[redacted] 2019 SOLUTION GUIDE

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
1	(a)	$2\ 460 \div 1\ 000$ 2,460	1	Knowledge of conversion of cm^3 to litres ($1\ 000\ cm^3 = 1$ litre)
	(b)	$\frac{10\ 000\ m^2}{250\ 000\ m^2} \times \frac{100}{1}$ $= 4\%$	1 1	Knowledge of conversion of hectares to square metres and square kilometres to square metres. 1 hectare $= 10\ 000\ m^2$ $1\ Km^2 = 1\ 000\ 000\ m^2$ $0{,}25\ Km^2 = 250\ 000\ m^2$
2	(a)	$(-8)^{\frac{2}{3}}$ $= \left(3\sqrt{-8^3}\ \right)^2$ $= (-2)^2$ $= 4$	1	Application of the law of indices $(x)^{\frac{a}{b}} = \left(b\sqrt{x}\right)^a$ or $b\sqrt{x^a}$ $(-8)^{\frac{2}{3}}$ $= 3\sqrt{(-8)^2}$ $= 3\sqrt{64}$ $= 4$
	(b)	$\sqrt{147} + \sqrt{108}$ $= \sqrt{49 \times 3} + \sqrt{36 \times 3}$ $= 7\sqrt{3} + 6\sqrt{3}$ $= 13\sqrt{3}$	1 1	Knowledge of rules of surds and ability to identify perfect squares is essential in simplifying the expression.
3		$3x - y = 2$ (1) $\times 2$ $5x - 2y = 0$ (2) $\times 1$ $6x - 2y = 4$ $\underline{5x - 2y = 0}$ Subtract $x = 4$ Substitute 4 for x in (1) $3 \times 4 - y = 2$ $12 - 2 = y$ $y = 10$ $x = 4$ and $y = 10$	1 1 1	Any correct method of solving simultaneous equations is acceptable (elimination as illustrated in the working, substitution or the graphical method. Alternatively use the matrix method as shown below. $\begin{pmatrix} x \\ y \end{pmatrix} = -1 \begin{pmatrix} -2 & 1 \\ -5 & 3 \end{pmatrix} \begin{pmatrix} 2 \\ 0 \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 4 \\ 10 \end{pmatrix}$ $x = 4$ and $y = 10$

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4	(a)	$\frac{qr}{t}$ $=\frac{-6\times(-1)}{2}$ $=\frac{6}{2}$ $=3$	1	Substitution of given values and simplify accurately. Ability to manipulate directed numbers.
4	(b)	$qt-r$ $=(-6)\times2-(-1)$ $=-12+1$ $=-11$	1	Substitution of given values and simplify accurately.
	(c)	$(q+r)^t$ $=(-6-1)^2$ $=(-7)^2$ $=49$	1	Substitution of given values and simplify accurately.
5	(a)	2	1	Understanding the concept of order of rotational symmetry being the number of times the shape has to be rotated through the same angle to get to its original position.
	(b)	$x+x+x+x$ $+2x+2x+2x$ $+2x+2x+2x$ $+2x+2x$ $=(12-2)\times180°$ $4x+16x=1\ 800$ $20x=1\ 800$ $x-90°$	1 1	Use of the formula for finding the sum of interior angles of a polygon. $[(n-2)\times180°]$ Ability to formulate a linear equation and solve it.

