Cambridge Pre-U

MATHEMATICS **9794/01**

Paper 1 Pure Mathematics 1 **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.

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This document consists of **13** 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	Mid-point of *AB* is (4, 6)	**B1**	Identify correct mid-point
	Length of *AB* is $\sqrt{6^2+8^2}$	**M1**	Attempt length of diameter, or of radius
	= 10	**A1**	Obtain diameter as 10, or radius as 5
	$(x-4)^2+(y-6)^2=25$	**A1FT**	Obtain correct equation of circle, following their mid-point and length *AB*

Question	Answer	Marks	Guidance
2(a)	$k^2-4\times1\times(2k-3)$	**M1**	Attempt b^2-4ac Must be just discriminant and not part of quadratic formula
	$k^2-8k+12$	**A1**	Obtain $k^2-8k+12$, or $k^2-4(2k-3)$
2(b)	$k^2-8k+12>0$	**B1FT**	Their discriminant > 0 soi Must be attempt at just discriminant
	$(k-2)(k-6)>0$	**M1**	Attempt to solve their quadratic from attempt at discriminant
	$k<2,\ k>6$	**A1**	Critical values of 2 and 6 seen
		A1FT	Correct inequality FT their distinct roots

Question	Answer	Marks	Guidance
3(a)	$\sqrt{27} = 3\sqrt{3}$	B1	Soi at any stage
	$8 + 12\sqrt{3} + 10\sqrt{3} + 45$	M1	Attempt to expand brackets – allow unsimplified terms Detail needed to justify non-calculator solution
	$53 + 22\sqrt{3}$	A1	Obtain $53 + 22\sqrt{3}$
3(b)	$\dfrac{12(3-2\sqrt{3})}{(3+2\sqrt{3})(3-2\sqrt{3})}$	M1	Attempt to rationalise denominator Detail needed to justify non-calculator solution
	$\dfrac{12(3-2\sqrt{3})}{9-12}$	A1	Either numerator or denominator correct
	$-12 + 8\sqrt{3}$	A1	Obtain $-12 + 8\sqrt{3}$

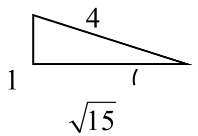
Question	Answer	Marks	Guidance
4(a)	segment area = $\frac{1}{2}r^2(1.4 - \sin 1.4)$	B1	Correct sector area
		B1	Correct triangle area
	$r^2 = 57.894$ $r = 7.609$	M1	Attempt to find r from $\left(\frac{1}{2}\right)r^2\theta - \left(\frac{1}{2}\right)r^2\sin\theta$ Allow BOD if using 1.4π not 1.4
		A1	Obtain $r = 7.609$ or better

Question	Answer	Marks	Guidance
4(b)	arc length = 1.4 × 7.61 = 10.65 (cm)	**M1**	Attempt arc length
	chord length = 2 × 7.61 × sin0.7 = 9.80 (cm)	**M1**	Attempt chord length – could use cosine rule
	perimeter = 20.5 (cm)	**A1**	Obtain 20.5 Condone no units

Question	Answer	Marks	Guidance
5	Vol = $\pi\int(e^{2x}+1)^2\,dx$	**B1**	State or imply correct volume
	$\pi\int(e^{4x}+2e^{2x}+1)dx$	**M1**	Expand brackets and attempt integration of 3 term expression
	$=\pi\left(\frac{1}{4}e^{4x}+e^{2x}+x\right)$	**A1**	Obtain correct integral (condone no π)
	$\pi\left[\left(\frac{1}{4}e^{8}+e^{4}+2\right)-\left(\frac{1}{4}+1\right)\right]$	**M1**	Attempt use of limits – correct order and subtraction
	$=\pi\left(\frac{1}{4}e^{8}+e^{4}+\frac{3}{4}\right)$	**A1**	Obtain correct answer – any exact 3 term or factorised equiv

Question	Answer	Marks	Guidance
6(a)	u_{20} = 4 + 19 × 3 = 61	**M1**	Attempt u_{20} using 4 + 19 × 3
	v_{20} = 1200×0.8^{19} = 17.29…	**M1**	Attempt v_{20} using 1200×0.8^{19}
	61 – 17.3 = 43.7	**A1**	Obtain 43.7

