Mock Topics 9-20 Test

Name:

Q1.

Work out $$\frac{4 \times 10^9 + 3.2 \times 10^7}{1.6 \times 10^{-6}}$$

Give your answer in standard form.

....

(Total for Question is 2 marks)

Q2.

(a) Write 5 400 000 as a number in standard form.

....

(1)

(b) Write 3.2×10^{-4} as an ordinary number.

....

(1)

The mass of the Sun is 2×10^{30} kg.
The mass of the largest known star is 315 times the mass of the Sun.

(c) Work out the mass of this star.

Give your answer in kg in standard form.

.... kg

(2)

(Total for question = 4 marks)

Q3.

Express the recurring decimal $0.2\dot{8}\dot{1}$ as a fraction in its simplest form.

....

(Total for Question is 3 marks)

Q4.

(a) Express $5\sqrt{27}$ in the form $n\sqrt{3}$, where *n* is a positive integer.

....

(2)

(b) Rationalise the denominator of $\dfrac{21}{\sqrt{3}}$

....

(2)

(Total for Question is 4 marks)

Q5.

Write $(5 - \sqrt{5})^2$ in the form $a + b\sqrt{5}$, where *a* and *b* are integers.

....

(Total for Question is 2 marks)

Q6.

Rationalise the denominator of $\frac{10}{\sqrt{5}}$
Give your answer in its simplest form.

....

(Total for question = 2 marks)

Q7.

(a) Solve $3x^2 = 147$

x = ...

(2)

(b) Solve $\frac{y-1}{2} + \frac{y+1}{3} = 15$

y = ...

(3)

(Total for question = 5 marks)

Q8.

(a) Solve $4(y + 3) = 19$

$y =$ ....

(2)

(b) Solve the inequality $2p - 8 > 7$

....

(2)

(c) Solve $x^2 + 2x - 15 = 0$

....

(3)

(Total for question = 7 marks)

Q9.

$-2 \leq n < 3$

n is an integer.

(a) Write down all the possible values of n.

....

(2)

(b) Solve $4 - x < 2x - 5$

....

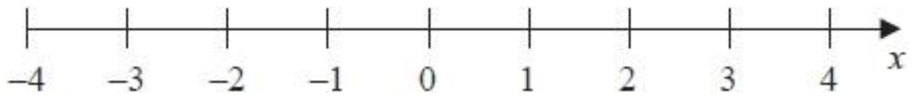
(2)

(Total for question = 4 marks)

Q10.

(a) $x > -2$

Show this inequality on the number line.



(2)

(b) Work out the greatest integer that satisfies the inequality

$$4y - 1 < y + 7$$

....

(3)

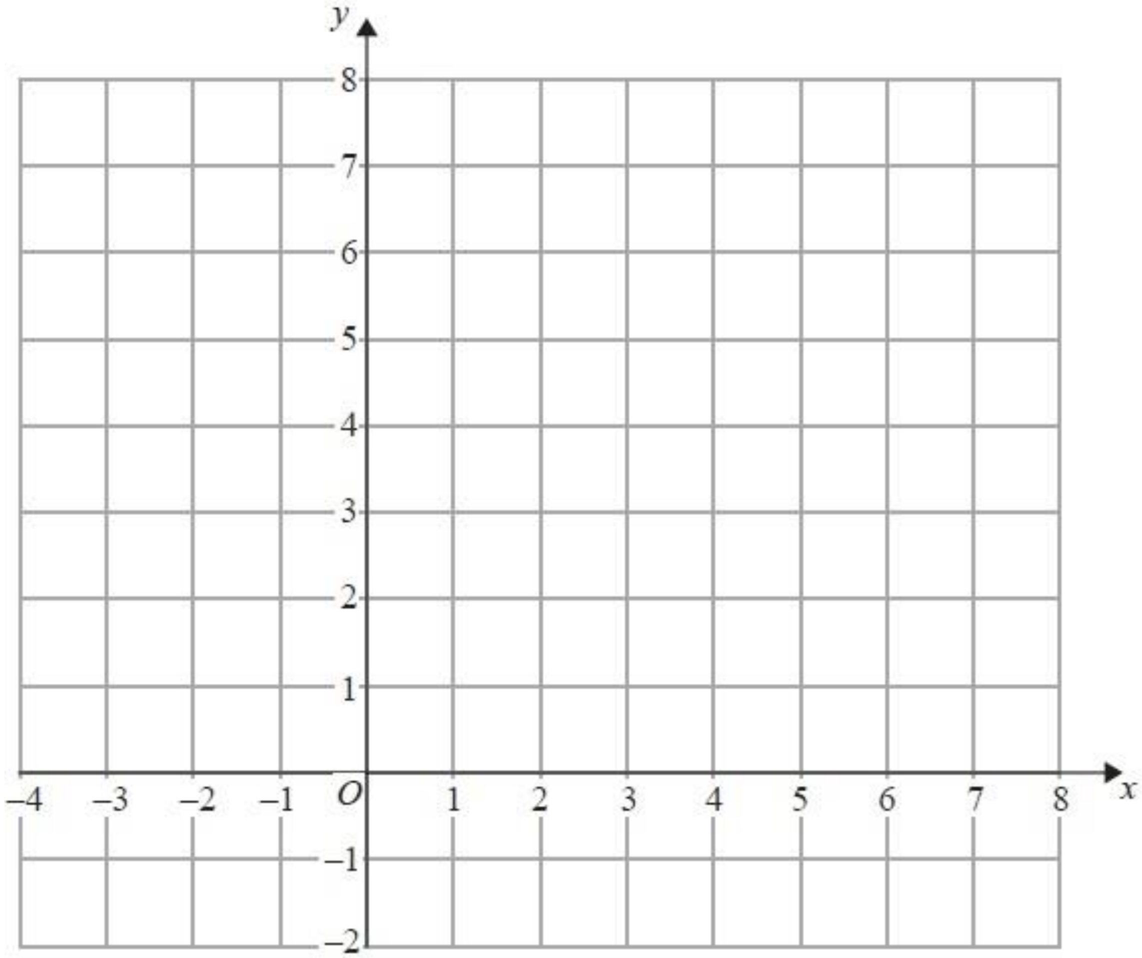
(Total for question = 5 marks)