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6	(a)	$\frac{2}{3}$ of 54 Km $\frac{2}{3}\times\frac{54}{1}$ $= 36$	1	Ability to simplify accurately.
	(b)	5:3:7 7 is to 35 15 is to -- $\frac{15}{7}\times\frac{35}{1}$ $= 75$	 1 1	Find the total of the ratios and then use simple proportion to calculate the total number of sweets.
7	(a) (i)	$P' = \{1; 2; 7; 8; 9; 10\}$ $Q = \{4; 5; 6; 7; 8\}$ $P' \cap Q = \{7; 8\}$	1	Understanding of the meaning of compliment of a set and intersection was key for the candidate to list the elements in the intersection.
	(ii)	$(P \cup Q)' = \{1; 2; 9; 10\}$ $\therefore n(P \cup Q)' = 4$	1	Ability to identify the elements in the compliment set and then state the number.
7	(b)	$(K \cap L)'$ or $K' \cup L'$	1	Identify the unshaded region which is $K \cap L$. The shaded region is not $K \cap L$. hence in set notation it is $(K \cap L)'$.
8	(a)	$x^2 - \frac{1}{4}$ $= \left(x + \frac{1}{2}\right)\left(x - \frac{1}{2}\right)$	1	Knowledge of the difference of two squares. Brackets are essential.
	(b)	$x(x-2) - 2xy + 4y$ $= x(x-2) - 2y(x-2)$ $= (x-2y)(x-2)$	 1 1	Knowledge of factoring using the method of grouping pairs. Brackets are essential.

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9	(a)	$2\,214_5 = 2\times5^3 + 2\times5^2 + 1\times5^1 + 4\times5^0$	1	There is need for recognition of expanded index format of numbers in base 5.
	(b)	$101_n = 37_{10}$ $1\times n^2 + 0\times n^1 + 1\times n^0 = 37$ $n^2 + 0 + 1 = 37$ $n^2 + 1 - 37 = 0$ $n^2 - 36 = 0$ $(n+6)(n-6) = 0$ Either n + 6 = 0 or n – 6 = 0 $n = -6$ or 6 $n = 6$	 1 1	Use of the expanded index format of a number in base n and then formulate a quadratic equation. Solve the quadratic equation. Take note that the base cannot be negative hence $n = 6$.
10	(a)	P is a 2×3 matrix Q is a 3×1 matrix PQ = H 2×3 product 3×1 = 2×1 Order of H is 2×1 or 2 by 1	1	Knowledge of order of matrices and that if two matrices are multiplied the product has number of rows equal to the first matrix and number of columns equal to the second matrix. [p by q X q by r = p by r matrix]
10	(b)	$A^2 = \begin{pmatrix} 2 & 1 \\ 3 & -3 \end{pmatrix}\begin{pmatrix} 2 & 1 \\ 3 & -3 \end{pmatrix}$ $= \begin{pmatrix} 2\times2 + 1\times3 & 2\times1 + 1\times(-3) \\ 3\times2 + (-3)\times3 & 3\times1 + (-3)\times(-3) \end{pmatrix}$ $= \begin{pmatrix} 4+3 & 2-3 \\ 6-9 & 3+9 \end{pmatrix}$ $\begin{pmatrix} 7 & -1 \\ -3 & 12 \end{pmatrix}$	2	Knowledge of multiplication of matrices that is row by column and the ability to manipulate directed numbers. Brackets are essential.

