

Task 1

Question 1

Skill involved: 167a: Multiply mixed numbers.

Show that $3\frac{1}{5} \times 2\frac{5}{8} = 8\frac{a}{b}$, where a and b are integers to be found.

Input note: The fraction $\frac{a}{b}$ is in its simplest form.

$a = \dots\dots\dots, b = \dots\dots\dots$

(3 marks)

Question 2

Skill involved: 130f: Calculate the percentage of an amount without a calculator, using chunking with multiples of 10%.

Work out 70% of 50.

.....

(2 marks)

Question 3

Skill involved: E169: Fractional increase and decrease

Beth multiplies a number by 3 and divides the answer by 10.

By what fraction has the number been reduced?

(2 marks)

Question 4

Skill involved: 29d: DELETED Compare two fractions.

Select the fraction which is bigger than $\frac{3}{7}$ and smaller than $\frac{4}{7}$.

$\frac{3}{8} []$

$\frac{2}{3} []$

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

$\frac{3}{4} []$

$\frac{1}{3} []$

(2 marks)

Question 5

Skill involved: 298d: Raise an algebraic term to a negative integer power.

Simplify

$$(3m)^{-2}$$

.....

Question 6

Skill involved: 298a: Raise a whole number to a negative integer power.

Find the value of $(-2)^{-2}$

Give your answer as a fraction.

(2 marks)

Question 7

Skill involved: 394c: Determine the unknown power in an expression involving unit fractions as indices, given its numeric equivalent.

$a^b = 3$ where a is an integer and b is a proper fraction.

Select one possible pair of values of a and b .

$$a = 9, b = \frac{1}{3} \quad [\quad]$$

$$a = 9, b = \frac{1}{2} \quad [\quad]$$

$$a = 3, b = 1 \quad [\quad]$$

(1 mark)

Question 8

Skill involved: 158f: Raise a number to the power of 0.

Evaluate 9^0 .

.....

(1 mark)

Question 9

Skill involved: 394h: Raise a number to the power of a negative fraction.

Express $9^{-\frac{1}{2}}$ as a fraction.

(2 marks)

Question 10

Skill involved: 364b: Factorise quadratic expressions given in the form $ax^2 - bx + c$ with $a > 1$

Factorise $2x^2 - 7x + 6$

.....

(2 marks)

Question 11

Skill involved: 258k: Solve equations of the form $\frac{ax+b}{c} = dx + e$

Solve $\frac{4m+9}{3} = 7 - 2m$

$m = \dots\dots\dots$

(4 marks)

Question 12

Skill involved: 394p: Write a surd expression in one variable as a power of that variable (or value).

Write $\frac{\sqrt[4]{y}}{y}$ in the form y^b where b is a fraction.

$\dots\dots\dots$

(2 marks)

Question 13

Skill involved: 304e: Divide numbers in standard form/scientific notation with the second power positive and where no index adjustment is required.

Trains using electrified railway tracks produce fewer emissions than other trains.

In 2020, the USA had the longest total length of railway track of any country in the world.

	Approximate length of electrified railway track (km)	Approximate total length of railway track (km)
USA	2×10^3	2×10^5

Rest of the world	3.98×10^5	1.2×10^6
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Answer the following question using information from the table.

Calculate the percentage of track in the USA that was electrified in 2020.

..... %

(2 marks)

Question 14

Skill involved: 303b: Add or subtract large numbers in standard form/scientific notation by conversion to ordinary numbers.

Trains using electrified railway tracks produce fewer emissions than other trains.

In 2020, the USA had the longest total length of railway track of any country in the world.

	Approximate length of electrified railway track (km)	Approximate total length of railway track (km)
USA	2×10^3	2×10^5
Rest of the world	3.98×10^5	1.2×10^6

Answer the following question using information from the table.

Calculate the fraction of the **whole world's** railway track that was electrified in 2020.

Give your answer in its simplest form.

(5 marks)

Question 15

Skill involved: 299i: Expand double brackets involving binomial expressions with multiple variables.

Expand and simplify

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

.....

(3 marks)

Question 16

Skill involved: 365o: Factorise an expression using the substitution of a variable or expression with a power to reduce to quadratic form.

Expand and simplify

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

Input note: give your answer as a single fraction

.....

(3 marks)

Question 17

Skill involved: 364c: Factorise quadratic expressions given in the form $ax^2 + bx - c$ with $a > 1$

Solve by factorisation.

$$3x^2 + 10x - 8 = 0$$

$$x = \dots\dots\dots$$

$$\text{or } x = \dots\dots\dots$$

(3 marks)

Question 18

Skill involved: 413a: Complete the square for quadratic expressions given in the form $x^2 + bx + c$ where b is even.