Q11.

On the grid below, show by shading, the region defined by the inequalities

$x + y < 6$ $\qquad$ $x > -1$ $\qquad$ $y > 2$

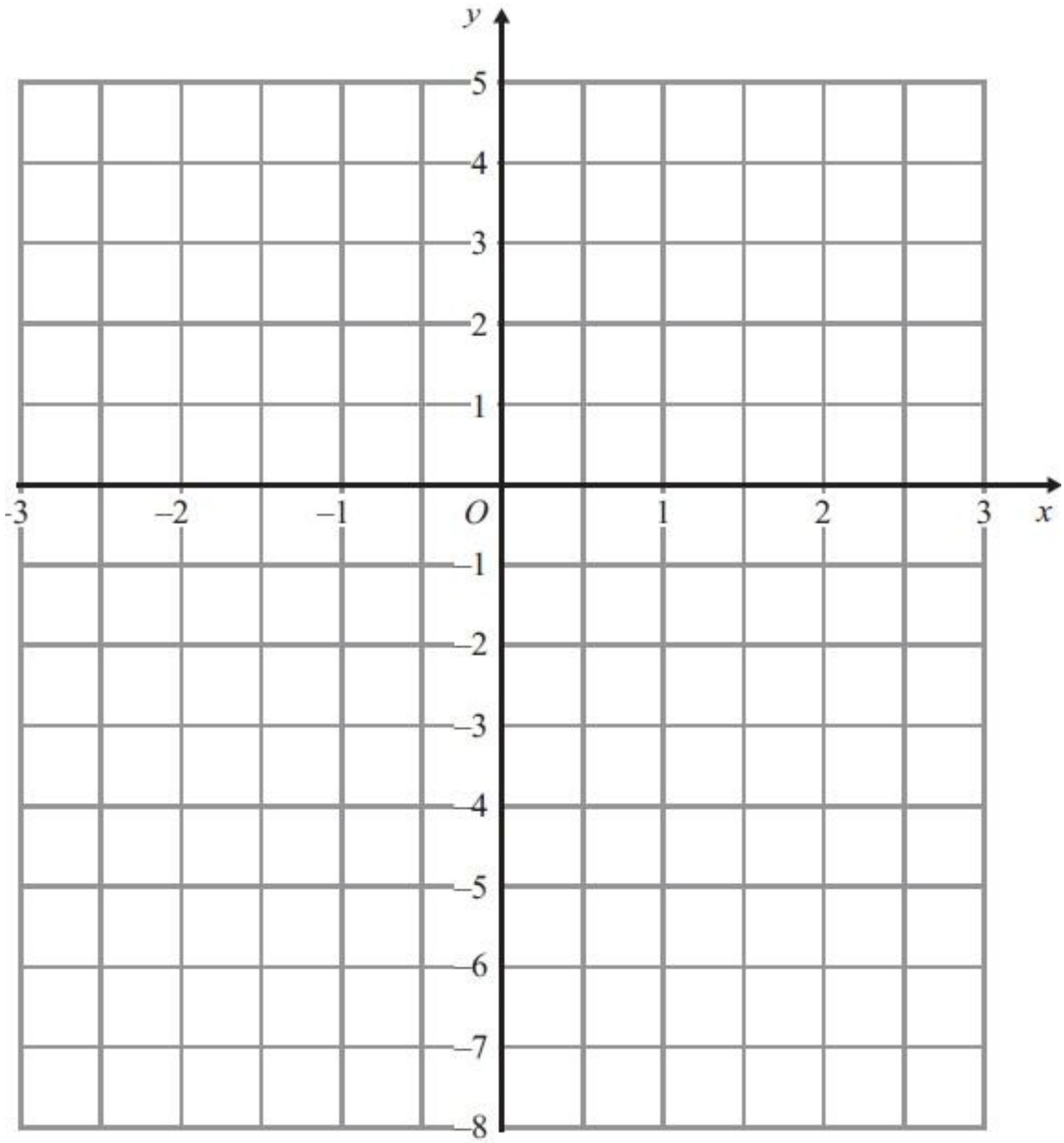
Mark this region with the letter R.