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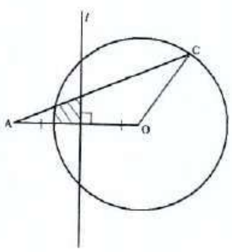
11	(a)	$O\hat{D}B$=30°	1	Identify that $D\hat{A}C = C\hat{B}D$ angles subtended by the same chord DC. $O\hat{D}B = C\hat{B}D$ [alternate angles are equal].
	(b)	$A\hat{B}D = 60°$	1	Realise that triangle AOD is isosceles, hence $D\hat{A}O = A\hat{D}O$. Using the knowledge that the angle in a semi-circle is a right angle, $D\hat{A}C$ *and* $D\hat{C}A$ are complimentary. $D\hat{C}A = A\hat{B}D$ [angles are subtended by the same chord AD.]
	(c)	$A\hat{C}B = 60°$	1	Realize that $A\hat{D}B = A\hat{C}B$ [angles subtended by the same chord AB are equal].
12	(a) (i)	Locus of points 4 cm from O.	1	Key words are "points 4 cm from O".
	(ii)	Locus of points equidistant from point A and point O.	1	The key words are equidistant from A and O
	(b)		1	Ability to identify and shade the region which suits the given description of P.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
13	(a)	US$1 is to 12 Rands US$5,40 is to -- $\frac{5{,}40}{1} \times \frac{12}{1}$ = R64,80	1	Use simple proportion to calculate the amount in Rands using the exchange rate.
	(b)	$I = \frac{2\,000 \times 20 \times 2}{100}$ $I = 20 \times 20 \times 2$ $I = 800$ Total amount payable = $2 000 + $800 = $2 800	1 1 1	Use of the formula for calculating Simple Interest $\left[I = \frac{PTR}{100}\right]$. Substitute the numerical values in the formula and simplify accurately. Add the Principal to the Simple Interest to get the amount payable after 2 years. Alternatively the Simple Interest can be calculated yearly and then add the interest for the 2 years to the Principal.
14	(a)	The bearing of B from C is 210° or S30° W or 30° West of South.	1	Key word is "from C" where the angle to give the bearing should be calculated. Drawing a line at point C parallel to the north line can assist to calculate the angle.
	(b)	$\frac{BC}{Sin10°} = \frac{4}{Sin50°}$ $\frac{BC}{0{,}2} = \frac{4}{0{,}8}$ BC = $\frac{4 \times 0{,}2}{0{,}8}$ BC = $\frac{0{,}8}{0{,}8}$ BC = 1 Km	1 1 1	Use the Sine Rule to calculate BC as the length of one side is given. Use knowledge of sum of interior angles to find the third angle which is required in the calculation.
15	(a)	$Log_3 \frac{1}{243} = log_3 \frac{1}{3^5}$ $= log_3 3^{-5}$ $= -5 log_3 3$ $= -5$	1 1	Use of the law of logarithms $logM^P = plogM$ and the knowledge that $log_3 3 = 1$.

	(b)	$log_3 81 = (2x-1)$ $3^{(2x-1)} = 81$ $3^{(2x-1)} = 3^4$ $2x - 1 = 4$ $2x = 5$ $x = 2\frac{1}{2}$	1 1	Use knowledge of $log_a^b = x$ means $a^x = b$. Realise the need to have same bases in order to equate the powers, hence $3^{2x-1} = 3^4$ $2x - 1 = 4$ Solve the linear equation.
16	(a)	$V \propto h^3$ $V = kh^3$ $3 = 1^3 k$ $3 = 1\,k$ $K = 3$ $V = 3h^3$	 1 1	The general equation of direct variation is to be used to find the equation. Use any set of the given values of h and V to find the constant of variation.
	(b)	$V = 3h^3$ $648 = 3h^3$ $\frac{648}{3} = h^3$ $h^3 = 216$ $h = 3\sqrt{216}$ $h = 6$ Value of $q = 6$	1 1 1	Substitution of the numerical value of V in the equation found in (a) to find the numerical value of h which is represented by q in the table. Solving for h is by finding the cube root on both sides.

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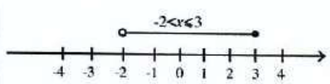
17	**(a)**	$\begin{pmatrix}1 & 0\\-3 & 1\end{pmatrix}\begin{pmatrix}4\\2\end{pmatrix}$ $=\begin{pmatrix}1\times4+0\times2\\-3\times4+1\times2\end{pmatrix}$ $=\begin{pmatrix}4\\-10\end{pmatrix}$ $A_1(4;\,-10)$	1	Multiply the transformation matrix by the position vector of A to get the coordinates of A_1. Coordinates to be given in the correct form and not as a column vector. Brackets are essential
	(b)	Shear Invariant line $x=0$ Shear factor -3	3	The invariant line is $x = 0$ *or y - axis*. The distance from point A to A_1 is 12 units. Note that it is negative since it is counted downwards shear factor $=\frac{-12}{4}=-3$.
18	**(a)**	$3x-6\le 2x-3<4x+1$ $3x-6\le 2x-3\ :\ 2x-3<4x+1$ $3x-2x\le 6-3\ :\ -3-1<4x-2x$ $x\le 3\ :\ -4<2x$ $-2<x$ $-2<x\le 3$	3	Split the inequality in two parts. Solve each inequality separately. Combine the solutions.
	(b)		1	Realise that – 2 is not part of the solution set hence the circle above – 2 is not shaded whilst the one above 3 is shaded because 5 is part of the solution set.

