology? [2]

$\frac{16}{28}$ B1 B1

Examiner only

15. *(a)* The diagram below shows the graph of a straight line for values of x from −3 to 3.



rise / run

(i) Write down the gradient of the above line. [1]

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

B1

(ii) Write down the equation of the line in the form $y = mx + c$, where m and c are whole numbers. [2]

cut on y axis

$y = 2x + 4$

B1 B1

(b) Without drawing, show that the line $2y = 5x - 3$ is parallel to the line $4y = 10x + 7$. You must show working to support your answer. [2]

$2y = 5x - 3$

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

$m = 2.5$

$4y = 10x + 7$

$y = \frac{10}{4}x + \frac{7}{4}$

$m = 2.5$

B1 B1

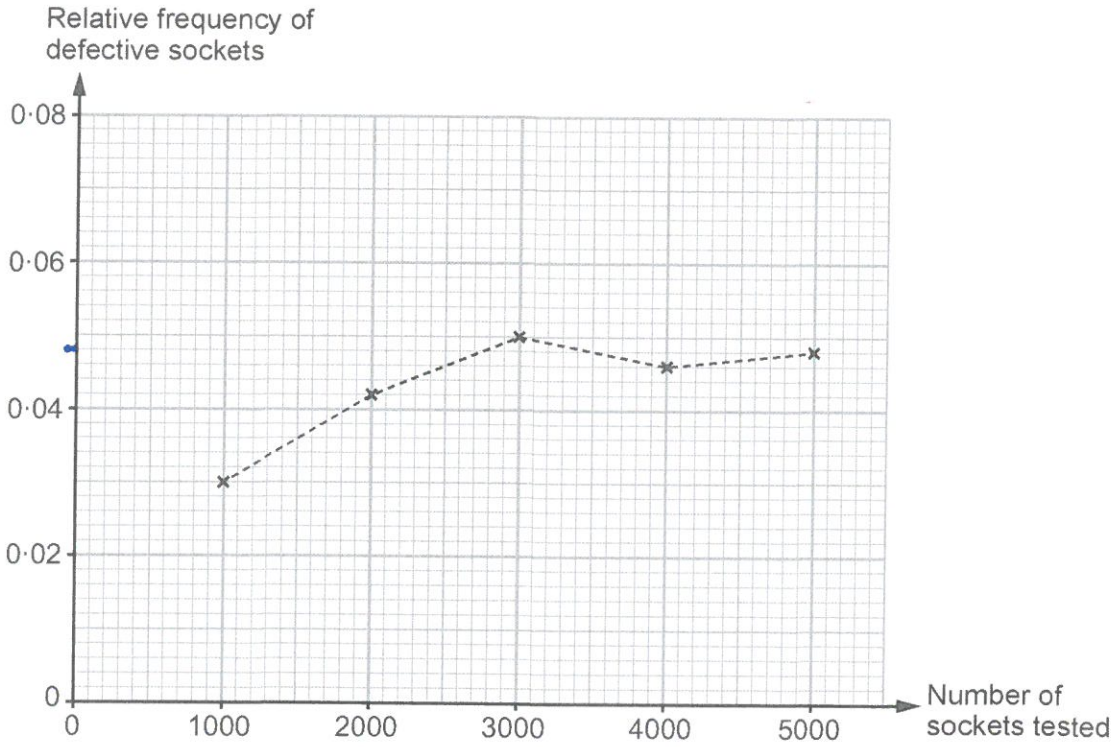
gradients are same, so parallel

B1

Examiner only

16. A factory uses a machine to produce electrical sockets.
The manager carries out a survey to investigate the probability of the machine producing a defective socket.

The relative frequency of defective sockets produced was calculated after testing a total of 1000, 2000, 3000, 4000 and 5000 sockets.
The results are plotted on the graph below.



(a) How many of the first 3000 sockets tested were defective? [2]

0.05 × 3000 = 150

M1

A1

(b) Write down the best estimate for the probability that one socket, selected at random, will be defective.
You must give a reason for your choice. [2]

Probability: 0.048

B1

Reason: because the more tests the more reliable the relative frequency

B1

Examiner only

17. Points A, B, C and D lie on the circumference of a circle, centre O.
BD is a diameter of the circle.
The straight line $BC = 4{\cdot}7$ cm and $B\hat{A}C = 28°$.

