CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge Pre-U Certificate

MARK SCHEME for the May/June 2015 series

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.

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CAMBRIDGE
International Examinations

1		$S_{xx} = 804.34 - \frac{87.6^2}{10} = 36.964$ $S_{yy} = 596 - \frac{76.4^2}{10} = 12.304$ $S_{xy} = 684.02 - \frac{87.6 \times 76.4}{10} = 14.756$ $r = \frac{S_{xy}}{\sqrt{S_{xx} \times S_{yy}}} = 0.69192... \approx 0.692$ (3sf)	M1 M1 M1 M1 A1 [5]	Correct use of formula or equivalent form. As above. As above As above. c.a.o.
2	**(a)**	$\frac{5!}{5^5} = \frac{120}{3125} = \frac{24}{625} = 0.0384$	M1 A1 [2]	Product of 5 probabilities, at least 4 correct. c.a.o. Either fraction or decimal.
	(b) (i)	$X \sim \text{Geo}\left(\frac{1}{5}\right)$	B1 [1]	Must give parameter as well as name.
	(ii)	E(X) = 5	B1 [1]	Allow $\frac{1}{\textit{their } p}$ from **(ii)**
	(iii)	$P(X \geqslant 3) = \left(\frac{4}{5}\right)^2 = \frac{16}{25} = 0.64$	M1 A1 [2]	Attempt P($X > 3$). Or equivalent methods. c.a.o. Either fraction or decimal.
3	**(i)**	$T \sim$ N(43.2, 6.3^2) Require P($T < 50$) $= P\left(Z < \frac{50 - 43.2}{6.3} = 1.079(3...)\right)$ = 0.8598	M1 M1 A1 A1 [4]	Formulate the problem. Standardising. c.a.o. Z value. From tables. Ft *their Z* value. Must involve use of difference columns.
	(ii)	$\frac{T - 43.2}{6.3} = 1.645$ $\therefore$ $T = 43.2 + 1.645 \times 6.3 = 53.56$ 60 – 53.56 = 6.44 (min) $\therefore$ Jack should leave by 08 06	M1 B1 A1 A1 [4]	Set up equation for T. 1.645 seen. c.a.o. Interpret as time of day. Accept 08 07.

4 Answers as fractions need not be fully cancelled down.

(i)

$\text{P(Same Sex)} = \left(\frac{9}{16}\times\frac{8}{15}\right)+\left(\frac{7}{16}\times\frac{6}{15}\right)$

$= \frac{114}{240} = \frac{19}{40}$ or 0.475

M1 One product with correct denominator.
M1 Add second product; same denominator.
A1 c.a.o.
[3]

(ii)

P(Same sex AND Same year)

$= \left(\frac{6}{16}\times\frac{5}{15}\right)+\left(\frac{4}{16}\times\frac{3}{15}\right)+\left(\frac{3}{16}\times\frac{2}{15}\right)+\left(\frac{3}{16}\times\frac{2}{15}\right)$

$= \frac{54}{240} = \frac{9}{40}$ or 0.225

M1 4 cases considered; sum of 4 products or terms.
A1 All correct.
A1 c.a.o.
[3]

(iii)

P(Same year GIVEN Same sex)

$= \frac{54/240}{114/240} = \frac{9}{19}$ or 0.4736

M1 Attempt a quotient of 2 probabilities, with either *their* **(i)** or **(ii)** used correctly.
A1 Quotient of $\frac{\textit{their}\ \textbf{(ii)}}{\textit{their}\ \textbf{(i)}}$
A1 Ft $\textit{their}\ \frac{\textbf{(ii)}}{\textbf{(i)}}$ provided final answer is between 0 and 1.
[3]

5 (i)

$(X\sim)$ Bin(3, 0.7)

B2 All 3 elements present and correct. Allow B1 for only 1 error/omission.
[2]

(ii) (a)

$\text{P}(X=2) = 3\times0.7^2\times0.3$

= 0.441

M1 ${}^3C_2 \times \ldots$
M1 $\ldots p^2 \times q$
A1 c.a.o.
[3]

(b)

$\text{P}(X\geqslant1) = 1-0.3^3$

= 0.973

M1 Or by summing P(1) … P(3)
A1 c.a.o.
[2]

(iii)

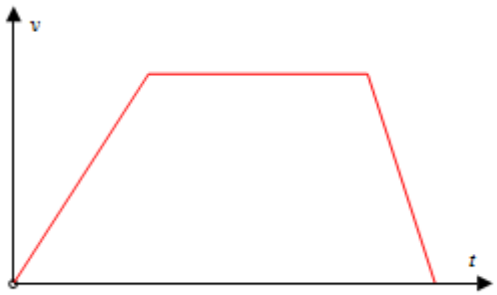
x	0	1
P($X = x$)	0.027	0.973

B1 Values in top row.
B1 P(X = 1) = *their* **(ii)(b)**
B1 P(X = 0) = 1 − *their* **(ii)(b)**
Bin(1, 0.973) earns full marks.
[3]

(iv)

P(All contain a seedling) = 0.973^6
= 0.84854… ≈ 0.849

M1 Ft *their* P(X = 1).
A1 c.a.o.
[2]

