4004/01 JUNE 2019 SOLUTION GUIDE

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
1	(a)	$\frac{12}{25} = 0{,}48$	1	Evidence of accurate division by 25.
	(b)	$\frac{2}{5} \times \frac{100}{1} = 40\%$	1	To express a fraction as a percentage you multiply by 100.
	(c)	$0{,}0375 = \frac{375}{10\,000}$ $= \frac{3}{80}$	1	Correct reduction of the numerator and the denominator using common factors till they are in their simplest form.
2	(a)	49	1	Study the pattern and identify that these are perfect squares.
	(b)	$\sqrt{13}$	1	Study the sequence and identify that these are square roots of prime numbers.
	(c)	$\frac{1}{2}$	1	Study the sequence and identify that the next term is obtained by dividing by 2 or multiplying by $\frac{1}{2}$ the previous term.
3		12:13:15 12+13+15=40 $\frac{12}{40} \times \frac{100}{1} = \$30$ $\frac{13}{40} \times \frac{100}{1} = \$32.50$	 1 1	The candidate should find the total of the ratios and then calculate each ration over the total ratio and multiply by $100

<table>
<tr><th colspan="2">QUESTION</th><th>SOLUTION</th><th>MARK</th><th>ADDITIONAL GUIDANCE</th></tr>
<tr><td></td><td></td><td>$\frac{15}{40}\times\frac{100}{1}=\$37.50$</td><td>1</td><td></td></tr>
<tr><td>4</td><td>(a)(i)</td><td>$434_5=4\times5^2+3\times5^1+\ 4\times5^0$

$=4\times25+3\times5\times4\times1$
$=100+15+4$
$=119_{10}$</td><td>Bases to base ten

1</td><td>Recognition of expanded index format of numbers in different bases when converting from other.

Alternatively the candidate can use the method of repeated multiplication as shown 434 below.

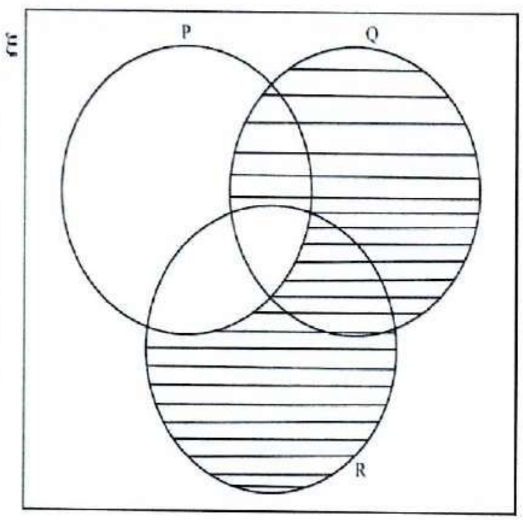
$\underline{\times5}$
$20+3$

$=23$
$\underline{\times\ 5}$

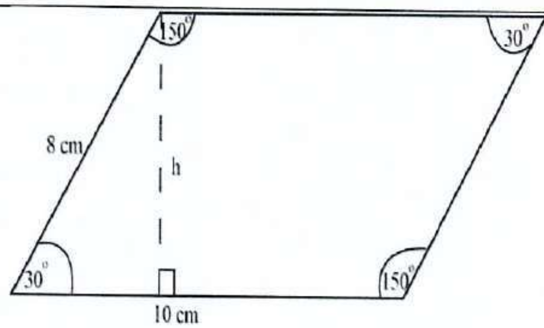
$115+4=119_{10}$</td></tr>
<tr><td></td><td>(ii)</td><td>75_{10} to base two

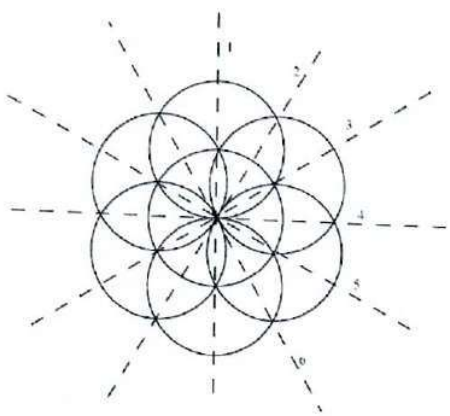
2 75
2 37 rem 1
2 18 rem 1
2 9 rem 0
2 4 rem 1
2 2 rem 0
2 1 rem 0
0 rem 1

