No. 141/3

Pacific Community
Communauté du Pacifique

EDUCATIONAL QUALITY AND ASSESSMENT PROGRAMME

EQAP

MATHS with STATS

Scoring Rubric 2022

South Pacific Form Seven Certificate

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Probability					
Item Number	**Solution**	**Skill Level**			
		1	**2**	**3**	**4**
1.1	B. {2, 4, 6}	B. {2, 4, 6}			
1.2	**Complementary events** -events where every possible outcome of a trial belongs in one or other of the events. - events where $P(A)+P(A')=1$ or $P(A\cup A')=1$ - probability of complementary events add up to 1 - occurs where there are two outcomes/are mutually exclusive	Any One Correct definition			
1.3	$P(at\ least\ 2\ of\ each\ gender) = \dfrac{\binom{7}{3}\times\binom{5}{2}+\binom{7}{2}\times\binom{5}{3}}{\binom{12}{5}}$ $= \dfrac{35\times 10+21\times 10}{792}$ $= \dfrac{560}{792}=\dfrac{70}{99}\ or\ 0.707$	One of the following • Identifies total number of possible 5 member committees $\left[\binom{12}{5}=792\right]$ • Identifies/Calculates $7C3\ or\ 5C2$ • Identifies/Calculates $7C2\ or\ 5C3$	Two of the following • Identifies total number of possible 5 member committees $\left[\binom{12}{5}=792\right]$ • Identifies/Calculates $7C3\times 5C2$ • Identifies/Calculates $7C2\times 5C3$	Correct probability *[allow for slip]*	
1.4	**D. probability distribution**	D. probability distribution			
1.5	Parameters - a quantity that influences the output - are numbers which completely define a distribution - number describing whole population e.g. population mean - numerical characteristic of a population, such as mean or standard deviation.	Any one Correct definition			
1.6	Average number of visitors in 1 minute = $\lambda = 6$ $P(X<3) = [P(X=2)+P(X=1)+P(X=0)]$ $= \left[\left(\dfrac{6^2e^{-6}}{2!}\right)+\left(\dfrac{6^1e^{-6}}{1!}\right)+\left(\dfrac{6^0e^{-6}}{0!}\right)\right]$ $= 18e^{-6}+6e^{-6}+e^{-6}$ $= 25e^{-6}=0.0620$ Formula: $P(X=x)=\dfrac{\lambda^x e^{-\lambda}}{x!}$	One of the following: • Identifies correct formula • Identifies correct probability interval • Finds $P(X=0)$ or $P(X=1)$ or $P(X=2)$	Two of the following: • Correct formula • Identifies correct probability interval • Finds $P(X=0)$ or $P(X=1)$ or $P(X=2)$	Correct answer obtained using correct formula *[allow for slip]*	
	From Poisson distribution table: $\lambda = 6$, $x = 0, 1,$ 0.0025 + 0.0149 +0.0446 = 0.062	Any one correct probability	• Any two correct probabilities	Correct answer obtained after addition	

Probability					
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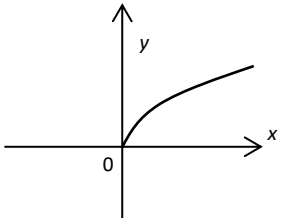
1.7	Features of normal distribution: • Area under the curve adds up to 1 • Is symmetrical about the mean • Mean is always at 50% [mean = median = mode] • The curve is bell shaped	Any one correct feature			
1.8a	$k = 1 - (0.2 + 0.2 + 0.3 + 0.2) = 0.1$	Correct value as in evidence			
1.8b	$Var(X) = E(X^2) - [E(X)]^2$ **Follow through from 1.8a** $= [0.2(6)^2 + 0.2(7)^2 + 0.3(8)^2 + 0.2(9)^2 + 0.1(10)^2] - 7.8^2$ $= 62.4 - 60.84$ $= 1.56$ $E(x) = 6(0.2) + 7(0.2) + 8(0.3) + 9(0.2) + 10(0.1) = 7.8$	One of the following: • Identifies correct formula • Finds $E(X^2)$ correctly • Finds $E(X)$ • Finds $[E(X)]^2$ correctly	Correct answer obtained using correct formula *[allow for slip]*		
1.9	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $= 0.3 + 0.2 - 0.3 \times 0.2$ $= 0.5 - 0.06$ $= 0.44$	One of the following: • Identifies correct formula • Finds $P(A \cap B)$ correctly • Evidence of multiplication 0.3×0.2	Correct answer obtained using correct formula *[allow for slip]*		
1.10	$x = 6.95$, $Z_1 = -0.3$; $x = 10.8$, $Z_2 = 0.8$ $P = 0.1179$ $P = 0.2881$ $P = 0.1179 + 0.2881$ $= 0.406$ $E = n \times p$ $= 1500 \times 0.406$ $= 609$  $Formula: Z = \frac{x - \mu}{\sigma}$	One of the following: • Finds correct Z values Z_1 or Z_2 • Draws the normal curve with the values • Finds $P_1 = 0.1179$ or $P_2 = 0.2881$ • Identifies the correct formula to find Z • Identifies the formula $E = n \times p$	Two of the following: • Finds correct Z values Z_1 or Z_2 • Draws the normal curve with the values • Finds $P_1 = 0.1179$ or $P_2 = 0.2881$ • Identifies the correct formula to find Z • Identifies the formula $E = n \times p$	Three of the following: • Finds correct Z values Z_1 or Z_2 • Draws the normal curve with the values • Finds $P_1 = 0.1179$ or $P_2 = 0.2881$ • Identifies the correct formula to find Z • Identifies the formula $E = n \times p$ • Finds P = 0.406	Correct expected number obtained using correct method *[Allow for slip]*

