Cambridge Pre-U

Cambridge International Examinations
Cambridge Pre-U Certificate

MATHEMATICS (PRINCIPAL) **9794/03**

Paper 3 Applications of Mathematics **For Examination from 2016**

SPECIMEN MARK SCHEME

2 hours

MAXIMUM MARK: 80

The syllabus is approved in England, Wales and Northern Ireland as a Level 3 Pre-U Certificate.

This document consists of **6** printed pages.

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Mark Scheme Notes

Marks are of the following three types:

M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B Mark for a correct result or statement independent of method marks.

The following abbreviations may be used in a mark scheme:

AG Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
CAO Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
aef Any equivalent form
art Answers rounding to
cwo Correct working only (emphasising that there must be no incorrect working in the solution)
ft Follow through from previous error is allowed
o.e. Or equivalent

1	**(i)**	$z = \dfrac{27-24}{4} = 0.75$	B1
		$P(X > 27) = P(Z > 0.75)$	M1
		$= 0.2266$	A1
	(ii)	$P(X \leqslant 25) - P(X \leqslant 20) = P(Z \leqslant 0.25) - P(Z \leqslant -1)$	M1
		$0.5987 - (1 - 0.8413)$	M1
		0.44	A1
2	**(a) (i)**	$75 - x + x + 130 - x = 170$	
		$x = 35$ (Finding the intersection)	M1
		State $75 - 35$ o.e.	A1
		$\dfrac{40}{200}$ o.e.	A1
	(ii)	Use conditional probability	
		$\dfrac{their\ 35}{their\ 130}$	M1
		$\dfrac{35}{130}$ o.e.	A1
	(b) (i)	Recognise combination problem	M1
		${}^{15}C_7 = \dfrac{15!}{8!7!}$ $= 6435$	A1
	(ii)	${}^6C_2 \times {}^9C_5$ correct method	M1
		=1890	A1
	(iii)	(6M 1C) + (5M 2C) + (4M 3C) correct method	M1
		${}^6C_6 \times {}^9C_1 + {}^6C_5 \times {}^9C_2 + {}^6C_4 \times {}^9C_3$	M1
		1485	A1
3	**(i)**	Median = 30 mpg	B1
		Quartiles = 34 mpg and 23 mpg	B1
	(ii)	IQR = 11 mpg	M1
		Outliers have mpg < 6.5 or > 50.5	A1
		Car A	B1

4	**(i)**	Independence between children	B1
		Class is typical of population in respect of left-handedness	B1
	(ii)	13% of 20 = 2.6, so want P($X \leqslant 2$)	B1
		$(0.87)^{20} + 20(0.13)(0.87)^{19} + 190(0.13)^2(0.87)^{18}$ At least one probability in B(20, 0.13)	M1
		= 0.061714 + 0.18443 + 0.26181	A1
		= 0.50795… = 0.508 to 3sf	A1
5	**(i)**	Table shows (–1, 0.7) (0, 0.25) and (9, 0.05)	B1 B1
	(ii)	Use E(X) formula	M1
		Obtain –0.25 AG	A1
		Use E(X^2) formula	M1
		Obtain 4.6875 (or 4.69) o.e.	A1
	(iii)	Use 10 + 10E(X)	M1
		Obtain 10 + 10(–0.25) = 7.5	A1
	(iv)	P(Must win at least one game)	M1
		States $(0.25)^{10}$	B1
		Obtain $1 - (0.95)^{10} + (0.25)^{10} = 0.401$	A1
6	**(i)**	$x = 7$ $y = 24$ (award B1 only if not identified)	B1 B1
	(ii)	$r^2 = 7^2 + 24^2$	M1
		Magnitude is 25 N	A1
		$\tan\theta = \frac{24}{7}$	M1
		Angle is 73.7°	A1
7	**(i)**	$v = t(t-4)(t-5)$	M1
		$t = 4$ and 5	A1
	(ii)	$x = \frac{t^4}{4} - 3t^3 + 10t^2 + c$	M1
		All terms correct including "+ c"	A1
		When $x = 0$, $t = 0$ therefore $c = 0$	A1
		When $t = 2$, $x = 4 - 24 + 40 = 20$	A1

8	**(i)**	$P - 1050 = 18000 \times 0.3$	M1
		$P = 6450$	A1
	(ii)	New acceleration $6450 - 2850 = 18000a$	M1
		$A = 0.2$	A1
	(iii)	$6450 - 450 - T = 8000\ (0.2)$	M1
		$T = 4400$ N	A1
9	**(i)**	COM: $1 \times 14 + 2 \times 0 = U + 2V$	B1
		NEL: $V - U = 0.5(14 - 0)$	B1
		$U = 0$ ms^{-1}	B1
		$V = 7$ ms^{-1}	B1
	(ii)	COM: $2 \times 7 + 5 \times 0 = 2U + 5V$	B1
		NEL: $V - U = 0.5(7 - 0)$	B1
		$U = -0.5$ ms^{-1}	B1
	(iii)	$V = 3$ ms^{-1}	B1
		B reaches A in 2 seconds	B1
		Distance between A and C is $1 + 2 \times 3 = 7$ metres	B1

10	**(i)**	As system is in equilibrium, tension in string is $T = mg$	B1
		Resolving at right angles to the plane : $R + T \sin \alpha = 2mg \cos \alpha$	M1
		giving $R = mg\,(2 \cos \alpha - \sin \alpha)$ AG	A1
	(ii)	By implication $\alpha \leqslant 45°$	M1
		$\cos \alpha \geqslant \frac{1}{\sqrt{2}}$; $\sin \alpha \leqslant \frac{1}{\sqrt{2}}$	A1
		$R \geqslant mg\left(\frac{2}{\sqrt{2}} - \frac{1}{\sqrt{2}}\right)$ AG	A1
	(iii)	Resolving up the slope $F = 2mg \sin \alpha - T \cos \alpha = mg(2 \sin \alpha - \cos \alpha)$	M1
		For this to be non-negative	A1
		and combined with first line of solution to **(ii)** $0.5 \leqslant \tan \alpha \leqslant 1$ AG	A1
	(iv)	Using $F = \mu R$	M1
		$\mu = \frac{2 \sin \alpha - \cos \alpha}{2 \cos \alpha - \sin \varepsilon} = \frac{2t - 1}{2 - t}$	A1
		Max value of μ is 1 when $t = 1$	A1