1001011_2</td><td>1</td><td>Understanding of conversion of numbers in base ten to other bases. The remainders are written from bottom to top.</td></tr>
<tr><td></td><td>(b)</td><td>377_8
$\underline{411_8}$</td><td>1</td><td>Understanding of the general rules of addition</td></tr>
</table>

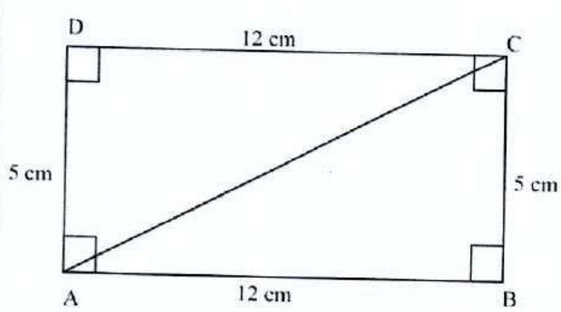
QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
		1010_8		of members in base eight.
5	(a)	Kite	1	Knowledge of the properties of different shapes.
	(b)(i)	$A\hat{D}C = 90°$	1	Use of the theorem "the angle in a semi-circle is a right angle."
6		$(P' \cap R) \cup (R' \cap Q)$ 	3	Understanding of the set notation or meaning of; compliment of a set, intersection and union was required for the candidate to be able to share the set $(P' \cap R) \cup (R' \cap Q)$

7	(a)	647 cents to dollars $647 \div 100$ $= \$6,47$	1	Conversion of cents to dollar you divide by 100
	(b)	US\$11:R13,80 US\$75,90: ? More $\frac{75,90}{1} \times 13,80$ $= R1047,42$	1 1	
8		$5x - 2y = 26 \quad (1)\times 2$ $3x + 4y = 0 \quad (2)\times 1$ $10x - 4y = 52$ $\underline{\quad 3x + 4y = 0}$ $Add\ 13x = 52$ $x = 4$ $Substiture\ 4\ for\ x\ in\ (2)$ $3\times 4 + 4y = 0$ $12 + y = 0$ $4y = -12$ $y = -3$ $x = 4\ and\ y = -3$	1 1 1	Any correct method of solving simultaneous equations is acceptable. [elimination as shown substitution, matrix and graphical methods of which candidate may ask for graph paper.] Matrix Method $\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{26}\begin{pmatrix} 4 & 2 \\ -3 & 5 \end{pmatrix}\begin{pmatrix} 26 \\ 0 \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \frac{1}{26}\begin{pmatrix} 104 \\ -78 \end{pmatrix}$ $\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$ $x = 4\ and\ y = -3$

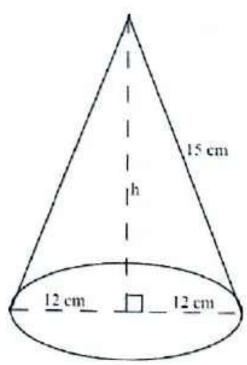
QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
9		 Area of the parallelogram = $10 \times 8\times$ $\sin 150°$ $= 10\times8\times0{,}5$ $= 80\times0{,}5$ $= 40cm^2$	 1 1 1	Recall of the formula for calculating area of a parallelogram given two sides and an angle. Alternatively the candidate can find the perpendicular height and then use it to calculate the area. $\sin 30° = \frac{h}{8}$ $h = \sin 30°\times8$ $h = 0{,}5 \times8$ $h = 4cm$ $\therefore Area\ of\ parallelogram = 10\times4$ $= 40cm^2$
10	(a)	Probability of picking a yellow sweet = $\frac{8}{20}$ $= \frac{2}{5}$	 1	Use the knowledge that the probability of picking a yellow sweet is equal to the number of yellow sweets over the total number of sweets in the box.
	(b)	Probability of picking two sweets of the same colour $=\frac{8}{20}\times\frac{7}{19}+\frac{12}{20}\times\frac{11}{19}$ $= \frac{56}{380}+\frac{132}{380}$ $=\frac{188}{380}$	 1	Apply the law of probability of picking two sweets of the same colour without replacement. Alternatively the candidate can use the tree diagram to find the probability.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
11	(a)	 7	1	Identify circles in the diagram.
	(b)	6	1	Identify the number of lines of symmetry in the diagram. Understanding of the concept of line of symmetry is important.
	(c)	6	1	Identifying the number of angles through which the shape can be rotated to its original position gives the order of rotational symmetry.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
12	(a)	$\log 30 = \log(6\times5)$ $= \log 6 + \log 5$ $= 0{,}8881 + 0{,}6990$ $= 1{,}4771$	 1 1	Application of the law of logarithm $\log ab = \log a + \log b$
	(b)	$\log 1\,200\,000 = \log(1{,}2 \times 1\,000\,000)$ $= \log 1{,}2 + \log 1\,000\,000$ $= \log\left(\frac{6}{5}\right) + 6$ $= \log 6 - \log 5 + 6$ $= 0{,}0791 + 6$ $= 6{,}0791$	1 1	Application of the laws of logarithms; $\log ab = \log a + \log b$ $\log \frac{a}{b} = \log a - \log b$ Thee was also need to know that the $\log 1\,000\,000 = 6$
13	(a)	$\frac{360°}{18}$ $= 20°$	1 1	Recall of the theorem of the sum of exterior angles of a polygon is 360°. Understanding of a regular polygon would assist the candidate to know that the exterior angles are of the same size since the interior angles will also be of the same size.
	(b)	$(7-2)\times180°$ $= 5\times180°$ $= 900°$	1 1	Recall of the formula for calculating the sum of interior angles of any polygon. $[(n-2)\times180° or\ (2n-4)\times 90°]$