(Total for Question is 4 marks)

Q12.

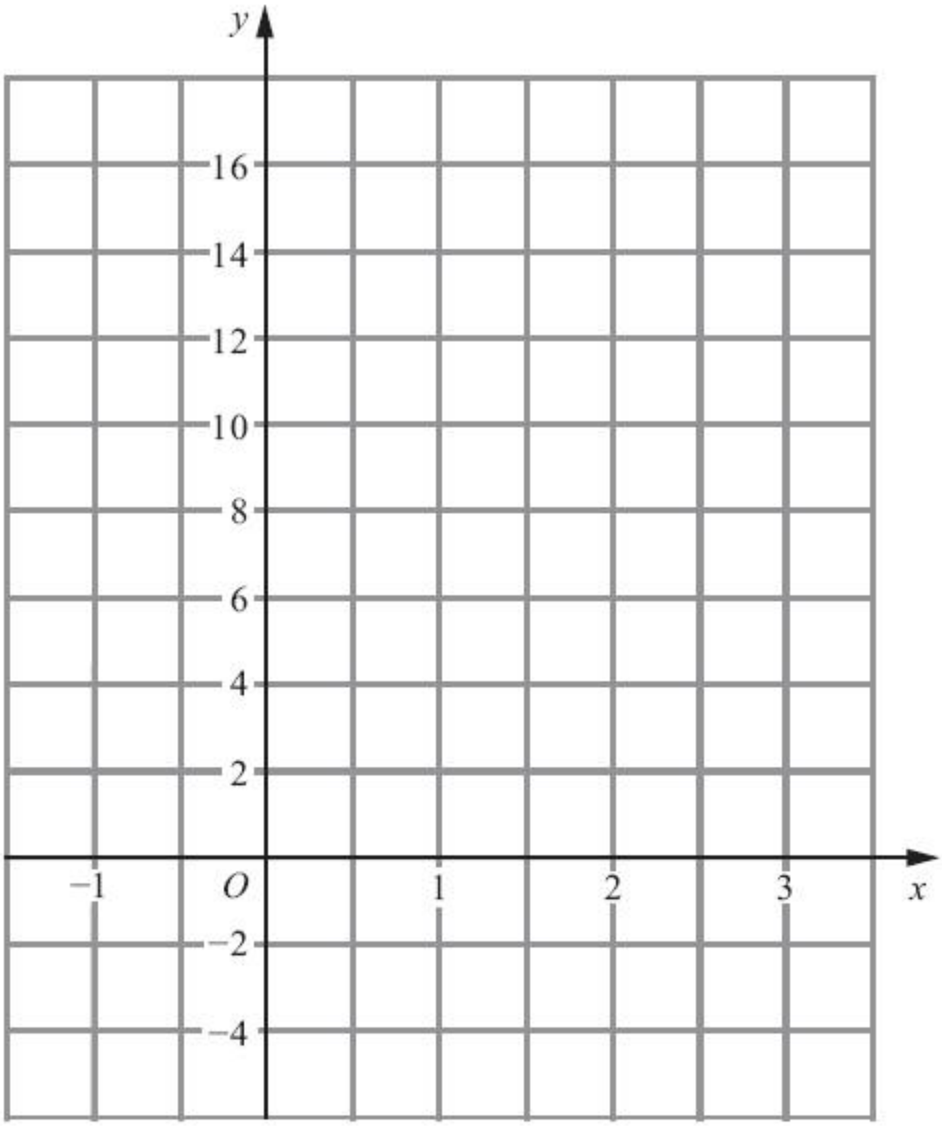
On the grid, draw the graph of $y = 2x - 3$ for values of x from –2 to 2



(Total for Question is 3 marks)

Q13.