Write $x^2 + 8x + 11$ in the form $(x + a)^2 - b$.

$a = \dots\dots\dots, b = \dots\dots\dots$

(3 marks)

Question 19

Skill involved: 195e: Determine the missing operation in a function machine given a single variable as the input and an algebraic expression as the output.

Here is a function.



Complete the diagram below to show the **inverse** of the function.



Select the correct answer below.

$a = +3$ and $b = \times 2$ []

$a = -3$ and $b = \div 2$ []

$a = \div 2$ and $b = -3$ []

$a = \times 2$ and $b = +3$ []

(2 marks)

Question 20

Skill involved: 276i: Form and solve linear simultaneous equations/systems of equations for a given non-geometric context.

Here is a function.



When the input is 5, the output is 8.5.

When the input is 10, the output is 11.

Find the value of m and the value of p .

$$m = \dots\dots\dots, p = \dots\dots\dots$$

(5 marks)

Question 21

Skill involved: 419b: Solve non-linear simultaneous equations/systems of equations where y is the subject of both equations, to give a quadratic equation to be solved.

Solve the simultaneous equations

$$y - x = 2$$

$$y = 2x^2 + 5x + 1$$

Give your answers correct to 1 decimal place.

$$x = \dots\dots\dots, y = \dots\dots\dots$$

$$\text{Or } x = \dots\dots\dots, y = \dots\dots\dots$$

(6 marks)

Question 22

Skill involved: 341a: Solve a two-ended linear inequality in one variable with a single step.

Find all the possible integer values that satisfy the inequality $-4 \leq x - 3 < 1$

.....

(3 marks)

Question 23

Skill involved: 458f: Solve quadratic inequalities given in the form $ax^2 + bx + c > 0$ or $ax^2 + bx + c < 0$

Solve the inequality $2y^2 - 7y - 30 \leq 0$

.....

(3 marks)

Mark scheme

Question 1

$$a = 2, b = 5$$

e.g. $\frac{16}{5}$ and $\frac{21}{8}$ oe			M1 both fractions expressed as improper fractions
e.g. $\frac{16^2}{5} \times \frac{21}{8^1}$ OR $\frac{336}{40}$ oe			M1 correct cancelling OR multiplication of numerators and denominators without cancelling
e.g. $\frac{16}{5} \times \frac{21}{8} = \frac{336}{40} = \frac{42}{5} = 8\frac{2}{5}$ or $\frac{16}{5} \times \frac{21}{8} = \frac{336}{40} = 8\frac{16}{40} = 8\frac{2}{5}$ or $\frac{16^2}{5} \times \frac{21}{8^1} = \frac{42}{5} = 8\frac{2}{5}$ or candidate clearly shows that in the question, the result of $8\frac{2}{5} = \frac{42}{5}$ and that their answer becomes $\frac{42}{5}$	shown	3	A1 Dep on M2 for conclusion to $8\frac{2}{5}$ from correct working – either sight of the result of the multiplication e.g. $\frac{336}{40}$ must be seen or correct cancelling prior to the multiplication to $\frac{42}{5}$ NB: use of decimals scores no marks

Question 2

35

35	2	M1 for 50×0.7 oe
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Question 3

$$\frac{7}{10}$$

$\frac{7}{10}$ or equivalent fraction	2	B1 for $\frac{3}{10}$ oe or answer 0.7 or 70%
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Question 4

$$\frac{1}{2}$$

Correct fraction	2	M1 for common denominator of form $7n$ where n is integer > 1 or for 0.428[5...] and 0.571[4...] or 42.8[5...] % and 57.1[4...] % or $\left(\frac{3}{7} + \frac{4}{7}\right) \div 2$
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Question 5

$$\frac{1}{9m^2} \text{ or } \frac{1}{9}m^{-2}$$

① Take the reciprocal of $(3m)$ due to the negative power.

$$(3m)^{-2} = \frac{1}{(3m)^2}$$

② Raise each term to the power of 2.

$$\begin{aligned} \frac{1}{(3m)^2} &= \frac{1}{3^2(m)^2} \\ &= \frac{1}{9m^2} \end{aligned}$$