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
14	(a)	$N \propto S$ $N = ks$ $40 = 1000k$ $k = \frac{40}{10000}$ $k - \frac{1}{25}$ $N = \frac{1}{25}S$	 1 1	The general form of direct variation is to be used to find the equation. [$N \propto S$]. Use the given values of N and S to find the constant of variation.
	(b)	$N = \frac{1}{25}S$ $180 = \frac{1}{25}S$ $S = 180 \times 25$ $S = 4500$	1 1	Substitution of given value of N in the equation found in (a) to find the numerical value of 3. Make 3 the subject.
15	(a)	 $\tan A\widehat{C}D = \frac{5}{12}$	 1	Knowledge of trigonometric ratios is required for the candidate to express tan $A\hat{C}D$ as a common fraction.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
	(b)	$AC^2 = 5^2 + 12^2$ $AC^2 = 25 + 144$ $AC^2 = 169$ $AC^2 = \sqrt{169}$ $AC = 13$ $\text{Cos}\, D\hat{A}\, C = \frac{5}{13}$	1 1	Using the triangle in (a). Use the Pythagoras Theorem to find the length of AC. Use trigonometric ratio for cosine to find $\cos D\hat{A}\, C$.
	(c)	$\sin B\hat{D}\, C = \frac{5}{13}$	1	Use the triangle in (a) and knowledge of the trigonometric ration for sin to find $\sin B\hat{D}\, C$.
16	(a)	Modal mass = 10kg	1	Modal class is the class with the highest frequency.
	(b)	Median mass $= \frac{10+10}{2}$ $= \frac{20}{2}$ $= 10\ kg$	1	The median is the entry in the middle if data is arranged in order. In this case the median is the mean of the 3rd and 4th entries.
	(c)	Mean mass $= \frac{5+5+10+10+10+20}{6}$ $= \frac{60}{6}$ $= 10kg$	 1	The mean is calculated by finding the sum of the entries and then divided by total frequency.
17	(a)(i)	$p^2 - 4$ $= (p+2)(p-2)$	1	Use the concept of difference of two squares to factorise the expression. Brackets are essential.
	(ii)	$2p^2 + 7p + 6$ $= 2p + 4p + 3p + 6$		Knowledge of factorising quadratic expression either