(a) On the grid, draw the graph of $y = 4x + 2$ from $x = –1$ to $x = 3$



(3)

(b) (i) Write down the equation of a straight line that is parallel to $y = 4x + 2$

....

(ii) Write down the gradient of a straight line that is perpendicular to $y = 4x + 2$

....

(2)

(Total for Question is 5 marks)

Q14.

Here are the first four terms of an arithmetic sequence.

11 17 23 29

(a) Find, in terms of n, an expression for the nth term of this arithmetic sequence.

....

(2)

(b) Is 121 a term of this arithmetic sequence?
You must explain your answer.

....

....

....

(2)

(Total for question = 4 marks)

Q15.

Here are the first five terms of an arithmetic sequence.

1 5 9 13 17

(a) Write down an expression, in terms of n, for the nth term of this sequence.

....

(2)

The nth term of a different number sequence is $3n^2 + 7$

(b) Find the 10th term of this sequence.

....

(2)

(Total for Question is 4 marks)

Q16.

Work out $\frac{2}{5} + \frac{3}{8}$

Give your answer in its simplest form.

....

(Total for Question is 2 marks)

Q17.

(a) Work out $1\frac{1}{5} \times 2\frac{1}{3}$

Give your answer as a mixed number in its simplest form.

....

(3)

(b) Work out $2\frac{7}{15} - 1\frac{2}{3}$

....

(3)

(Total for question = 6 marks)

Q18.

Simplify fully $\dfrac{3x^2 - 6x}{x^2 + 2x - 8}$

....

(Total for Question is 3 marks)

Examiner's Report

Q1.

Many correct answers were seen, usually without any intermediate working. Those who didn't get the correct answer often gained one mark for showing the digits 252 (2.52×10^3 was a common wrong answer) or for working out the numerator as 4 032 000 000. Many candidates, though, made hard work of this question which could have been done easily with the correct use of a calculator. Many converted the values to ordinary numbers to do the calculation, often resulting in an answer not given in standard form or causing them to lose their way. Errors were frequently made in the evaluation of the numerator with many candidates failing to understand the place value implications of the different powers of 10.

Q2.

There were a lot of correct answers to part (a) showing that most students knew how to write a number in standard form. The most common errors came from the power of 10 with 5.4×10^5, 5.4×10^{-6} and 5.4×10^7 seen. Other errors seen came from writing 54 or 540 instead of 5.4

Part (b) also produced many correct responses. The most common error was to write 00032 i.e. the correct number of zeros and the correct digits but no decimal point at all.

Part (c) proved quite challenging for most with some poor arithmetic errors made when finding the product of 2 and 315 such as $2 \times 315 = 620$ or 635 or 615 or 640. Examples of common totally incorrect answers include 2×10^{9450}, 2×10^{315} and 63^{30}. Some students did manage to score one mark for the figures 63 with $\times 10^n$ but fully correct answers were seldom seen.

Q3.

Candidates who were able to recognise that the given recurring decimal was 0.28181… rather than 0.281281… gained a generous first method mark. In order to gain the second method mark a full correct method had to be seen. Unfortunately, many attempted the subtraction of 281.8181… and 0.28181… which is an incorrect method. Some got as far as $\frac{27.9}{99}$ or $\frac{279}{99}$ but were then unable to finish their solution correctly to arrive at the correct answer of $\frac{31}{110}$. There were many incorrect guesses of $\frac{281}{10000}$ and $\frac{281}{999}$ seen.

Q4.

In part (a) of this question approximately 10% of candidates could express $5\sqrt{27}$ as $15\sqrt{3}$, with a further 10% of candidates making some progress in breaking down to $\sqrt{9 \times 3}$, $\sqrt{9}\sqrt{3}$ or .

In part (b) about one quarter of candidates knew that multiplying both the numerator and the denominator by $\sqrt{3}$ (or a multiple of $\sqrt{3}$) was the key to rationalising the denominator and most of these candidates were successful in expressing $\frac{21}{\sqrt{27}}$ as $7\sqrt{3}$ or an acceptable equivalent (e.g.). A common error seen was multiplication of only the denominator by . Other candidates progressed as far as = , only to conclude their argument with "5 + $\frac{21\sqrt{3}}{3}$ = $8\sqrt{3}$ ".

Q5.

