UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9794 MATHEMATICS

9794/03 Paper 3 (Applications of Mathematics), maximum raw mark 80

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 must be read in conjunction with the question papers and the report on the examination.

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UNIVERSITY of CAMBRIDGE
International Examinations

1	Obtain 154.3 Attempt standard deviation formula Obtain $\sqrt{\left(\frac{239093}{10}-(154.3)^2\right)}=\sqrt{100.81}$ Obtain 10.0(4)	B1 M1 A1 A1 [4]	**[4]**	With no working shown allow only correct answers. 154 used for sd (gives 13.9…) gets max M1A1A0. Allow unbiased estimator (10.58 …) for full marks.
2 (i)	State Geometric	B1 [1]		
(ii)	Attempt $\left(\frac{4}{5}\right)^2\left(\frac{1}{5}\right)$ Obtain $\frac{16}{125}=0.128$	M1 A1 [2]		SC When $p=\frac{1}{4}$ used, allow max M1A0.
(iii)	Attempt $\frac{1}{5}+\left(\frac{4}{5}\right)\left(\frac{1}{5}\right)$ Or $1-\left(\frac{4}{5}\right)^2$ Obtain $\frac{9}{25}=0.36$	M1 A1 [2]	**[5]**	SC When $p=\frac{1}{4}$ used, allow max M1A0.
3	Use of $z=\frac{x-\mu}{\sigma}$ Use $\sigma=6$ and $\mu=160$ Obtain $z=1.667$ Obtain 0.952	M1 B1 A1 A1 [4]	**[4]**	Accept 0.9522, 0.9521 but not 0.9515 or 0.9525
4 (i)	Recognise combination problem Obtain 3060	M1 A1 [2]		
(ii)	Obtain 5	B1 [1]		
(iii)	State or imply Bin(20, 0.05) Attempt P($X<5$) via cumulative tables or P($X=0$) + P($X=1$) +..... +P($X=4$) Obtain 0.997(4)	B1 M1 A1 [3]	**[6]**	"1 – this" gets M0A0

5 (i)	Their product of three fails (0.55 × 0.4 × 0.85) Obtain 0.187	M1 A1 [2]		
(ii)	Attempt P(F)P(S) (0.55 × 0.6 = 0.33) Attempt P(F)P(F)P(S) (0.55 × 0.4 × 0.15 = 0.033) Or 1 – (0.45 + **(i)**) Obtain 0.363	M1 M1 A1 [3]		 ft **(i)** if appropriate.
(iii)	Use P(S) + answer to **(ii)** Or 1 – **(i)** Obtain 0.813	M1 A1 [2]		 ft **(i)** or **(ii)** as appropriate.
(iv)	Attempt to divide two probabilities Divide their P(F)P(S) by their **(iii)** Obtain 0.406 or (110/271)	M1 M1 A1 [3]	**[10]**	 ft **(iii)**.
6 (i)	Table shows (–1, 0.7) (0, 0.25) and (9, 0.05)	B1 B1 [2]		SC For (0, 1, 10) allow max B1B0.
(ii)	Use E(X) formula Obtain –0.25 AG Use E(X^2) formula Obtain 4.69 or $\left(\frac{75}{16}\right)$	M1 A1 M1 A1 [4]		If wrong dist^n used (0, 1, 10) then max M1A0 (including when cand subtracts 1 subsequently (AG)). If wrong dist^n used (0, 1, 10) then max M1A0.
(iii)	Use 10 + 10E(X) Obtain 10 + 10(–0.25) = 7.5	M1 A1 [2]		 Do not ISW if cand rounds answer (to 7 or 8)
(iv)	P(Must win at least one game) State $(0.25)^{10}$ Obtain $1 - (0.95)^{10} + (0.25)^{10} = 0.401$ $(0.25)^{10}$ must be seen in the final calculation though it does not affect the value of 0.401 OR $1 - \sum_{r=0}^{r=9}\left({}^{10}C_r\, 0.7^{10-r} 0.25^r\right)$ = 1 – 0.59873… = 0.401(26…)	M1 B1 A1 [3] M1 A1 A1	**[11]**	 Summation of attempt at relevant terms. All terms correct.