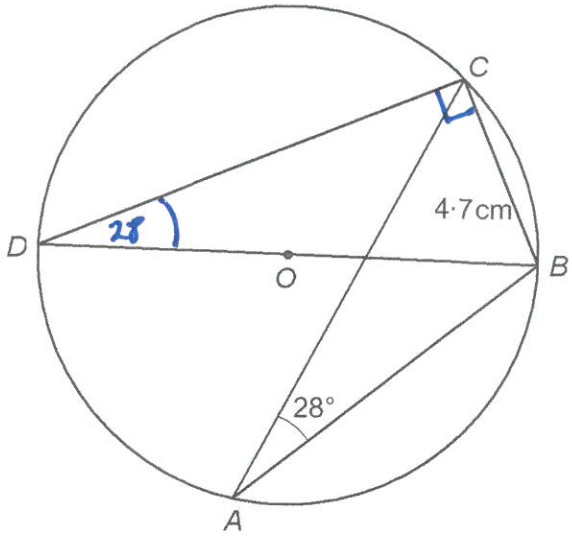
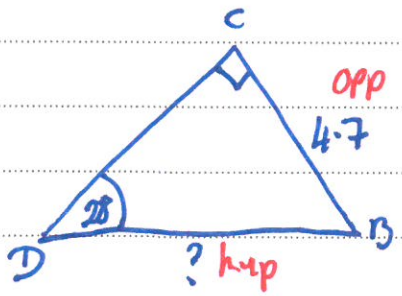


Diagram not drawn to scale

Write down the size of $B\hat{D}C$.
Hence, calculate the length BD.
You must show all your working. [5]

$B\hat{D}C = 28°$ B1

$B\hat{C}D = 90°$ B1



SOH CAH TOA

$BD = \frac{4.7}{\sin 28}$ M1 M1

$= 10.01$ cm

$= 10$ cm A1

Examiner only

18. *(a)* Factorise $x^2 - 2x - 24$, and hence solve $x^2 - 2x - 24 = 0$. [3]

$(x+4)(x-6) = 0$ B1 B1

either $x+4=0$ or $x-6=0$

$x=-4$ $x=6$ B1

(b) Solve the equation $\frac{4x-3}{2} + \frac{7x+1}{6} = \frac{29}{2}$. [4]

$\times 6$

$6\left(\frac{4x-3}{2}\right) + 6\left(\frac{7x+1}{6}\right) = 6\left(\frac{29}{2}\right)$

$3(4x-3) + (7x+1) = 3(29)$

$12x - 9 + 7x + 1 = 87$ B2

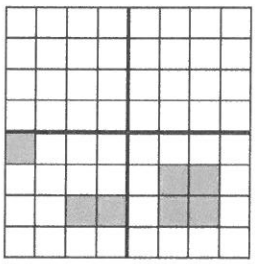
$19x - 8 = 87$

$19x = 95$ B1

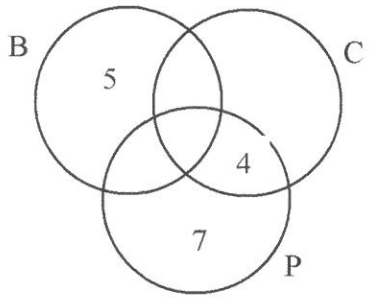
$x = \frac{95}{19}$

$x = 5$ B1

END OF PAPER

GCSE MATHEMATICS Unit 2 : Intermediate Tier Autumn 2016	✓	Mark	Comment
1.(a) 59 or 61		B1	Still only B1 if both given (with no incorrect value(s)). B0 if any incorrect value given.
1.(b) 64		B1	Do not accept 4^3 or 4×4×4 unless 64 also shown.
1.(c) 62		B1	Do not accept 186/3 unless 62 also shown.
1.(d) 58		B1	Do not accept 7·25×8 unless 58 also shown.
2.(a) 30°		B1	
2.(b) 110°		B1	
2.(c) 270°		B1	
3. 		B3	B1 for each individual shape. Penalise −1 if more than 7 squares are shaded. Ignore clearly deleted shading.
4.(a) $3x = 12$ $x = 4$		B1 B1	F.T. from $3x = k$. x = 12/3 is B1B0 Allow an embedded answer. Mark final answer.
4.(b) (i) 21		B1	
4.(b) (ii) $7(n + 5)$ or $7\times(n + 5)$ or $(n + 5)7$ or $(n + 5) \times 7$ or $7n + 35$		B2	B1 for $n + 5 \times 7$ OR $7 \times n + 5$. B0 for unsupported $n + 35$ OR unsupported $7n + 5$. Mark final answer.
5. Up 4(°C) −1(°C) −4(°C)		B1 B1 B1	Allow +4 (but not 4) for this B1.
6. (Interior angle =) $55^{(o)}$ (x =) 360 – (117 + 74 + 55) $= 114^{(o)}$		B1 M1 A1	For sight of $55^{(o)}$. May be on diagram. F.T. 'their 55' but not 125°. *Alternative method* *(x=) 180-74-117+125 or equivalent* M2 $= 114^{(o)}$ A1
7. e.g. 1·1 × 100 or equivalent. = 110 0·9 × 110 or equivalent. = 99 AND 'FALSE'	✓ ✓ ✓ ✓	M1 A1 M1 A1	Candidates may use any value or amount. F.T. 0·9 × 'their answer'. Accept any equivalent indication that statement is 'FALSE'. *Alternative method* *Sight of either 1·1 OR 0·9* *AND used in a calculation* B1 *1·1 × 0·9* M1 *= 0·99* A1 *Convincing statement.* A1
8. FALSE TRUE TRUE FALSE		B2	B1 for 3 correct.