Many students were unable to deal with the surds. Many of those that could expand the two brackets wrote − 5 as the last term rather than + 5. This led to an incorrect answer of 20 − 10√5. Many others could not correctly combine the two 'middle' terms writing an answer of 30 + 10√5 whilst others gave an answer of 30 − 55.

Q6.

Many who appreciated the need to multiply numerator and denominator by √5 went on to simplify their expression correctly. A significant number replaced √5 with 2.5 to reach a final answer of 4. If they did get M1 they often left their answer unsimplified.

Q7.

This question proved to be the most challenging question on the paper for many candidates. One in six candidates gave a fully correct answer.

Some candidates simplified $(\sqrt{5}-1)(\sqrt{5}+1)$ without showing sufficient intermediate working. A good proportion of candidates knew that $\sqrt{5}\,)^2 = 5$, but it was not uncommon to see $(\sqrt{5}\,)^2 = 2\sqrt{5}$.

Examiners were surprised to see many candidates leave their answer in the form $\frac{(5-1)}{4}$, or perhaps more often, in the incorrect form $\frac{(5-1)}{2}$.

Q8.

The majority of students found $x = 7$ but few students recognised that $x^2 = 49$ implies $x = \pm 7$. The responses seen included the algebraic approach of solving the equation, but a trial and improvement approach was also seen on many occasions.

Part (b) of the question was poorly answered with very few students showing any understanding of how to deal with the algebraic fractions in the equation. Examiners were unable to give partial credit to most responses and very few students obtained the correct answer.

Q9.

Students were most successful in part (a) and incorrect responses were rare. Of those who did not gain full marks most gained the method mark for correctly expanding the bracket but then failed to correctly do (19 − 12) ÷ 4 usually forgetting to use inverse operations.

Students were less successful in part (b) than in part (a) although many gained full marks for p> 7.5. Those that gained one mark either used '=' rather than '>' or having solved the inequality correctly then wrote p = 7.5 or just 7.5 on the answer line. The weaker candidates subtracted 8 from both sides or unsuccessfully attempted a trial and improvement method and gained no marks.

Students were least successful in part (c) though blank responses were rare and many did gain full marks. Most students were using factorisation to solve the quadratic equation though a few stopped short of the complete method, writing (x − 3)(x + 5) as their final answer, to only gain two marks and few wrote (x + 3)(x − 5) gaining just one mark. Some attempted to use the quadratic formula, though those that did were considerably less successful, often only gaining one mark for the substitution. The weaker candidates tried to solve the quadratic equation by isolating the x, leading to e.g. x = $\frac{15-2x}{x}$ or similar incorrect rearrangements of the quadratic equation.

Q10.

Many students taking this paper found part (a) of this question to be straightforward. Common errors included a confusion between the signs ≤ and <. Some students scored 1 mark because they omitted one of the values required or they included one extra value.

In part (b) of the question a large proportion of students were able to identify x = 3 as the critical value but far fewer were able to give the correct inequality, x > 3, as their final answer. It was interesting to see that many students gave their (correct) final answer in the form 3 < x rather than x > 3.

Q11.

A fully correct solution was not the norm in this question. A great many candidates were unable to draw the three lines correctly; x = −1 and y = 2 were often drawn as y = −1 and x = 2 and often x + y = 5 or x = 6 and y = 6 were drawn instead of x + y = 6. Shading, whether 'in' or 'out', was generally well done but credit was dependent upon at least two correct lines.

Q12.

Part (a) of this question was not well done by most students. Common errors included drawing a line from −2 to the left, using a filled in circle at −2 and indicating a line of finite length which ended at 4. Not all students attempted part (b) of the question. Of those students who did attempt this part, a fair proportion of them got as far as obtaining the value $\frac{8}{3}$ and used this value in their final answer giving $\frac{8}{3}, y=\frac{8}{3}$ or $y<\frac{8}{3}$ on the answer line. Only a small number of students gave an integer answer with some of these students giving 3 as their answer. Some students employed a trial and error approach. A surprising number of these higher tier students made basic errors in the manipulation of the inequality. For example, "4y − y < 7 − 1" was commonly seen.

Q13.

Many correct straight line graphs were seen, usually by candidates working out the coordinates of 5 points (3 for the more able) and often by applying $y = mx + c$. Although candidates using the latter method often misread the scale and just counted one square across and two squares up to get their gradient of 2. Candidates lost marks if they did not fully draw their line from (−2,−7) to (2, 1). Weaker candidates, drawing tables of values, often made arithmetic errors in their calculations, particularly with the negative x values. For example: 6.5 – 2.8 = 3.7 or calculating ⅕ or ⅓ of 60.