Question	Answer	Marks	Guidance
6(b)	$\sum_1^\infty v_n = \frac{1200}{1-0.8}$	**B1**	Correct sum to infinity stated
	$\sum_1^N u_n = \frac{1}{2}N(8+(N-1)\times 3)$	**B1**	Correct S_N stated
	$N(3N+5) > 12000$ $3N^2 + 5N - 12000 > 0$	**M1***	Link S_N to S_∞ (any sign) and attempt to rearrange Must be attempt at S_N and not u_N
		A1	Obtain correct three term quadratic
	$N = 62.4\ldots$	**M1dep***	Attempt to solve quadratic
	hence $N = 63$	**A1**	Obtain $N = 63$ (must be equality in words or symbol) A0 if negative root also given (– 64.08…)

Question	Answer	Marks	Guidance
7(a)	 OR $\cos^2\theta = 1 - \left(\frac{1}{4}\right)^2$	**M1**	Either use right-angled triangle or identity M0 if going via decimals on calculator SR B1 for verifying $\left(\frac{1}{4}\right)^2 + \left(\frac{\sqrt{15}}{4}\right)^2 = \frac{1}{4} + \frac{15}{4} = 1$
	hence $\cos\theta = \frac{\sqrt{15}}{4}$ **AG**	**A1**	Obtain $\cos\theta = \frac{\sqrt{15}}{4}$ convincingly
7(b)	$\cos\theta\cos 30 + \sin\theta\sin 30$ $\frac{\sqrt{15}}{4}\times\frac{\sqrt{3}}{2}+\frac{1}{4}\times\frac{1}{2}$	**M1**	Substitute numerical values into correct expansion M0 if $\cos\frac{\sqrt{15}}{4}$ not $\cos\theta = \frac{\sqrt{15}}{4}$
	$\frac{3\sqrt{5}+1}{8}$	**A1**	Obtain $\frac{3\sqrt{5}+1}{8}$, or any exact equiv

Question	Answer	Marks	Guidance
7(c)	$\text{cosec}\,2\theta = \frac{1}{\sin 2\theta}$	**B1**	State or imply that $\text{cosec}\,2\theta = \frac{1}{\sin 2\theta}$ (could be with numerical values)
	$\sin 2\theta = 2\sin\theta\cos\theta$ $= 2\times\frac{1}{4}\times\frac{\sqrt{15}}{4}$	**M1**	Substitute numerical values into correct expansion for $\sin 2\theta$
	$\text{cosec}\,2\theta = \frac{8}{15}\sqrt{15}$	**A1**	Obtain $\frac{8}{15}\sqrt{15}$, or any exact equiv

Question	Answer	Marks	Guidance
8(a)	quotient is $3x^2 - 4x + 1$	**B1**	Obtain $3x^2$ as first term of quotient
		M1	Attempt complete method for division Allow any complete method such as coefficient matching, grid method, synthetic division or inspection
		A1	Obtain correct quotient
	remainder is $6x + 12$ **AG**	**A1**	Obtain correct remainder, from correct method

Question	Answer	Marks	Guidance
8(b)	$\dfrac{3x^4+8x^3-24x^2+22x+9}{x^2+4x-3}=3x^2-4x+1+\dfrac{6x+12}{x^2+4x-3}$	**B1FT**	Recognise integrand, following their quotient
	$\int \mathrm{f}(x)\mathrm{d}x = x^3-2x^2+x+3\ln(x^2+4x-3)$	**M1***	Obtain integral involving $k\ln(x^2+4x-3)$, from attempt to integrate correct fraction
		A1FT	Obtain fully correct integral, following their quadratic quotient
	(27 – 18 + 3 + 3ln18) – (1 – 2 + 1 + 3ln2)	**M1dep***	Attempt correct use of limits
	12 + 6ln3 or 12 + 3ln9 or 12 + ln729	**A1**	Obtain any correct answer in the form $a+b\ln c$

Question	Answer	Marks	Guidance
9(a)	$1+2\lambda=4+\mu$ $6+\lambda=9+2\mu$	**M1**	Set up two equations and attempt to solve simultaneously to find at least λ or μ
	$\lambda=1,\ \mu=-1$	**A1**	Obtain $\lambda=1,\ \mu=-1$
	$4+1\times a=4+(-1)\times b$	**M1**	Use their λ and μ in third equation
	$a+b=0$ **A.G.**	**A1**	Obtain $a+b=0$

