



Cambridge Pre-U

MATHEMATICS

9794/03

Paper 3 Applications of Mathematics

May/June 2022

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

PUBLISHED**Generic Marking Principles**

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Maths-Specific Marking Principles

1	Unless a particular method has been specified in the question, full marks may be awarded for any correct method. However, if a calculation is required then no marks will be awarded for a scale drawing.
2	Unless specified in the question, answers may be given as fractions, decimals or in standard form. Ignore superfluous zeros, provided that the degree of accuracy is not affected.
3	Allow alternative conventions for notation if used consistently throughout the paper, e.g. commas being used as decimal points.
4	Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored (isw).
5	Where a candidate has misread a number in the question and used that value consistently throughout, provided that number does not alter the difficulty or the method required, award all marks earned and deduct just 1 mark for the misread.
6	Recovery within working is allowed, e.g. a notation error in the working where the following line of working makes the candidate's intent clear.

Question	Answer	Marks	Guidance
1(a)	Mean = 58.5	B1	
	$sd = \sqrt{\frac{108364}{28} - 58.5^2}$	M1	Using their 58.5
	21.2	A1	
1(b)	Mean = 62.5	B1ft	ft their mean
	sd = 21.2	B1ft	ft their sd Allow comment of no change

Question	Answer	Marks	Guidance
2(a)	Use $P(A \cap B') = P(B') \times P(A B') = \left[\left(1 - \frac{7}{10} \right) \times \frac{2}{3} \right]$	M1	soi
	$P(A \cap B') = \frac{1}{5}$	A1	
	Use $P(A \cap B) = P(A) - P(A \cap B') = \left[\frac{1}{2} - \frac{1}{5} \right]$	M1	Using their $\frac{1}{5}$
	$P(A \cap B) = \frac{3}{10}$	A1	

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Question	Answer	Marks	Guidance
2(b)	Use $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $\left[= \frac{1}{2} + \frac{7}{10} - \frac{3}{10} \right]$	M1	Use their $\frac{3}{10}$
	$\frac{9}{10}$	A1ft	ft for their $\frac{3}{10}$ only if $0 < P(A \cup B) < 1$ $\frac{12}{10} - P(A \cap B)$
2(c)	A and B not mutually exclusive, as $P(A \cap B) \neq 0$ or $P(A \cup B) \neq P(A) + P(B)$	B1ft	ft their answer to 2(a) A and B can both occur, A and B not mutually exclusive; allow $P(A \cap B) > 0$; allow $A \cap B$ exists. Must give a reason If more than one reason, then all must be correct

Question	Answer	Marks	Guidance
3(a)	$p + q = 0.35$	B1*	Allow $0.25 + p + q + 0.4 = 1$
	$2p + 4q + 2.4 = 3.5$	B1*	
	Solve for p or q	M1dep	Dependent on both B marks If using calculator to solve, must get one value correct
	$p = 0.15$ and $q = 0.2$	A1	oe
3(b)	Attempt $E(X^2) - 3.5^2$	M1	Using their p and q with at least 2 of the 4 terms of $E(X^2)$ correct
	5.95	A1	If 0 marks scored SCB1 for $E(X^2)=18.2?$

Question	Answer	Marks	Guidance
4(a)	1.282 seen	B1	Allow 1.281
	Equate $\pm\left(\frac{7-\mu}{1.8}\right)$ to their ± 1.282	M1	
	$\mu = 4.69$	A1	Awrt 4.69
4(b)	Standardise 3 as $\pm\left(\frac{3-\mu}{1.8}\right)$	M1	-0.9388... -0.9402... (from use of 4.6924)
	Get 0.174	A1	0.173 from use of 4.6924

Question	Answer	Marks	Guidance
5(a)(i)	11!	B1	
	Attempt to use repetitions by dividing their 11! $\left[\frac{11!}{2! \times 2! \times 3!}\right]$	M1	See at least two of 2!, 2! and 3!
	1663200	A1	
5(a)(ii)	Attempt all vowels together	M1	Consider arranging 8 things E.g. $\frac{8!}{2! \times 3!}$
	Get $\frac{4!}{2!} \times \frac{8!}{2! \times 3!} = 40320$	A1	

Question	Answer	Marks	Guidance
5(b)	$\frac{3}{11} \times \frac{1}{10} \times \frac{1}{9} \times \frac{2}{8}$ $\frac{7!}{11!}$ Or $\frac{2! \times 2!}{11!}$	M1	Attempt with denominators correct and at least 2 numerators correct including 2 or 3. Denominators may be ${}^{11}P_4$
	Their attempt $\times 4!$	M1	
	$\frac{144}{7920} = \frac{6}{330} = \frac{1}{55}$	A1	Allow 0.0182
Alternative method for question 5(b)			
	Denominator as total number of choices ${}^{11}C_4$	M1	330
	Numerator as number of ways of choosing letters ${}^3C_2 \cdot (1.1.)^2 C_1$ $= 3(\times 1 \times 1) \times 2$	M1	6
	$\frac{6}{330} = \frac{1}{55}$	A1	Allow 0.0182

Question	Answer	Marks	Guidance
6(a)(i)	Use B(20, 0.03)	B1	Implied by one correct probability of the form $\binom{20}{r}(1-0.03)^r(0.03)^{20-r}$ for $r = 18, 19$ or 20
	Sum correct 3 binomial probabilities	M1	
	0.979	A1	SCB1 if M1 not scored
6(a)(ii)	Use B(5, 0.979)	B1ft	ft their 0.979
	Attempt $\binom{5}{3}(0.979)^3(1-0.979)^2$	M1	
	0.00414	A1	Allow 0.0041 SCB1 if M1 not scored
6(b)	Obtain $(1-0.03)^n = 0.1$	B1	oe, e.g. $(1-0.03)^n \leq 0.1$, $(1-0.03)^n < 0.1$ Allow with wrong inequality
	Get $n = 75.5(9\dots\dots)$	B1	Soi; Allow $n \geq 75.5(9\dots\dots)$; $n > 75.5(9\dots\dots)$ If T&I, both $n = 75$ $\left[(1-0.03)^{75} = 0.1018\dots \right]$ and $n = 76$ $\left[(1-0.03)^{76} = 0.09877\dots \right]$ stated correctly. Allow with wrong inequality
	Least $n = 76$	B1	Allow $n \geq 76$; from correct work