Modelling Using Graphical Methods					
Item Number	**Solution**	**Skill Level**			
		1	**2**	**3**	**4**
2.1	Features of linear function • General form $y = mx + c$ • Graph is a straight line • The highest power of x or independent variable is 1 • Domain: Real numbers	Gives one of the features listed			
2.2	• Breaks off at a certain point or multiple points • Gaps, holes, jump, sudden end • Limit at the point of discontinuity does not exist for most discontinuous function. • Not a continuous curve • Pencil lifted at least once while drawing	Gives one of the properties listed			
2.3	$g(x) = 2(3)^x$ $g(0) = 2(3)^0$ $= 2$	Finds the correct value.			
2.4	$x = -1, x = 2$	Identifies one x value correctly	Both x values are correct.		
2.5	$y = a\,m^x$ $\log m = slope$ $\log y = \log a + x \log m$ $= \frac{1.6 - 0.36}{30 - 0}$ $Y = A + Bx$ $= 0.0413$ $A = \log a = y - \text{int}$ $m = 10^{0.0413}$ $= 0.36$ $= 1.10$ $a = 10^{0.36} = 2.29$	One of the following • Takes log of both sides • Correctly writes in linear form • Finds y-int correctly • Finds slope correctly	Two of the following • Takes log of both sides • Correctly writes in linear form • Finds y-int correctly • Finds slope correctly • Finds m or a correctly	Correct value of a and m using correct method. [*allow for slip*]	
2.6		Correct shape of the graph with y- int & x-int at (0, 0)	Bonus Score		

Modelling Using Graphical Methods					
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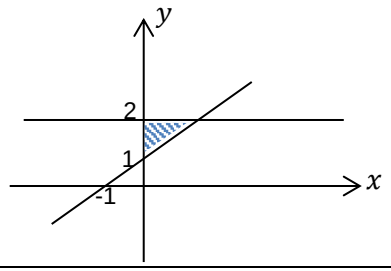
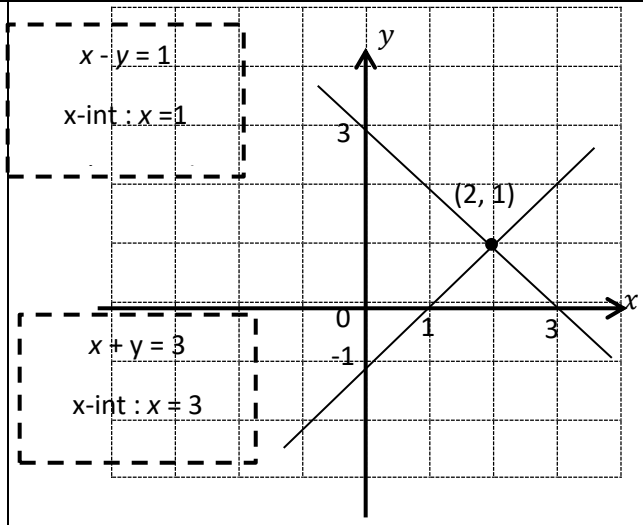
		1	**2**	**3**	**4**
2.7	$x^{\frac{3}{2}} - 4 = 23$ $x^{\frac{3}{2}} = 27$ $x = 27^{\frac{2}{3}}$ $= 9$ Can also use ln or log to solve	One correct idea • Starts to solve by adding 4 on both sides • Gets $x^{\frac{3}{2}} = 27$	Correct answer with correct method	**Bonus Score**	
2.8	$e^{x-2} = 12$ $\ln(e^{x-2}) = \ln 12$ $x - 2 = \ln 12$ $x = \ln 12 + 2 = 4.485$	Starts to solve the equation by taking ln of both sides. (Cannot proceed further)	Correct answer obtained through correct method [*allow for slip*]		
2.9	Features • Consists of inequality signs such as >, < etc • Multiplying or dividing an inequality by negative number the sign is reversed • Taking reciprocal of both sides of an inequality changes direction of inequality	Any one correct idea/feature			
2.10		Correct shading			
2.11	$(2,2)\ P = 3x - 2y$ $= 3(2) - 2(2)$ $= 2$ $(6,2)\ P = 3x - 2y$ $= 3(6) - 2(2)$ $= 14$ $(4,4)\ P = 3x - 2y$ $= 3(4) - 2(4)$ $= 4$ $\therefore Minimum\ \ value = 2$	One correct idea • Identifies the point (2, 2) for min value • Substitutes to find any other value (4 or 14)	Correct answer.		