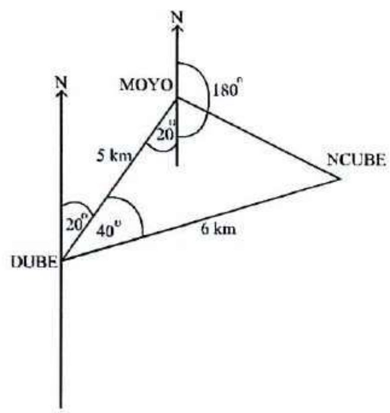
		$= 2p(p+2) + 3(p+2)$ $= (2p+3)(p+2)$	2	by grouping in pairs or the ring number method.
	(b)	$p^2 - 4 = (p+2)(p-2)$ $2p^2 + 7p + 6 = (2p+3)(p+2)$ The H.C.P of $p^2 - 4\ and\ 2p^2 + 7p + 6\ is\ p + 2$	1	Use the factorised expressions in (a) to find the highest common factor.
18	(a)	 Vertical height $h = \sqrt{15^2 - 12^2}$ $h = \sqrt{225 - 144}$ $h = \sqrt{81}$ $h = 9cm$	1 1	There is need to visualise the diagram or to draw a sketch diagram. Use the Pythagoras Theorem to calculate the vertical height. The candidates should know that the vertical height is perpendicular to the diameter.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
	(b)	$V = \frac{1}{3} \times \pi \times \frac{12}{1} \times \frac{12}{1} \times \frac{9}{1}$ $= 12 \times 12 \times 3 \times \pi$ $= 432\pi$	1 1	Substitution of value of r (radius) and h (height) in the given formula and simplify accurately. The candidate should remember not to substitute the value of π as the answer is required in terms of π.
19	(a)	$f(x) = 3x^2 - 2x - 8$ $f(-4) = 3 \times (-4)^2$ $- 2 \times (-4)$ $- 8$ $f(-4) = 3 \times 16 + 8 - 8$ $f(-4) = 48 + 8 - 8$ $f(-4) = 48$	1	Understanding of function notation where $f(-4)$ means that substitute -4 for x in the function.
	(b)	$f(x) = 0$ $3x^2 - 2x - 8 = 0$ $(3x + 4)(x - 2) = 0$ either $3x + 4 = 0$ or $x - 2 = 0$ $or\ x = 2$ $3x = -4$ $x = \frac{-4}{3}$ $x = -1\frac{1}{3}\ or\ 2$	1 1 1	The candidate can solve the quadratic equation by factorisation or use the quadratic formula. $x = 2 \pm \sqrt{(-2)^2 4 \times (3) \times (-8)}$ 2×3 $x = 2 \pm \sqrt{4 + 96}$ 6 $x = \frac{2 \pm \sqrt{100}}{6}$ $x = \frac{2 + 10}{6}\ or\ \frac{2 - 10}{6}$ $x = 2\ or - 1\frac{1}{3}$

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
20	(a)	$\left(x^{2/3}\right)^{3/2} = (4)^{3/2}$ $x = \left(\sqrt{4}\right)^3$ $x = \pm 2^3$ $x = 8\ or - 8$	 1 1	Use of law of indices $x^{a/b} = \sqrt[b]{x^a}$ is required to solve the equation.
	(b)	$\frac{2}{x-2} = \frac{3}{x+2}$ $2(x+2) = 3(x - 2)$ $2x + 4 = 3x - 6$ $2x - 3x - 6 - 4$ $-x = -10$ $x = 10$	 1 1	Knowledge of method of solving equations involving fractions by first multiplying every term by the L.C.M of the denominators to remove the denominators. The equation that remains is a linear equation in one variable.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
21	(a)	Line that passes through the points (0;0) and (100;200) Gradient of the line $=\frac{200-0}{100-0}$ $=\frac{2}{1}$ $=2$ Equation of the line$y = mx + c$ $0 = 2\times0 + c$ $c = o$ $\therefore$ Equation of the line is $y = 2x$ Inequality is $y \leq 2x$ line that passes through the points (300;0) and (0;300) Gradient of the line $= \frac{300-0}{0-300}$ $= -1$ Equation of the line $y = mx + c$ $0 = 1\times300 + c$ $c = +300$ Equation of the line is $y = -x + 300$ Inequality is $y < -x + 300$ The two inequalities are $y \leq 2x$ $y < -x + 300$	 1 1	Realization that equation of a straight line is in the form $y = mx + c$ (where m is the gradient and c is the y–intercept). The gradient can be found using different methods. (measurement or two points on the line). Knowledge of the fact that if the line is broken it will be < or > and when it is continuous it will be $\leq$or $\geq$.