6	**(i)**	$240\sin 25$ $= 101.428\ldots \approx 101$ N	M1 A1 [2]	Resolve perpendicular to direction of travel. Allow sin/cos error. c.a.o.
	(ii)	$1100a = 240\cos 25 - 100$ $\therefore\ a = 0.1068\ldots \approx 0.107\ \text{ms}^{-2}$	B1 M1 A1 A1 [4]	Resolve 240 in direction of travel. Allow consistent sin/cos error. N2L in direction of travel. Allow 1error, omission or extraneous term. All terms correct. c.a.o.
7	**(i)**	Horiz: $18 = 2u\cos\theta$ Vert: $4 = 2u\sin\theta - 20$ $\therefore u\cos\theta = 9$ and $u\sin\theta = 12$ $\therefore \tan\theta = \frac{12}{9} = \frac{4}{3}$ $u^2 = 9^2 + 12^2 = 225$ $\therefore\ u = 15\ \text{ms}^{-1}$	B1 B1 M1 A1 M1 A1 [6]	Use of $x = ut\cos\theta$ Use of $y = ut\sin\theta - \frac{1}{2}gt^2$ Attempt to eliminate u. A.G. Convincingly shown. Eliminate or substitute for θ. Allow u found first then θ using u provided it does not involve a circular argument. c.a.o.
	(ii)	$R = \frac{2u^2}{g}\sin\theta\cos\theta = \frac{2\times 15^2}{10}\times\frac{4}{5}\times\frac{3}{5}$ $= 21.6$ m	M1 A1 [2]	Use of formula for range, or equivalent. Ft *their u*.
8	**(i)**		 B1 B1 [2]	 Trapezium (middle portion horizontal), one vertex at the origin, fourth vertex on the t axis. Third part steeper than first. Axes labelled t and v.
	(ii)	At the end of the first 16 seconds: $v_1 = (0+)\ 0.5 \times 16 = 8\ \text{ms}^{-1}$ $s_1 = \frac{1}{2}(0 + 8) \times 16 = 64$ m or $(0+)\ \frac{1}{2} \times 0.5 \times 16^2$	 B1 B1 [2]	 Gradient of first line or '*suvat*'. Area of LH triangle or '*suvat*'.

(iii)	When slowing down: $0 = 8 - 1 \times t_3 \quad \therefore t_3 = 8$ s $s_3 = ½(8 + 0) \times 8 = 32$ m At constant speed: $s_2 = 300 - (64 + 32) = 204$ m $t_2 = 204/8 = 25.5$ s $\therefore$ Total time = 16 + 25.5 + 8 = 49.5 s ALTERNATIVE 1 When slowing down: $0 = 8 - 1 \times t_3 \quad \therefore t_3 = 8$ s $\frac{1}{2}(2t_2 + 24) \times 8 = 300$ $\therefore 2t_2 + 24 = 75$ $\therefore t_2 = 25.5$ s $\therefore$ Total time = 16 + 25.5 + 8 = 49.5 s ALTERNATIVE 2 When slowing down: $0 = 8 - 1 \times t_3 \quad \therefore t_3 = 8$ s $\frac{1}{2}(2T - 24) \times 8 = 300$ $\therefore 2T - 24 = 75$ $\therefore 2T = 99$ $\therefore$ Total time T = 49.5 s	B1 B1 M1 A1 A1 [5] B1 B1 M1 A1 A1 [5] B1 B1 M1 A1 A1 [5]	Gradient of third line or '*suvat*'. Ft *their* v_1. Area of RH triangle or '*suvat*'. Ft *their* v_1 and/or t_3. Use area of rectangle … … to find the time. Ft *their* v_1 and/or t_3. A.G. Shown convincingly. Gradient of third line or '*suvat*'. Ft *their* v_1. Total time = t_2 + 24. Area of trapezium. Ft *their* v_1 and/or t_3. A.G. Shown convincingly. Gradient of third line or '*suvat*'. Ft *their* v_1. Total time $T = t_2 + 24$. Area of trapezium. Fully correct. Ft *their* v_1 and/or t_3. A.G. Shown convincingly.
9 (i)	C of M: $0.5u\ (+0) = (0+)\ kv$ $\therefore v = \frac{u}{2k}$	M1 A1 [2]	 c.a.o.
(ii)	NEL: $v\ (-0) = e(u\ (-0))$ $\therefore \frac{u}{2k} = eu$ $\therefore e = \frac{1}{2k}$	M1 M1 A1 [3]	 Substitute or use *their* expression for v. c.a.o.
(iii)	$(0 \leqslant)\ e \leqslant 1$ $\therefore \frac{1}{2k} \leqslant 1 \qquad \therefore k \geqslant \frac{1}{2}$	M1 A1 [2]	Use of condition on e. A.G. Convincingly shown.

10	$a = -g\sin\theta = -0.4$ When $t = 2$ $s = 2.5 \times 2 - \frac{1}{2} \times 0.4 \times 2^2$ $= 4.2$ m When $s = 4.2$ $4.2 = 2.5t - 0.2t^2$ $\therefore t^2 - 12.5t + 21 = 0$ $\therefore (t - 2)(t - 10.5) = 0$ $\therefore t = 10.5$ s At top of motion: $t = \frac{1}{2}(2 + 10.5) = 6.25$ s $s = 2.5 \times 6.25 - \frac{1}{2} \times 0.4 \times 6.25^2$ $= 7.8125$ m Total distance $= 2 \times 7.8125 - 4.2$ $= 11.425$ m	B1 M1 A1 M1 A1 A1 M1 A1 M1 A1 [10]	 Use an appropriate '*suvat*' equation. Or could find v (= 1.7 ms^{-1}). Correct outcome. Or could use $v = -1.7$ ms^{-1}. Use another appropriate '*suvat*' equation. E.g. quadratic equation for t. Solved. Correct value of t chosen. c.a.o. Ft *their* 10.5. Or $0^2 = 2.5^2 - 2 \times 0.4 \times s$. Or find distance from the mark to the top (= 3.6125). Or equivalent. c.a.o.