Cambridge Pre-U

MATHEMATICS **9794/03**

Paper 3 Applications of Mathematics **October/November 2020**

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.

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This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **11** printed pages.

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)	Attempt $P(A)\times P(B\mid A)=0.6\times 0.4=0.24$	**B1**	
1(b)	Attempt $P(A)+P(B)-P(A\cap B)=0.6+0.3-\text{their}\,0.24$	**M1**	$\text{their}\,0.24<0.3$
	0.66	**A1ft**	ft their 0.24
1(c)	Attempt $P(A'\cap B)=0.3-\text{their}\,0.24$	**M1**	$\text{their}\,0.24<0.3$; may be seen on a diagram
	Attempt $\dfrac{P(A'\cap B)}{P(B)}$	**M1**	Using $\dfrac{\text{their}\,P(A'\cap B)}{0.3}$
	0.2	**A1ft**	ft their 0.24

Question	Answer	Marks	Guidance
2(a)	Either ${}^6C_4$ or ${}^9C_4$ seen	**M1**	15 or 126
	15 + 126 = 141	**A1**	
2(b)	Identify 2 cases ONLY as 2W+2M or 3W+1M	**M1**	May be implied
	Either ${}^6C_2\times{}^9C_2$ or ${}^9C_3\times{}^6C_1$	**M1**	15×36 or 84×6
	540 + 504 = 1044	**A1**	

Question	Answer	Marks	Guidance
3(a)	$\overline{x} = 1.9$ and $\overline{y} = 2.64$	**B1**	No ISW
3(b)	$S_{xx} = 3.3$	**B1**	
	$S_{xy} = \dfrac{4}{15} \times "3.3"$	**B1ft**	Expect 0.88
	Use of $\sum xy - \dfrac{19 \times 26.4}{10} = "0.88"$ to find $\sum xy$	**M1**	
	51.04	**A1**	Allow 51(.0)

Question	Answer	Marks	Guidance
4	$np = 12.8$	**B1**	
	$np(1 - p) = 1.6^2$ or $npq = 1.6^2$	**B1**	oe
	Solve for p or q	**M1**	
	$p = 0.8$ and $n = 16$	**A1**	
	Attempt at binomial for $P(X = 14)$	**M1**	Using their n and p
	$P(X = 14) = 0.211$	**A1**	Awrt 0.211

Question	Answer	Marks	Guidance
5(a)(i)	Standardise 28 as $\dfrac{28-25}{2}$	**M1**	
	Use tables to get 0.933	**A1**	

Question	Answer	Marks	Guidance
5(a)(ii)	$P(X \leqslant 26) - P(X \leqslant 24) = P(Z \leqslant 0.5) - P(Z \leqslant -0.5)$	**M1**	A difference found from standardising 26 and 24
	$0.6915 - (1 - 0.6915)$	**M1**	
	0.383	**A1**	
5(b)	1.282	**B1**	Allow 1.3
	$\frac{29-26}{\sigma} = \text{their}\,1.282$	**M1**	Must be attempt at $\Phi^{-1}(0.9)$ not just 0.9
	$\sigma = 2.34$	**A1**	2.340093604
5(c)	Attempt $P(Y<28)$ as $\Phi\left(\frac{28-26}{\text{"}2.34\text{"}}\right) = \Phi(0.855)$	**M1**	Expect 0.8037; may only look at $\frac{28-26}{\text{"}2.34\text{"}}$ and compare with $\frac{28-25}{2} = 1.5$
	Route *R*	**A1ft**	ft on their 2.34, ft their answer to **(a)(i)**
	OR		
	As $P(S > 29) = 0.1$, so $P(S < 29) = 0.9$, hence $P(S < 28) < 0.9$ and compare with answer to **(a)(i)**	**(M1)**	
	Route *R*	**(A1ft)**	ft their answer to **(a)(i)**

Question	Answer	Marks	Guidance
6(a)	Attempt at geometric	**M1**	Expect $0.4^3 \times 0.6$
	$\frac{24}{625}$ or 0.0384	**A1**	

Question	Answer	Marks	Guidance
6(b)(i)	$0.7 \times 0.6 = 0.42$	**B1**	
6(b)(ii)	$0.7 \times 0.4 \times 0.7 \times 0.6$	**M1**	
	0.1176	**A1**	
6(b)(iii)	Recognise sum of a GP	**M1**	See at least 3 terms
	Use S_∞ with $a = 0.42$ and $r = 0.28$	**M1**	
	0.583	**A1**	Accept $\frac{7}{12}$; allow from repeated addition

Question	Answer	Marks	Guidance
7	$R = 0.2g\cos 20$	**B1**	
	Attempt at N2L parallel to plane	**M1**	3 terms
	$0.2g\sin 20 - F = 0.2 \times 0.8$	**A1**	$F = 0.52404$……..
	Use $F = \mu R$	**M1**	R a component of $0.2g$, F from a 3 term equation
	$\mu = 0.279$	**A1**	0.278836015