Question 6

$$\frac{1}{4}$$

Question 7

$$a = 9, b = \frac{1}{2}$$

Q	Answer	Mark	Comments	
24	Any correct pair of values	B1	eg $a = 9 \quad b = \frac{1}{2}$ $a = 27 \quad b = \frac{1}{3}$ $a = 81 \quad b = \frac{1}{4}$	
	Additional Guidance			
	$a = 9 \quad b = \frac{1}{3}$		B0	
	$a = 3 \quad b = \frac{1}{1}$		B0	
	$a = 3 \quad b = 1$	B0		

Question 8

$$1$$

$$1$$

$$B1$$

Question 9

$$\frac{1}{3}$$

$$\frac{1}{3}$$

M1 $\frac{1}{9^{\frac{1}{2}}}$ or $\frac{1}{\sqrt{9}}$ soi
A1 2 cao

Question 10

$$(2x - 3)(x - 2)$$

$(2x - 3)(x - 2)$	2	B2
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Question 11

$$m = 1.2$$

$4m + 9 = 3(7 - 2m)$		4	M1
$4m + 9 = 21 - 6m$			M1
$4m + 6m = 21 - 9$ or $10m = 12$ or $-21 + 9 = -6m - 4m$ or $-10m = -12$			M1
	$\frac{12}{10}$ oe		A1

Question 12

$$y^{-\frac{3}{4}}$$

$\frac{y^{\frac{1}{4}}}{y}$ or $\sqrt[4]{y} = y^{\frac{1}{4}}$ or $y^{\frac{1}{4}-1}$		2	M1
	$y^{-\frac{3}{4}}$		A1

Question 13

$$1\%$$

7(a) $\frac{2 \times 10^3}{2 \times 10^5} (\times 100)$	or equivalent	M1
	$= 1 (\%)$	A1

Question 14

$$\frac{2}{7}$$

7(b) $(0.02 \times 10^5) + (3.98 \times 10^5)$ or $2000 + 398\,000$ OR $(0.2 \times 10^6) + (1.2 \times 10^6)$ or $200\,000 + 1\,200\,000$	M1
$= 400\,000$ AND $1\,400\,000$	A2
(Fraction that was electrified $\Rightarrow$) $\frac{400\,000}{1\,400\,000}$ or equivalent	B1
$= \frac{2}{7}$	B1

Question 15

$$3w^2 - 10wy - 8y^2$$

$3w^2 + 2wy - 12wy - 8y^2$	M1	oe 4 terms with 3 correct Terms may be seen in a grid May be implied eg1 $3w^2 - 10wy + 8y^2$ eg2 $w^2 - 10wy - 8y^2$
$3w^2 + 2wy - 12wy - 8y^2$	A1	Fully correct Do not allow if only seen in a grid
$3w^2 - 10wy - 8y^2$	A1ft	ft M1 A0

Question 16

$$\frac{x+9x^2-3}{x^2}$$

$\frac{3x}{3x^2}$ or $\frac{9x^2}{x^2}$ or $(-)\frac{3}{x^2}$	M1	oe eg1 $\frac{3 \times x}{x^2 \times 3}$ eg2 9 One correct product, unsimplified or simplified
$\frac{3x}{3x^2} + \frac{9x^2}{x^2} - \frac{3}{x^2}$ or $\frac{1}{x} + \frac{9x^2}{x^2} - 3x^{-2}$ or $\frac{3x + 27x^2}{3x^2} - \frac{3}{x^2}$ or $\frac{x}{x^2} + \frac{9x^2 - 3}{x^2}$ or $\frac{9x^2}{x^2} + \frac{3(x-3)}{3x^2}$ or $\frac{3x + 27x^2 - 9}{3x^2}$	A1	oe Fully correct expansion of given expression that requires further simplification Multiplication signs not allowed unless recovered eg $\frac{3 \times x}{x^2 \times 3} + \frac{9x^2}{x^2} - \frac{3}{x^2}$ M1 A0
$\frac{1}{x} + 9 - \frac{3}{x^2}$ or $x^{-1} + 9 - 3x^{-2}$ or $\frac{1}{x} + \frac{9x^2 - 3}{x^2}$ or $x^{-1} + \frac{9x^2 - 3}{x^2}$ or $\frac{x-3}{x^2} + 9$ or $\frac{1+9x}{x} - \frac{3}{x^2}$ or $\frac{x+9x^2-3}{x^2}$	A1	oe Any of these answers implies M1 A1 A1 Do not allow $\frac{9}{1}$ for 9 Multiplication signs or brackets that require expansion not allowed unless recovered After M1 A1 A1 penalise further work eg $\frac{x+9x^2-3}{x^2}$ followed by $\frac{3x+27x^2-9}{3x^2}$ M1 A1 A0