19	**(a)**	$g = \sqrt{\frac{h-4}{5+h}}$ $g = \sqrt{\frac{20-4}{5+20}}$ $g = \sqrt{\frac{16}{25}}$ $g = \frac{4}{5}$ or 0, 8	1 1	Substitute 20 for h in the expression and simplify. Realize that 16 and 25 are perfect squares hence the $\sqrt{\frac{16}{25}}$ can be found.
	(b)	$(g)^2 = \left(\sqrt{\frac{h-4}{5+h}}\right)^2$ $g^2 = \frac{h-4}{5+h}$ $g^2(5+h) = h = 4$ $5g^2 + g^2h = h - 4$ $g^2h - h = -4 - 5g^2$ $h(g^2-1) = -4 - 5g^2$ $h = \frac{-4-5g^2}{g^2-1}$ or $\frac{5g^2+4}{1-g^2}$	1 1 1	Realise that the square root can be removed by raising both sides to the power 2. Clear fractions and remove brackets. Collect terms with *h* on one side of the equation. Make *h* the subject of the formula. Alternatively it can be worked depending on how grouping of like terms is done having the answer with all signs changed.
20	**(a)**	$\boldsymbol{AB} = \boldsymbol{AO} + \boldsymbol{OB}$ $= \binom{2}{-2} + \binom{4}{1}$ $= \binom{6}{-2}$	2	Use the triangular rule to add the vectors. Note that $\boldsymbol{AO} = \boldsymbol{OA}$

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20	(b)	Let the coordinates of P be (x, y). **BP = OA + 2OB** $\binom{x}{y} - \binom{4}{1} = \binom{-2}{3} + 2\binom{4}{1}$ $\binom{x}{y} - \binom{4}{1} = \binom{-2}{3} + \binom{8}{2}$ $\binom{x}{y} - \binom{4}{1} = \binom{6}{5}$ $\binom{x}{y} = \binom{6}{5} + \binom{4}{1}$ $P(10; 6)\binom{x}{y} = \binom{10}{6}$	 1 1 + 1	Consider the coordinates of P to be $(x ; y)$. Express the coordinates of P in column form and equate to **OA + 2OB.**
21	(a) (i)	$3x + 4y = 12$ When $y = 0$ $3x + 4\times0 = 12$ $3x = 12$ $x = 4$ P(4; 0)	 1	Realise that when the line cuts the x-axis the y coordinate will be equal to zero. Substitute 0 for y in the equation $3x + 4y = 12$ to find the x coordinate. Note that the coordinates should have brackets.
	(ii)	$3x + 4y = 12$ When $x = 0$ $3\times0 + 4y = 12$ $4y = 12$ Q (0;3)	 1	Realise that when the line cuts the y axis the x coordinate will be equal to zero. Substitute 0 for x in the equation $3x + 4y = 12$ to find the y coordinate. Brackets are essential.

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	(b)(i)	$3x + 4y = 12$ $4y = -3x + 12$ $y = \frac{-3}{4}x + 3$ Gradient of line is $\frac{-3}{4}$		Express the given equation in the form $y = mx + c$ where m is the gradient of the of the line
	(b) (ii)	$PQ = \sqrt{3^2 + 4^2}$ $PQ = \sqrt{9 + 16}$ $PQ = \sqrt{25}$ $PQ = 5$ units	1 1	Realise that OQ = 3 units and OP = 4 units. Use the Pythagoras Theorem to find the length of PQ.
22	(a)(i)	The modal class is $40 < h \leq 50$	1	Modal class is the class with the highest frequency.
	(ii)	Mean = $\left[4\left(\frac{20+30}{2}\right) + 6\left(\frac{30+40}{2}\right) + 10\left(\frac{40+50}{2}\right) + 2\left(\frac{50+60}{2}\right) + 8\left(\frac{60+70}{2}\right)\right]/30$ $= \frac{4\times25+6\times35+10\times45+2\times55+8\times6}{30}$ $= \frac{100+210+450+110+520}{30}$ $= \frac{1\,390}{30}$ $= 46\frac{1}{3}$ or equivalent form	1 1 1	There is need to calculate the class centres of each class by adding the lower and upper limit then divide by two. This class centre is then multiplied by the frequency and all the products of class centres and frequency are added. The sum is divided by total frequency.
	(b)	$\frac{12}{30}$	1	There is need to add the frequencies of the two classes where the plant can be chosen from and then divide it by total frequency.