Question	Answer	Marks	Guidance
9(b)	$2 + ab + 2 = \sqrt{a^2+5}\times\sqrt{b^2+5}\times\frac{1}{2}$	**B1**	Correct (unsimplified) ***a*.*b*** soi
		M1	Attempt scalar product, using direction vectors
		A1	Obtain correct (simplified) equation, with $\frac{1}{2}$ not cos60°
	$8 - 2a^2 = \sqrt{a^2+5}\times\sqrt{a^2+5}$ $3a^2 = 3 \Rightarrow a^2 = 1 \Rightarrow a = \pm 1$	**M1**	Attempt to obtain (and solve) equation in a single variable
	$a = 1, b = -1$ and $a = -1, b = 1$	**A1**	Obtain $a = 1$, $b = -1$ and $a = -1$, $b = 1$ May also see $\pm\sqrt{13}$, from 120°

Question	Answer	Marks	Guidance
10	$\frac{\mathrm{d}P}{\mathrm{d}t} = k(3P+50)^{\frac{1}{3}}$	**B1**	State correct differential equation
	$\int (3P+50)^{-\frac{1}{3}}\mathrm{d}P = kt + c$	**M1**	Separate variables and attempt to integrate LHS to obtain $A(3P+50)^{\frac{2}{3}}$
	$\frac{1}{2}(3P+50)^{\frac{2}{3}} = kt + c$	**A1**	Obtain $\frac{1}{2}(3P+50)^{\frac{2}{3}}$
	$\frac{1}{2}(125)^{\frac{2}{3}} = 0k + c$ $\frac{1}{2}(512)^{\frac{2}{3}} = 13k + c$	**M1**	Substitute $t = 0$, $P = 25$ and $t = 13$, $P = 154$ into an equation involving k and c Must use both pairs of values, or equiv using limits
		M1	Attempt to find k and c Must attempt both k and c – either in sequence or simultaneously depending on position of k
	$k = 1.5$, $c = 12.5$	**A1**	Obtain correct values for k and c
	$P = \frac{1}{3}\left((3t+25)^{\frac{3}{2}} - 50\right)$	**A1**	Obtain correct equation aef

Question	Answer	Marks	Guidance
11(a)	$\frac{\mathrm{d}x}{\mathrm{d}t} = \frac{-2}{t^2}$	B1	Correct $\frac{\mathrm{d}x}{\mathrm{d}t}$
	$\frac{\mathrm{d}y}{\mathrm{d}t} = \frac{3-2t}{3t-t^2}$	B1	Correct $\frac{\mathrm{d}y}{\mathrm{d}t}$
	$\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{-t^2(3-2t)}{2(3t-t^2)}$	M1	Attempt $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{\mathrm{d}y}{\mathrm{d}t} \times \frac{\mathrm{d}t}{\mathrm{d}x}$
	$t^2(3-2t) = 0 \Rightarrow t = 0, t = \frac{3}{2}$ $t = 0$ not valid, so $t = \frac{3}{2}$	M1	Equate derivative to 0 and attempt to solve for t – must involve two term numerator (could instead solve $\frac{\mathrm{d}y}{\mathrm{d}t} = 0$)
		A1	Obtain $t = \frac{3}{2}$ www
	hence stationary point is $\left(\frac{1}{3}, \ln\frac{9}{4}\right)$	A1	Obtain correct coordinates – any exact equiv www

Question	Answer	Marks	Guidance
11(b)	$\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)=\frac{(4t-3)(6-2t)-(2t^2-3t)(-2)}{(6-2t)^2}$	**M1**	Attempt use of quotient rule – correct order and subtraction in numerator
	$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=\frac{(4t-3)(6-2t)-(2t^2-3t)(-2)}{(6-2t)^2}\times\frac{-t^2}{2}$	**M1***	Attempt use of $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=\frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}y}{\mathrm{d}x}\right)\times\frac{\mathrm{d}t}{\mathrm{d}x}$
	$\frac{\mathrm{d}^2y}{\mathrm{d}x^2}=\frac{3\times3-0}{3^2}\times\frac{-1.5^2}{2}=-\frac{9}{8}$	**M1dep***	Substitute their t into attempt at second derivative
		A1	Obtain $-\frac{9}{8}$
	$-\frac{9}{8}<0$ hence stationary point is a maximum	**A1**	Conclude appropriately CWO