Question	Answer	Marks	Guidance
8(a)	Attempt conservation of linear momentum	**M1**	Allow with sign errors
	$3v_A + 4v_B = 3 \times 2 - 4 \times 1$	**A1**	
	Attempt at NEL	**M1**	Allow with sign errors
	$\frac{v_A - v_B}{2-(-1)} = -0.75$	**A1**	check for consistency between NEL and CoLM
	Solve for v_A and v_B	**M1**	
	Get speed of A as 1 m s^{-1}	**A1**	Cwo; Must be positive
	and B as 1.25 m s^{-1}	**A1**	
8(b)	$3\times(2+1)\text{or}4\times(1+1.25)$	**M1**	Attempt at change in momentum of either particle
	9 Ns	**A1**	Must be positive. Cwo, do not ISW if find 2 values and combine.

Question	Answer	Marks	Guidance
9(a)	Attempt to differentiate v	**M1**	
	Get $a = \frac{3}{\sqrt{t}} - 2$	**A1**	oe
	Solve $a = 0$ for t and substitute into v	**M1**	$t = 2.25$
	4.5 m s^{-1}	**A1**	

Question	Answer	Marks	Guidance
9(b)	Attempt to integrate v	**M1**	
	Get $4t^{\frac{3}{2}} - t^2\,(+c)$	**A1**	oe
	Use limits 0 and 4 correctly	**M1**	Or gets $c = 0$ (may be implied) and substitutes $t = 4$
	Get 16 m	**A1**	

Question	Answer	Marks	Guidance
10(a)	Use N2L on either particle or use system equation	**M1**	
	$T - 3g = 3 \times 2$	**A1**	If system equation then A2, allow A1 for one error
	$mg - T = 2m$	**A1**	$mg - 3g = 2(m + 3)$
	Eliminate T	**M1**	Solve for m or evaluate T and substitute Equations must have correct number of correct terms
	$m = 4.5$	**A1**	
10(b)	$v = 2 \times 0.5$ (= 1)	**B1**	Allow -1
	$s = ½ \times 2 \times 0.5^2$ (= 0.25)	**B1**	Allow -0.25
	Use $v^2 = u^2 + 2as$ to find v	**M1**	$u \neq 0$ u = -cv(1), a = 10, s = 1.5 + cv(0.25) OR u = cv(1), a = -10, s = -[1.5 + cv(0.25)] Complete method to find v
	$v = 6\text{ m s}^{-1}$	**A1**	

Question	Answer	Marks	Guidance
11(a)	$25\cos\alpha(t) = 14\cos 60(t)$	**M1**	Use horizontal displacement or velocity equal
	Get $\cos\alpha = \frac{7}{25}$	**A1**	**AG**
11(b)	For P, $s_P = 14\sin 60t - \frac{1}{2}.10.t^2$	**B1**	
	For Q, $s_Q = 25\sin\alpha t - \frac{1}{2}.10.t^2$	**B1**	Either $\sin\alpha$ substituted or $\alpha = 73.7$ substituted
	Attempt to use $s_P + 40 = s_Q$	**M1***	Allow sign error, s_P and s_Q coming from a reasonable attempt at constant acceleration to find expressions for distance
	Solve for t	**M1dep***	
	Get t = 3.3(68238….)	**A1**	Allow 3.369619….. ; awrt 3.4 from correct work
	Use $v = u + at$ for Q to find a numerical expression for v	**M1dep***	$v = 25\sin\alpha - 10\times 3.3(68238\ldots) = -9.6(8233\ldots)$ $25\sin 73.7 - 10\times 3.3(696\ldots) = -9.7(0106\ldots)$
	(Negative velocity) so Q falling	**A1**	v need not be evaluated for this mark; cwo
	OR For last 2 marks		
	Complete method to find t for Q at max height	**(M1)**	Expect t = 2.4 or 2.39951323 (from $\alpha = 73.7$)
	2.4 < 3.3 so meet after Q at max point, so Q falling	**(A1**	

Question	Answer	Marks	Guidance
11(b)	**OR**		
	Complete method to find t for Q at max height	**(M1*)**	Eg $0 = 25\sin\alpha - 10t$
	Get $t = 2.4$	**(A1)**	2.39951323 (from $\alpha = 73.7$)
	Attempt $s_P = 14\sin 60 \times 2.4 - \frac{1}{2} \times 10 \times (2.4)^2$ Or $s_Q = 25\sin\alpha \times 2.4 - \frac{1}{2} \times 10 \times (2.4)^2$	**(M1dep*)**	May use $0 = (25\sin\alpha)^2 - 2gs_Q$ for M1 (not dependent) either $\sin\alpha$ substituted or $\alpha = 73.7$ substituted
	Get $s_P = 0.29(84535672)$	**(A1)**	0.3042330906 (from $\alpha = 73.7$)
	Get $s_Q = 28.8$	**(A1)**	28.7883187
	Compare $s_P + 40$ with s_Q	**(M1dep*)**	
	$(s_P + 40 > s_Q)$ so Q falling	**(A1)**	cwo