Q14.

Over 50% of candidates drew clear, accurate graphs and scored full marks in the first part of this question. Most candidates plotted two or more points which they then joined to form a straight line. Relatively few candidates constructed a table of values before plotting points. A significant minority of candidates tried to use the gradient-intercept method to draw the line. This approach proved less successful. Most candidates using this method drew lines passing through (0, 2) but with an incorrect gradient. There was little evidence to suggest that the different scales on the x and y axes had confused candidates.

In part (b)(i) nearly 60% of candidates gave a correct equation. Of those who were not successful, a few gave an expression rather than an equation. In part (b)(ii) correct answers were rare. A large number of candidates who demonstrated an understanding of the situation gave the equation of a perpendicular line rather than the gradient. This highlights the need for candidates to ensure they read the particular demands of a question carefully.

Q15.

Most students attempted this question. Where students did not earn full marks in part (a) they typically wrote $5n+6$, or $n+6$. There was evidence also that students thought that terms were increasing by 7 each time, so poor arithmetic skills even at this basic level.

In part (b) students who were most successful listed all the terms up to 119 and 125 to come to the correct conclusion. Errors included those who thought that they needed to substitute 121 into their expression from (a). In other cases, students got as far as a correct equation = 121, but then could not use inverse operations correctly to find n. There were also a lot of empty spaces on this question, where students did not know how to begin solving the problem.

Q16.

Part (a) was well attempted by most candidates with many scoring full marks. In most cases those who didn't score full marks either wrote an expression containing $4n$ scoring B1 or wrote $n + 4$ scoring B0. There were very few responses seen with other coefficients of n.

Part (b) was well attempted by most candidates though more candidates were successful in part (a). The most common incorrect response was 907, however, those candidates who presented full working out and initially wrote $3 \times 10^2 + 7$ followed by $30^2 + 7$ did earn at least M1, unfortunately in most cases candidates wrote $3 \times 10 = 30$, $30^2 = 900$, $900 + 7 = 907$. Candidates who tried to generate all the terms of the sequence were usually unsuccessful.

Q17.

Although the incorrect answer of $\frac{5}{13}$ was seen often, most candidates did try to use a correct method identifying 40 as a common denominator. However unless at least one numerator was correct, no credit was given. Simple arithmetical errors in the addition of 16 and 15 (eg = 21) prevented a significant number of candidates from gaining full marks. Several candidates tried to cancel the correct answer of $\frac{31}{40}$ or even convert it to a mixed number. Such additional work was not penalised.

Q18.

In part (a) the majority of students were able to convert at least one of the given fractions to an improper fraction. Some students confused techniques for other operations at this point and tried to express the fractions with a common denominator. Those that were successful in achieving the correct multiplication were often unable to convert back to a mixed fraction in its simplest form. The most common answers were $\frac{42}{15}$, $\frac{14}{5}$ or $\frac{212}{15}$

In part (b) students generally scored full marks or no marks. Many who converted to improper fractions were unable to convert these to fractions with the same common denominator. Often they found the common denominator but failed to find the correct numerator. Very few subtracted the whole numbers and then dealt with the fractions. There appears to be widespread misunderstanding of the processes involved.

Q19.

The final question on the paper was well answered by the more able students although some of these students lost the final mark by writing $\frac{3x}{x+4} = \frac{3x}{4}$ or some other incorrect 'simplification'. The most common incorrect response was to try to 'cancel' the x^2 terms as well as the terms in x.

Mark Scheme

Q1.

		Working	Answer	Mark	Notes
			2.52×10^{15}	2	M1 for 4.032×10^9 or 4 032 000 000 or sight of figures 252 A1 for 2.52×10^{15}

Q2.

Question	Working	Answer	Mark	Notes
(a)		5.4×10^6	1	B1 cao
(b)		0.00032	1	B1 cao
(c)		6.3×10^{32}	2	M1 for 630×10^{30} oe or figures 63 with $\times 10^n$ A1 for 6.3×10^{32} or 6.30×10^{32}

Q3.

Question		Working	Answer	Mark	Notes
		eg. $x = 0.28181...$ $100x = 28.181...$ $99x = 27.9$	$^{31}/_{110}$	3	M1 for 0.28181(...) **or** 0.2 + 0.08181(...) **or** evidence of correct recurring decimal eg. 281.81(...) M1 for two correct recurring decimals that, when subtracted, would result in a terminating decimal, and attempting the subtraction eg. $100x = 28.1818...$, $x = 0.28181...$ and subtracting eg. $1000x = 281.8181...$, $10x = 2.8181...$ and subtracting **OR** $^{27.9}/_{99}$ or $^{279}/_{990}$ oe A1 cao

Q4.

