



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.

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

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

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

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