Statistical Investigations					
Item Number	**Solution**	**Skill Level**			
		1	**2**	**3**	**4**
3.1	Features • Has many data points • Can determine whether a relationship is linear or not • Used to determine the outlier • Has dependent and independent variables	Gives one of the features listed.			
3.2	• Simple random sampling • Cluster sampling • Stratified sampling • Systematic sampling	Any one correct sampling method			
3.3	**Sample size –** the number of observations in a survey/study - size of part of the population chosen for survey - number of individuals included in a research Note: (Size of the sample/population is incorrect)	States the correct definition			
3.4	There is moderate and positive relationship between GPA and motivation achievement. This means that as the GPA increases, there is good chance that motivation achievement will also increase.	Only gives one idea e.g. the strength (moderate or positive) without any description.	Gives the two features of the description (moderate with positive relationship) with a statement between the 2 variables.		
3.5	$\hat{p} = \frac{x}{n}$ $= \frac{238}{400}$ $= 0.595$	One of the following • Correct formula • Correct substitution • Identifies n or x correctly	Correct answer using correct formula		
3.6	For 95 % Confidence level, Z = 1.96 $\overline{X}_1 = 175$ $\overline{X}_2 = 169$ $\sigma_1 = 15, \sigma_2 = 12, n_1 = 36, n_2 = 48$ $\left(\overline{X}_1 - \overline{X}_2\right) \pm Z \times \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}} = 6 \pm 1.96 \times \sqrt{\frac{15^2}{36} + \frac{12^2}{48}}$ $= 6 \pm 5.961$ $\therefore 0.0389 < \mu_1 - \mu_2 < 11.961$	One of the following • Identifies correct Z value • Correct formula • Identifies $\overline{x_1}$ or $\overline{x_2}$ or σ_1 or σ_2 or n_1 or n_2 correctly • Finds standard error of the difference in sample means = $\sqrt{9.25}$ correctly $S.Error = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$	Two of the following • Identifies correct Z value • Correct formula • Identifies $\overline{x_1}$ or $\overline{x_2}$ or σ_1 or σ_2 or n_1 or n_2 correctly • Finds standard error of the difference in sample means = $\sqrt{9.25}$ correctly	Correct answer using correct formula and method [allow for slip]	

Numerical and Algebraic Methods					
Item Number	**Solution**	**Skill Level**			
		1	**2**	**3**	**4**
4.1	• one/unique solution; or • no solution	Any one correct type of solution			
4.2	**Disadvantages of the Newton Raphson method** • Convergence is not guaranteed/Poor global convergence • Converges slowly in case of multiple roots • Division by zero problem may occur/ $f'(x) = 0$ at some point • Difficult to obtain $f'(x)$ • Maybe too far from local root	Any one correct idea/disadvantage			
4.3	Equations are consistent with infinitely many solutions if they represent the same line. Multiplying equation (2) by 4 gives $12x + ay = k$ (1) $12x + 4y = 16$ (3) Choosing $a = 4$ and $k = 16$ makes the equations the same so the system has infinitely many solutions	One of the following • States the condition • Finds the value of a or k correctly	Both values are correct with the condition		
4.4		One of the following • Draws one graph correctly • Finds x and y int of one equation correctly • Plots the x and y-int of any equation correctly	Gives the correct coordinates of the point of intersection (2, 1) by graphing Or identifies the correct point of intersection on the graph correctly.		
4.5	$x + y + z = 120$ $3x + 5y + 6.5z = 513$ $3x + 8y + 10.50 = 715$	Any one equation is correct	Any two equations are correct	All three equations are correct	

Numerical and Algebraic Methods					
Item Number	**Solution**	**Skill Level**			
		1	**2**	**3**	**4**
4.6		One of the following • Computes and fills first two iterates correctly • Computes and fills some values correctly	Computes and fills first four iterates correctly Bonus Score	Computes and fills first 6 iterates correctly	Computes and fills all iterates correctly as well as gives the root to 2 decimal places *[Allow for slip]*

Iterations	a	b	$c = \frac{a+b}{2}$	$f(c)$
1	0.5	1	0.75	-0.328125
2	0.75	1	0.875	0.294921875
3	0.75	0.875	0.8125	-0.02612304
4	0.8125	0.875	0.84375	0.13192749
5	0.8125	0.84375	0.828125	0.05229568
6	0.8125	0.828125	0.8203125	0.0129361
7	0.8125	0.8203125	0.8164062	-0.006631

$$f(x) = x^3 + 3x - 3$$
$$f(0.75) = (0.75)^3 + 3(0.75) - 3$$
$$= -0.328125$$

The last two values of c agree to 2 dp. Hence, **the solution is 0.82**

1.8b Method 2

$$Var(x) = E(X-\mu)^2$$
$$= (6-7.8)^2 \times 0.2 + (7-7.8)^2 \times 0.2 + (8-7.8)^2 \times 0.3 + (9-7.8)^2 \times 0.2 + (10-7.8)^2 \times 0.1$$
$$= 1.56$$