Question 17

$$x = -4 \text{ or } x = \frac{2}{3}$$

15	(a)	$(3x-2)(x+4)$ oe	M2	M1 for $(3x+a)(x+b)$ with $a+3b=10$ or $ab=-8$ or $3x(x+4) - 2(x+4)$ or $x(3x-2) + 4(3x-2)$	For M2 and M1 condone the omission of the final bracket. $\frac{(3x-2)(3x+12)}{3}$ followed by $3x-2 [=0]$ and $x+4 [=0]$ scores M2. If no products of factors shown then $3x-2=0$ and $x+4=0$ scores M1. After $3x(x+4) - 2(x+4)$ or $x(3x-2) + 4(3x-2)$ followed by correct answers award M2B1 BOD
		- 4 and $\frac{2}{3}$	B1FT	correct or FT their linear factors	Condone 0.6 or 0.666... or 0.67 for $\frac{2}{3}$

Question 18

$$a = 4, b = 5$$

	(b)		$(x + 4)^2 - 5$	3	B1 for $(x + 4)^2$ B2FT <i>their</i> $(x + a)^2$ for <i>their</i> -5 If 0 scored SC2 for 'correct' answer with missing power or power written in the wrong place	e.g. $(x + 11)^2 - 110$ scores B2FT e.g. SC2 for $(x + 4) - 5$ or $(x + 4^2) - 5$
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Question 19

$$a = \div 2 \text{ and } b = -3$$

11	(a)		$\div 2 \quad -3$	2	B1 each or SC1 wrong order	
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Question 20

$$m = 0.5, p = 6$$

	(b)		$[m =] 0.5 \text{ nfww}$ $[p =] 6 \text{ nfww}$	5	M1 for $5m + p = 8.5$ oe M1 for $10m + p = 11$ oe AND B2 for $m = 0.5 \text{ nfww}$ or $p = 6 \text{ nfww}$ or M1 for $10m - 5m = 11 - 8.5$ or $5m = 2.5$ or $2p - p = 17 - 11$ If 0 scored, instead award SC1 for two answers which satisfy one of the original conditions	Correct answer from trial and improvement scores 5
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Question 21

$$x = -2.2, y = -0.2 \text{ or } x = 0.2, y = 2.2$$

$y = 2 + x$	B1	$x = y - 2$
$2x^2 + 5x + 1 = \text{their } (2 + x)$	M1	oe $y = 2(y - 2)^2 + 5(y - 2) + 1$ $2y^2 - 8y + 8 + 5y - y - 10 + 1 = 0$
$2x^2 + 4x - 1 = 0$	M1dep	$2y^2 - 4y - 1 = 0$
$\frac{-4 \pm \sqrt{4^2 - (4 \times 2 \times -1)}}{2 \times 2}$ or $\frac{-4 \pm \sqrt{24}}{4}$	M1	$\frac{-4 \pm \sqrt{(-4)^2 - (4 \times 2 \times -1)}}{2 \times 2}$ or $\frac{4 \pm \sqrt{24}}{4}$
$x = -2.2(\dots)$ and $x = 0.2(\dots)$ or $x = -2.2(\dots)$ and $y = -0.2(\dots)$ or $x = 0.2(\dots)$ and $y = 2.2(\dots)$	A1	$y = 2.2(\dots)$ and $y = -0.2(\dots)$ or $y = 2.2(\dots)$ and $x = 0.2(\dots)$ or $y = -0.2(\dots)$ and $x = -2.2(\dots)$
$x = -2.2$ and $y = -0.2$ and $x = 0.2$ and $y = 2.2$	A1	$y = 2.2$ and $x = 0.2$ and $y = -0.2$ and $x = -2.2$

Question 22

-1, 0, 1, 2, 3

-1, 0, 1, 2, 3	3	B2 for 5 correct values with one extra or for 4 correct with no extras or for $-1 \leq x < 4$ or M1 for $-4 + 3 \leq x$ or $x < 1 + 3$ oe
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Question 23

$-2.5 \leq y \leq 6$

$(2y + 5)(y - 6)$ or $\frac{-7 \pm \sqrt{(-7)^2 - 4 \times 2 \times -30}}{2 \times 2}$ $2 \left[\left(y - \frac{7}{4} \right)^2 - \frac{49}{16} \right] - 30 (= 0)$ oe		3
$(y =) 6, (y =) -2.5$ Working required	$-2.5 \leq y \leq 6$	