	(b)	299	2	Identify one value of x and y respectively from the shaded region that give $x + y$ its maximum value.
22	(a)(i)	$618\ 000 = 6{,}18\times10^5$	1	Knowledge of the standard form [A $\times10^n$ where $1 \le A < 10$ n is an integer] required.
	(ii)	$0{,}000423 = 4{,}23\times10^{-4}$	1	Expressing a decimal number in standard form.
	(b)	$(8{,}76\times10^{-2}) + (7{,}89\times10^{-2})$ $= 0{,}0876 + 0{,}0789$ $= 0{,}1665$ $= 1{,}665\times10^{-1}$	2	Candidate can convert both numbers to ordinary form, add and convert the sum to standard form. Alternatively, the candidate can use the factorisation method $(8{,}76\times10^{-2}) + (7{,}89\times10^{-2})$ $= 10^{-2}(8{,}76 + 7{,}89)$ $= 16{,}65\times10^{-2}$ $= 1{,}665\times10^{1}\times10^{-2}$ $= 1{,}665\times10^{-1}$
23	(a)(i)	$\overline{AX} = \overline{AO} + \overline{OX}$ $= -\underset{p}{\rightarrow} + \underset{q}{\rightarrow}$	1	Knowledge of the triangular law when adding vectors.
	(ii)	$\overline{BY} = \overline{BO} + \overline{OY}$ $= 3p - 3q$	1	Knowledge of the triangular law when adding vectors and application of the ratio given.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
	(b)	- AX is parallel to YB - YB is 3 times $AX [YB = 3AX]$	1 1	Understanding of the properties of the vectors.
24	(a)	 The bearing of Dube village from Moyo Village is 200° or $320°\ or\ 20°W\ of\ S.$	1	Use of a sketch diagram is required to assist the candidate to visualise what is on the ground. The sketch diagram is used to find the bearing.
	(b)	Let the distance be hd $d^2 = 5^2 + 6^2 - 2{\times}5{\times}6{\times} \cos 40°$ $d^2 = 25 + 36 - 60{\times}0{,}77$ $d^2 = 61 - 46{,}20$ $d^2 = 14{,}80$ $d = \sqrt{14{,}80}$	1 1 1	Use the cosine rule to find the distance as two sides and the included angle are given. Substitute the values in the formula and simplify correctly.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
25	(a)	8 is to 16 $1{,}44cm^2$ is to ? More $\left(\frac{16}{8}\right)^2 \times \frac{1{,}44}{1}$ $= \frac{4}{1} \times \frac{1{,}44}{1}$ $= 5{,}76cm^2$	 1 1	Candidate should use the knowledge that the area factor is equal to the square of the scale factor, that is; scale factor is 1:k area factor is $1^2:k^2$
	(b)	8 is to 16 ? is to $16cm^3$ $\left(\frac{8}{16}\right)^3 \times \frac{16}{1}$ $= \frac{1}{8} \times \frac{16}{1}$ $= 2cm^3$	 1 1	Candidate should use the knowledge that the volume factor is equal to the square of the cube of the scale factor, that is; scale factor is 1:k volume factor is $1^3:k^3$

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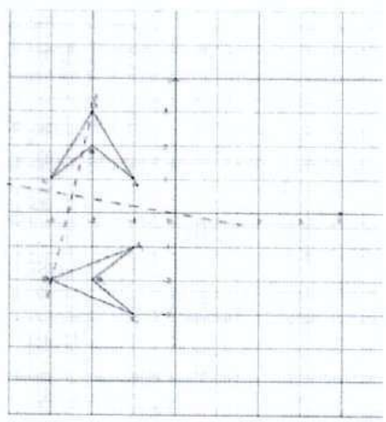
26	(a)	 Rotation 270° clockwise or 90° anticlockwise Centre of rotation (0;0)	1 1 1	Knowledge of constructing a perpendicular bisector is essential. To find the centre of rotation the candidate has to construct perpendicular bisector of BB_1 and DD_1 and where they intersect is the centre of rotation in this case it is (0;0).
	(b)	$A(-1;1)$ and $A_2(1;-2)$ Translation vector = $\begin{pmatrix}1\\-2\end{pmatrix} - \begin{pmatrix}-1\\1\end{pmatrix}$ $= \begin{pmatrix}2\\-3\end{pmatrix}$	2	The candidate should subtract the position vector of A_2 from A in order to get the transaction vector.

QUESTION		SOLUTION	MARK	ADDITIONAL GUIDANCE
27	(a)	Total distance covered $=\frac{1}{2}(90+60)10+\frac{1}{2}\times 5\times 60$ $=150\times 5+150$ $=750+150$ $=900m$	1 1	The area of the shape is the distance covered. The area can be divided into a trapezium and a triangle or into a rectangle and two triangles. If the shape is divided into a rectangle and two triangles it will be as follows. Total distance covered $=10\times 60+\frac{1}{2}\times 10\times 30+\frac{1}{2}\times 5\times 60$ $=600+150+150$ $=900m$
	(b)	Velocity $=\frac{900}{15}$ $=60m/s$	1 1	To calculate velocity, the candidate should divide the total distance covered by the total time taken.
	(c)	Deceleration $=\frac{60-0}{15-0}$ $=\frac{60}{5}$ $=12m/s^2$	1 1	The deceleration is equal to the gradient of graph from $t=10$ to $t=15$. $\left[\frac{-60}{5}=-12\right]$. The candidate should take note that the question is asking for deceleration so it will be positive unless if it was acceleration.