Question	Working	Answer	Mark	Notes
(a)	$5\sqrt{9\times 3}$	$15\sqrt{3}$	2	M1 for sight of $\sqrt{9\times 3}$ or $\sqrt{9}\ \sqrt{3}$ or $3\sqrt{3}$ A1 for $15\sqrt{3}$ (accept $n = 15$)
(b)		$7\sqrt{3}$	2	M1 for $\dfrac{21\sqrt{3}}{\sqrt{3}\sqrt{3}}$ A1 for $7\sqrt{3}$ (accept $\dfrac{21\sqrt{3}}{3}$)

Q5.

PAPER: 5MB2H_01					
Question		Working	Answer	Mark	Notes
			$30 - 10\sqrt{5}$	2	M1 for 4 terms correct with or without signs or 3 out of exactly 4 terms correct (the terms may be in an expression or table) or $25 - 10\sqrt{5} + 5$ A1 cao

Q6.

Question		Working	Answer	Mark	Notes
			$2\sqrt{5}$	2	M1 for multiplication of denominator and numerator by $\sqrt{5}$ A1 cao

Q7.

		Working	Answer	Mark	Notes
			1	3	M1 $(\sqrt{5})^2 - 1$ or $\sqrt{25} - 1$ or $\sqrt{5} \times \sqrt{5} - \sqrt{5} + \sqrt{5} - 1$ or $\sqrt{25} - \sqrt{5} + \sqrt{5} - 1$ M1 (indep) use of $(\sqrt{5})^2 = 5$ or $\sqrt{5} \times \sqrt{5} = 5$ A1 cao

Q8.

PAPER: 5MB3H_01					
Question		Working	Answer	Mark	Notes
	(a)		± 7	2	M1 for $147 \div 3$ $(= 49)$ or 7 A1 cao
	(b)		18.2	3	M1 for correct method to deal with denominators (condone one error in arithmetic) M1 (dep) for correct method to write in the form $ay = b$ A1 for 18.2 or $18\frac{1}{5}$

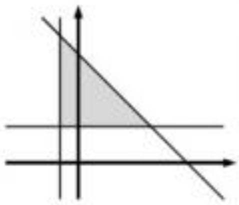
Q9.

5MB3H/01 June 2015				
Question	**Working**	**Answer**	**Mark**	**Notes**
(a)		1.75	2	M1 for intention to multiply brackets or for intention to divide all terms by 4 as the first step A1 for 1.75 oe
(b)		$p > 7.5$	2	M1 for correct method to isolate p or intention to divide all terms by 2 as the first step (condone the use of '=' in method) A1 for $p > 7.5$ oe
(c)		3, -5	3	M2 for $(x-3)(x+5)$ (M1 for $(x \pm 3)(x \pm 5)$) A1 cao 3 and -5 OR M1 for $\frac{-2 \pm \sqrt{2^2 - 4 \times 1 \times -15}}{2 \times 1}$ M1 for $\frac{-2 \pm \sqrt{64}}{2}$ A1 for 3 and -5 cao

Q10.

PAPER: 5MB3H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
(a)		$-2, -1, 0, 1, 2$	2	B2 for $-2, -1, 0, 1, 2$ (B1 for one error or omission)
(b)		$x > 3$	2	M1 for isolating either the constant terms or algebraic terms or for $x = 3$ A1 cao

Q11.

PAPER: 5MB3H_01				
Question	**Working**	**Answer**	**Mark**	**Notes**
		Region identified	4	B1 for $x + y = 6$ or $x = -1$ or $y = 2$ drawn B1 for $x + y = 6$ and $x = -1$ and $y = 2$ drawn M1 for consistent shading (in or out) for any two of the lines $x + y = 6$, $x = -1$, $y = 2$ A1 lines drawn, and correct region identified by either shading in, or shading out; the letter R is not required, but necessary if no shading Note: Lines may be solid or dotted/dashed etc

Q12.

PAPER: 5MB3H_01				
Question	Working	Answer	Mark	Notes
(a)		Inequality drawn	2	B2 for all three features of −2, O and right arrow (B1 for two of these features)
(b)		2	3	M1 for isolating the y terms A1 for $3y < 8$ or $3y = 8$ or better B1 ft

Q13.