23	(a)	EBD	1	Understanding of the concept of similar triangles is key. Ability to identify equal angles and corresponding sides is essential such that the similar triangle is named correctly.
	(b) (i)	$\frac{AB}{EB}=\frac{AC}{ED}$ $\frac{AB}{4,2}=\frac{3,5}{2,1}$ $AB=\frac{3,5\times4,2}{2,1}$ AB = 7 cm	 1 1	Use the answer in (a) to identify corresponding sides. Substitute the sides with numerical values and then simplify accurately.
	(ii)	$(2,1)^2$ is to $(3,5)^2$ 22,5 is to --- $\frac{22,5}{1}\times\left(\frac{3,5}{2,1}\right)^2$ $=\frac{22,5\times12,25}{4,41}$ $= 62,5\ cm^2$	 1 1 1	Square the scale factor $\left(\frac{2,1}{3,5}\right)$ in order to get the area factor. $\left(\frac{2,1}{3,5}\right)^2$ Use simple proportion and simplify accurately.
24	(c)	Acceleration $=\frac{54-36}{6-0}$ $=\frac{18}{6}$ $= 3\ m/s^2$	1 1	The acceleration is equal to the gradient of part of the graph from t = 0 to t = 6. Correct units of acceleration (m/s^2) should be stated.
	(b)	Let the velocity after 10 seconds be V $\frac{0-V}{15-10}=\frac{-54}{9}$ $\frac{-V}{5}=-6$ $-V=-30$ V = 30 m/s	1 1	Realise that the deceleration which is equal to the gradient is constant. Form an equation in V and solve it.

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	(c)	$\left[\frac{1}{2}(36+54)6+\frac{1}{2}\times9\times54\right]/15$ $=\frac{3\times90+2439\times27}{15}$ $=\frac{270+243}{15}$ $=\frac{513}{15}$ $=34\frac{3}{15}$	1 1 1	The area under the graph is the distance covered. Divide the shape into a trapezium and a triangle or into two triangles and a rectangle. Knowledge of the correct formula to find area of a trapezium. $[\frac{1}{2}(a+b)h]$
25	(a)	$=2\times\frac{22}{7}\times\frac{3,5}{1}$ $=44\times0,5$ $=22$ cm	1 1	Knowledge of the formula for calculating circumference of a circle ($2\pi r$ *or* πd). Substitute the numerical values of π and d and then simplify accurately.
	(b)	Perimeter $=14+10,5+[\frac{1}{2}\times2\times\frac{22}{7}\times3,5\times2]+10,5$ $=24,5+22+10,5$ $=57$ cm	1 1	Understanding of the concept of perimeter is important. Use the formula for calculating perimeter of a semi-circle. $[\pi r$ or $\frac{1}{2}\pi d]$ Substitute the numerical values in the formula and simplify correctly.
	(c)	Area of the shaded part $=14\times10,5-3\times\frac{22}{7}\times\frac{3,5}{1}\times\frac{3,5}{1}$ $=147-66\times0,5\times3,5$ $=147-115,5$ $=31,5$ cm^2	1 1 1	Calculate the area of the rectangle ABDE and then subtract area of 3 circles. Identify that the two semi-circles constitute one circle. Knowledge πd of the formula for calculating area of a circle. $[\pi r^2]$