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Question	Answer	Marks	Guidance
7	$R = 8g \cos 30$	B1	$40\sqrt{3}$
	Attempt to resolve parallel to the plane	M1*	3 terms, allow sin/cos mix, allow sign errors
	$F + 25 = 8g \sin 30$	A1	$F = 15$
	Use $F = \mu R$ to get an equation in μ only	M1dep	R a component of $8g$
	$\mu = \frac{\sqrt{3}}{8}$	A1	awrt 0.217

Question	Answer	Marks	Guidance
8	Use N2L at least once	M1	4 terms
	Particle A : $T + 0.3g - 0.8 = 0.3a$	A1	One equation correct
	Particle B : $0.5g - T - 0.6 = 0.5a$	A1	Second equation correct
	System: $0.8g - 0.6 - 0.8 = 0.8a$		
	Solve simultaneously for a or T or system equation for a	M1	From equation(s) with correct number of relevant terms; Allow if g missing.
	$a = 8.25 \text{ ms}^{-2}$	A1	
	$T = 0.275 \text{ N}$	A1	

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Question	Answer	Marks	Guidance
9(a)	$V = 8$	B1	
9(b)	$s = \frac{1}{2}(8+5)0.6$	M1	Complete method to find depth, using their $V = 8$. Using area or constant acceleration.
	3.9 m	A1ft	ft their V , $s = 1.5 + 0.3V$
9(c)	Method to find deceleration $a = \pm \frac{5-8}{0.6}$	M1*	Gradient or constant acceleration, using their $V = 8$
	$a = \pm 5$	A1	May have found deceleration in (b) , only award mark(s) if used/quoted here.
	$mg - 6 = ma$	M1dep	Use N2L with their negative a , 3 terms
	$m = 0.4 \text{ kg}$	A1	

Question	Answer	Marks	Guidance
10(a)	$0 = 4 \times 45 \sin \theta - \frac{1}{2} \times 10 \times 4^2$ or $0 = 45 \sin \theta - 10 \times 2$	M1*	Use $s = ut + \frac{1}{2}at^2$ with $s = 0, a = -g, t = 4$ or $v = u + at$ with $v = 0, a = -g, t = 2$ both with a component of 45.
	Solve for θ	M1dep	
	$\theta = 26.4$	A1	
	$PQ = 45 \cos \theta \times 4 = 161 \text{ m}$	B1	
	Alternative method for question 10(a)		
	Use time of flight $T = \frac{2u \sin \theta}{g}$	M1*	Use with $u = 45$ and $T = 4$
	Solve for θ	M1dep	
	$\theta = 26.4$	A1	
	$PQ = 45 \cos \theta \times 4 = 161 \text{ m}$	B1	
	10(b)	$0 = (45 \sin \theta)^2 - 2 \times 10 \times s$ or $s = 2 \times 45 \sin \theta - \frac{1}{2} \times 10 \times 2^2$	M1
20(.0) m		A1	

Question	Answer	Marks	Guidance
10(c)	Attempt velocity at point when at 10°	M1*	Expect $\frac{45\cos\theta}{\cos 10}$ allow sin/cos mix on θ , allow sin/cos mix on 10
	Get vertical component = $45\cos 26.4 \times \tan 10$	A1ft	ft their 26.4; 7.10796... ; allow to 2sf
	Method to find total time	M1dep	E.g. $0 = \text{their } 7.107\dots - 10t \rightarrow t = 0.7107\dots, T = 2t$
	1.42 s	A1	
	Alternative method for question 10(c)		
	Attempt velocity at point when at 10°	M1*	Expect $\frac{45\cos\theta}{\cos 10}$ allow sin/cos mix on θ , allow sin/cos mix on 10
	Get 40.9(331...)	A1	allow to 2sf
	Use time of flight $\frac{2u \sin 10}{g}$	M1dep	Using their 40.9
1.42 s	A1		

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Question	Answer	Marks	Guidance
11(a)	Use conservation of momentum	M1*	Allow sign errors, 3 terms
	$(m)u = -(m)v_A + 3(m)v_B$	A1	They may have v_A and/or v_B in different directions to those shown here
	Use NEL	M1*	Allow sign errors,
	$v_A + v_B = eu$	A1	oe, allow sign errors Must be consistent v_A and/or v_B with those seen in momentum equation. If inconsistent then M1A1M1A0 max 3/4
	Solve for v_A or v_B	M1dep	Dependent on previous 2 M's
	$v_A = \frac{u}{4}(3e - 1)$	A1	or 2 term simplified equivalent
	$v_B = \frac{u}{4}(1 + e)$	A1	Must be positive; or 2 term simplified equivalent

Question	Answer	Marks	Guidance
11(b)	Use $v_A > 0$ to clearly get $e > \frac{1}{3}$	B1	
	$v'_B = \frac{u}{8}(1+e)$	B1ft	ft their v_B , $v'_B = \frac{1}{2} \times$ their v_B
	Use $v'_B > v_A$ to get inequality in u and e	M1*	oe
	Attempt to solve inequality for e	M1dep	
	Clearly get $e < \frac{3}{5}$	A1	