GCSE MATHEMATICS Unit 2 : Intermediate Tier Autumn 2016	✓	Mark	Comment
9. (Diameter of circle =) 80 ÷4	✓	M1	
= 20(cm)	✓	A1	May be seen on the diagram as a side or a diameter. Radius (or '½ a side') =10; stated, used or seen on the diagram implies M1A1.
(Circumference =) π×20 or 2×π×10 or equivalent	✓	M1	F.T. 'their derived diameter (not 10 and not 80) or derived radius(not 20 and not 80).
= 62·8(cm)	✓	A1	Must be given to 1dp.
Organisation and Communication.	✓	OC1	For OC1, candidates will be expected to: • present their response in a structured way • explain to the reader what they are doing at each step of their response • lay out their explanation and working in a way that is clear and logical
Accuracy of writing.	✓	W1	For W1, candidates will be expected to: • show all their working • make few, if any, errors in spelling, punctuation and grammar • use correct mathematical form in their working • use appropriate terminology, units, etc.
10(a) $n + 2$		B2	B1 for sight of $n \pm k$ where $k \neq 0$. Allow the n to be shown as $1n$ or $n1$ or n^1 or $1\times n$. Penalise use of any other letter (apart from N) −1.
10.(b) (i) 8 11 16		B2	B1 for two correct OR for 7, 8, 11. OR for 11, 16, 23.
10.(b) (ii) $9^{(th}$ term)		B2	B1 for sight of $n^2 > 78$ OR sight of 88 OR sight of $9^2 + 7$
11.(a) Correct reflection in $y = 2$		B2	B1 for a correct reflection in $x = 2$ OR B1 for sight of line $y = 2$.
11.(b) Anticlockwise rotation of 90° about the origin.		B3	For all **four** components. Accept clockwise rotation of 270° about the origin. B2 for any three. B1 for any two. Treat '¼ turn' as one component. 'Origin' may be stated as (0,0) or 0 or O. Allow e.g. 'in the origin', 'around the origin'.
11.(c) (i) Correct translation.		B1	
11.(c) (ii) $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$		B1	B0 for 5 (missing brackets) OR (5,4) 4 B0 for $\frac{5}{4}$ with or without brackets.

GCSE MATHEMATICS Unit 2 : Intermediate Tier Autumn 2016	✓	Mark	Comment
12. (a) x^9		B1	
12.(b) $4x - 7y$		B1	
12.(c) $2x$		B1	
13. One correct evaluation $2 \le x \le 3$ 2 correct evaluations $2{\cdot}15 \le x \le 2{\cdot}35$, (one value < 0, one value > 0.) 2 correct evaluations $2{\cdot}25 \le x \le 2{\cdot}35$, (one value < 0, one value > 0.) $x = 2{\cdot}3$	 ✓ ✓ ✓ ✓	 B1 B1 M1 A1	*Correct evaluation regarded as enough to identify if negative or positive. If evaluations not seen accept 'too high' or 'too low'.* x $2x^3 - 3x - 17$ 2 −7 2·1 −4·778 2·2 −2·304 2·3 0·434 2·15 −3·573... 2·4 3·448 2·25 −0·968... 2·5 6·75 2·26 −0·693... 2·6 10·352 2·27 −0·415... 2·7 14·266 2·28 −0·135... 2·8 18·504 2·29 0·147... 2·9 23·078 2·35 1·905... 3 28
Ribbon marking for 14(a), 14(b) and 14(c). 14.(a)  5 in correct position. 4 in correct position. 7 in correct position.		 B1 B1 B1	Strict FT 'their entries such that total number of students = 28. Allow 'double entries' in some parts for this FT, e.g. 'the 4 placed alongside the 1'.
Ribbon marking for 14(a), 14(b) and 14(c). 14.(b) 2		B1	Allow 'double entries' in some parts for a possible FT, e.g. 'the 4 placed alongside the 2'.
Ribbon marking for 14(a), 14(b) and 14(c). 14.(c) $\frac{16}{28}$ or equivalent ISW		B2	FT 'their total number for Biology' for the numerator. Allow 'double entries'. B1 for a correct numerator in a fraction <1. B1 for a denominator of 28 in a fraction <1. Penalise −1 for only words (16 out of 28) or only ratio (16:28).