7 (i)	Attempt to find component $15\cos 60 = 7.5$N	M1 A1 [2]		Allow sin/cos error. Accept any correct (unsimplified) form.
(ii)	$15\sin 60 = \frac{15}{2}\sqrt{3} = 13.0$N to 3 sf	B1 [1]		Allow consistent sin/cos error. Accept any correct (unsimplified) form.
(iii)	Use Pythagoras, or cosine rule Obtain magnitude $\sqrt{475} = 5\sqrt{19} = 21.8$N to 3 sf Use inverse tan, or sine rule Obtain angle 36.6° to 3sf	M1 A1 M1 A1 [4]	**[7]**	 c.a.o. c.a.o.
8	The equation of motion is $T - 20g = 20a$ Using 'suvat', assuming zero initial speed: $10 = 0 + 0.5a \times 4^2$ $a = 1.25\,\text{ms}^{-2}$ $T = 225$	B1 M1 A1 A1 [4]	**[4]**	
9 (i)	Resolving perpendicular to the slope $R = 100\cos 35 = 81.9152\ldots$N So Max Friction = $\mu R = 16.38\ldots$N	M1 A1 [2]		
(ii)	Resolving parallel to the slope (friction down the slope) $P = 100\sin 35 + 16.38\ldots = 73.74\ldots$	M1 A1 [2]		
(iii)	(friction up the slope) $P = 100\sin 35 - 16.38\ldots = 40.97\ldots$	M1 A1 [2]	**[6]**	
10 (i)	COM: $1 \times 14 + 2 \times 0 = U + 2V$ NEL: $V - U = 0.5(14 - 0)$ Solution: $U = 0\,\text{ms}^{-1}$, $V = 7\,\text{ms}^{-1}$.	B1 B1 B1 B1 [4]		 Depends on 2nd B1. SC If NEL is $V + U = \ldots$ then max B1B0B0B1.
(ii)	For impact of B on C: COM: $2 \times 7 + 5 \times 0 = 2U + 5V$ NEL: $V - U = 0.5(7 - 0)$ Solution: $U = -0.5\,\text{ms}^{-1}$	 B1 B1 B1 [3]		
(iii)	$V = 3\,\text{ms}^{-1}$ B reaches A in 2 seconds. Distance between A and C is $1 + 2 \times 3 = 7$ metres	B1 B1 B1 [3]	**[10]**	May be seen/awarded in **(ii)**. ft their U. ft their V.

11 (i)	Acceleration parallel to the slope is $-g\cos 60 = -5\,\text{ms}^{-2}$	B1			
	Use 'suvat': $10 = 20t + 0.5(-5)t^2$	M1			Any appropriate 'suvat' used.
		A1			Correct equation.
	Solve quadratic $t^2 - 8t + 4 = 0$				
	Obtain $4 - \sqrt{12}$ $(= 4 - 2\sqrt{3} = 0.536$ seconds)	A1			Correct outcome.
	Initial speed of projectile is	M1			2^{nd} appropriate 'suvat' used.
	$20 - 5(4 - 2\sqrt{3}) = 10\sqrt{3}$ $(=17.32\,\text{ms}^{-1})$	A1	[6]		Correct outcome.
(ii)	For the vertical motion, the particle strikes the ground when				
	$-5 = 10\sqrt{3}\sin 30t + 0.5(-10)t^2$	M1			Condone sin/cos confusion.
	$t^2 - \sqrt{3}t - 1 = 0$	M1			
	Solve quadratic $t = \dfrac{\sqrt{3} + \sqrt{7}}{2}$				
	Obtain positive solution = 2.189 s	A1			
	Total horizontal distance travelled from O is given by *their* horizontal distance OA + (*their* horizontal velocity at A) × (*their* time of flight)	M1			
	$= 10\cos 30$	B1			
	$+ 10\sqrt{3}\cos 30 \times 2.189$	B1			ft their t.
	= 41.5 metres	A1	[7]	**[13]**	c.a.o.