Question		Working	Answer	Mark	Notes
		Table of values x: −2, −1, 0, 1, 2 y: −7, −5, −3, −1, 1 OR Using $y= mx + c$ Gradient 2 intercept -3	Single line drawn from (-2, -7) to (2, 1)	3	**(Table of values)** M1 for at least 2 correct attempts to find points by substituting values of x. M1 (dep) ft for correctly plotting at least 2 of their points (any points plotted from their table must be plotted correctly) A1 for the correct line from (-2, -7) to (2, 1) OR **(No table of values)** M2 for at least 2 correct points (and no incorrect points) correctly plotted or for a line segment of the graph of $y = 2x - 3$ drawn (ignore any additional incorrect line segments) [M1 for at least 3 correct points plotted with no more than 2 incorrect points] A1 for the correct line from (-2, -7) to (2, 1) OR **(Use of $y = mx + c$)** M2 for a single straight line of gradient 2, passing through (0, -3) [M1 for a single straight line of gradient 2 or for a single straight line passing through (0, - 3)] A1 for the correct line from (-2, -7) to (2, 1)

Q14.

Question	Working	Answer	Mark	Notes
(a)	Table of values x = -1 0 1 2 3 y = 2 2 6 10 14 OR Using $y = mx + c$, gradient = 4, y intercept = 2	Line from (1, 2) to (3,14)	3	**(Table of values)** M1 for at least 2 correct attempts to find points by substituting values of x. M1 ft for plotting at least 2 of their points (any points plotted from their table must be correct) A1 for correct line between 1 and 3 **(No table of values)** M2 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 4x + 2$ drawn (ignore any additional incorrect segments) (M1 for at least 3 correct points with no more than 2 incorrect points) A1 for correct line between -1 and 3 **(Use of $y = mx + c$)** M2 for at least 2 correct points (and no incorrect points) plotted OR line segment of $y = 4x + 2$ drawn (ignore any additional incorrect segments) (M1 for line drawn with gradient 4 OR line drawn with a y intercept of 2) A1 for correct line between 1 and 3
(b)(i)		$y = 4x + c$, $c \neq 2$	1	B1 Correct equation given.
(ii)		– 0.25	1	B1 Correct gradient given. Note – 0.25 could be written as -¼ oe

Q15.

Question		Working	Answer	Mark	Notes
	(a)		$6n + 5$	2	B2 for $6n + 5$ (B1 for $6n + k$ where k is an integer or absent)
	(b)		No with explanation	2	M1 for "$6n + 5$" = 121 or any other valid method, e.g. counting on 6s (to get to 119 or more) A1 for No with complete explanation, e.g. $6n$=116 will not give a whole number

Q16.

		Working	Answer	Mark	Notes
	(a)		$4n - 3$	2	B2 for $4n - 3$ oe (B1 for $4n + k$, $k \neq -3$ or $n = 4n$-3)
	(b)		307	2	M1 for substitution of 10 into $3n^2$+7 ($=3\times10^2+7$) A1 cao

Q17.

<table>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td></td><td></td><td>$^{16}/_{40} + {^{15}/_{40}} = {^{31}/_{40}}$

OR
<table><tr><td></td><td>2</td><td>5</td></tr><tr><td>3</td><td></td><td>15</td></tr><tr><td>8</td><td>16</td><td>40</td></tr></table>
OR
0.4 + 0.375</td><td>$^{31}/_{40}$ or 0.775</td><td>2</td><td>M1 for attempt to write both fractions with a common denominator (a multiple of 40) with at least one of them correct
A1 for $^{31}/_{40}$ oe

OR
M1 for 40 in the correct cell and 15 or 16 in the correct cell
A1 for $^{31}/_{40}$ oe

OR
M1 for changing both fractions to decimals with both 0.4 and 0.375 seen
A1 for 0.775</td></tr>
</table>

Q18.

Question	Working	Answer	Mark	Notes
(a)		$2\frac{4}{5}$	3	M1 for writing as improper fractions eg $\frac{6}{5}$ or $\frac{7}{3}$ M1 (dep) for multiplying improper fractions eg $\frac{6\times7}{5\times3}$ or $\frac{14}{5}$ oe A1 cao
(b)		$\frac{4}{5}$	3	M1 for finding two correct fractions with a common denominator eg $\frac{7}{15}-\frac{10}{15}$ or $\frac{21-30}{45}$ M1 (dep) for complete and correct method eg $1-\frac{3}{15}$ or $\frac{37}{15}-\frac{25}{15}$ or $\frac{111-75}{45}$ oe A1 for $\frac{4}{5}$ oe

Q19.

PAPER: 5MB2H_01					
Question		Working	Answer	Mark	Notes
			$\frac{3x}{x+4}$	3	M1 for $3x(x-2)$ M1 for $(x-2)(x+4)$ A1 cao