GCSE MATHEMATICS Unit 2 : Intermediate Tier Autumn 2016	✓	Mark	Comment
Ribbon marking for 15(a)(i) and 15(a)(ii). 15.(a) (i) 2		B1	Accept 12/6 or equivalent. The correct gradient has to be unambiguously shown. $y = 2x + 4$ is B0. Allow e.g. y = (2) x + 4 for B1.
Ribbon marking for 15(a)(i) and 15(a)(ii). 15.(a) (ii) $y = 2x + 4$		B2	F.T. 'their gradient' from (a) only if a whole number. B1 for $y = 2x \pm k$. B1 for $y = kx + 4$. B1 for 2x +4 ('y=' missing)
15.(b) (Both have) equal gradients of 2·5.		B2	Accept equivalent of 2·5. Accept $y = 2{\cdot}5x - 1{\cdot}5$ AND $y = 2{\cdot}5x + 1{\cdot}75$ for B2 unless a contradiction is seen. B1 for stating 'equal gradients' but not given as 2·5. B1 for sight of 2·5, or equivalent, but no mention of gradient. Also Correctly rewriting the equation(s) such that they show equal corresponding x and y coefficients, e.g. 2y = 5x – 3 and 2y = 5x + 3·5 gains a B1. In this case they need to make a further statement to show an understanding of gradients to gain 2nd B1.
16.(a) 3000 × 0·05 or equivalent. = 150		M1 A1	Allow 5% of 3000 for the M1. C.A.O. SC1 for sight of 3000 × 0·05 (= 150) within an incorrect solution. e.g. 1000 × 0·03 + 2000 × 0·042 + 3000 × 0·05 +... (= 30 + 84 + 150 + ...)
16.(b) 0·048 or equivalent e.g. 4·8% or 240/5000 Explanation e.g. 'all data used', 'last point plotted', 'the number of sockets tested was the highest'.		B1 B1	ISW from an answer given as a fraction. Accept any indication that the final reading should give the best estimate.

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17. BDC = 28(°) BCD = 90(°) BD = $\frac{4{\cdot}7}{\text{Sin } 28}$ BD = 10(·…)(cm)	 ✓ ✓ ✓✓ ✓	 B1 B1 M2 A1	*Angles may be shown on the diagram.* Allow D = 28. May be implied in later work. (Allow this B1 for any use of a right-angle triangle trigonometric relationship for triangle BCD) This implies previous B mark. FT 'their BDC'. M1 for $\frac{4{\cdot}7}{BD} = \sin 28$. *Alternative method* *COB = 56(°)* *B1* *OB* $= \frac{2{\cdot}35}{\sin 28}$ *M2* *(M1 for* $\frac{2{\cdot}35}{OB} = \sin 28$ *)* *OB = 5(·…)(cm)* *A1* *BD = 10(·..)(cm)* *A1*
18.(a) $(x - 6)(x + 4)$ $(x =) 6$ AND $(x =) -4$		B2 B1	B1 for $(x \ldots 6)(x \ldots 4)$. Strict F.T. from their brackets. Allow the following. B2 for x – 6 (=0) AND x + 4 (=0) (B1) (x =) 6 AND (x =) – 4 (B1) B1 for x + 6 (=0) AND x – 4 (=0) (B0) (x =) –6 AND (x =) 4 (B1) FT B1 if only (x =) 6 AND (x =) – 4 seen (B1)
18.(b) $\frac{12x - 9 + 7x + 1}{(6)} = \frac{87}{(6)}$ $19x = 95$ $x = 5$	✓✓ ✓ ✓	B2 B1 B1	F.T. until 2nd error. B1 for 1 error. Subsequent work may show use of common denominator in order to award the B2. B0 for 95/19. If a F.T. answer is not a whole number then allow answer in form '*a / b*'. Mark final answer. Allow a correct embedded answer.