## MARK SCHEME for the May/June 2014 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.

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

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2014 series for most IGCSE, Pre-U, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.



Page 2		Mark Scheme		Syllabus	Paper			
		Pre-U – May/June 2	014			9794	03	
1	$\overline{x} = \frac{206.2}{100}$ $s = \sqrt{\frac{431}{100}}$	$\frac{16}{0} = 2.062 \text{ (kg)}$ $\frac{16}{0} - 2.062^2$ $\overline{059756} = 0.244(45) \text{ (kg)}$	M1 A1 M1 B1 A1	[5]	With no working shown allow only correct answers (to 3 sf or better). Use of mid-points seen or implied. c.a.o. Use of correct formula for standard deviation; may be implied. Correct $\Sigma f x^2$ s.o.i. c.a.o. Allow unbiased estimator (0.24568) for full marks. 2.06 used for sd (gives 0.2607 or unbiased 0.2620) gets max M1 B1 A0.			
2 (i)		$= P(A) + P(B) - P(A \cup B)$ = 0.6 + 0.5 - 0.8 = 0.3	M1 A1	[2]	Probability rule applied, s.o.i. c.a.o. Accept solutions based on Venn diagrams.			
(ii)	P(B A) =	$\frac{P(A \cap B)}{P(A)}$ $\frac{0.3}{0.6} = 0.5$	M1 A1	[2]	s.o.i. ft <b>(i)</b> prov	Conditional probability rule applied, s.o.i. ft (i) provided both $P(A \cap B)$ and $P(B)$ lie between 0 and 1.		
(iii)	A and B at 0.5	re independent since $P(B A) = P(B) =$	B1	[1]	ft (ii). Must be supported by explicit numerical evidence. Accept alternatives, e.g. $P(A \cap B) = P(A) \times P(B)$ , with evidence.			
3 (i)	p = 1 - (0	(4+0.3+0.1)=0.2	B1	[1]				
(ii)	$(1 \times 0.4) + $ $\therefore 0.2n + $ $\therefore 0.2n = $		M1		Use of formula for $E(X)$ s.o.i. to set up an equation in $n$ .		s.o.i. to set up	
	$\therefore n = 4$		A1	[2]	c.a.o.			
(iii)	$(7^2 \times 0.1)$	$(2^{2} \times 0.4) + (2^{2} \times 0.3) + (4^{2} \times 0.2) +$ = 9.7 9.7 - 2.5 <sup>2</sup> = 3.45	B1 M1 A1	[3]	Correct expression for $E(X^2)$ s.o.i. ft c's <i>n</i> . Use of formula for $Var(X)$ s.o.i. c.a.o.			
4 (i)	E(X) = 20	× 0.4 = 8	B1	[1]				
(ii)	P(X=8)=	mply Bin(20, 0.4) = 0.5956 – 0.4159 = 0.1797	B1 M1 A1	[3]	May be awarded elsewhere if not here. Use of tables for $P(X \le 8) - P(X \le 7)$ or formula for $P(X = 8)$ . c.a.o			
(iii)	$P(X \ge 8) = 1 - 0.4159 \\= 0.5841$		M1 A1	[2]	Attempt $1 - P(X \le 7)$ c.a.o			

Page 3		Mark Scheme	Syllabus	Paper					
		Pre-U – May/June 2	9794	03					
			1						
5 (i)	Recognise	e combination problem.	M1						
	${}^{15}C_4 = \frac{15!}{11!4!} = 1365$			[2]	c.a.o.	c.a.o.			
(ii)	Recognise $15^4 = 506$	e implication of "no restrictions". 25	M1 A1	[2]	c.a.o.				
(iii)	$\frac{15 \times 14 \times 13 \times 12}{15^4} = \frac{32760}{50625} = \frac{728}{1125} = 0.647(11)$			[3]	Correct numerator. Correct denominator; ft (ii). c.a.o.				
6 (i)		$< 8.3) = P\left(\frac{8.1 - 8.3}{0.20} < Z < \frac{8.5 - 8.3}{0.20}\right)$	M1			Standardising, either term.			
	$= \Phi(1.0) - = 0.8413 - = 0.6826$	- Φ(-1.0) - (1 – 0.8413)	M1 B1 M1 A1	[5]	Relevant difference of 2 terms s.o.i. Correct table look-up: $0.8413$ seen. $1 - \dots$ to deal with negative <i>z</i> value.				
(ii)		$N(\mu, \sigma^{2})$ $= 0.88 \Rightarrow \frac{8.5 - \mu}{\sigma} = 1.175$ $= 0.10 \Rightarrow \frac{8.1 - \mu}{\sigma} = 1.282$	M1 B1 A1		Set up at least 1 equation for $\mu$ and $\sigma$ . 1.175 and/or (-)1.282 seen. Both equations correct. Attempt to eliminate either $\mu$ or $\sigma$ . One of $\sigma$ or $\mu$ found. c.a.o. The other found. c.a.o. Allow 0.163 used and a.w.r.t. 8.31				
	$\therefore 2.457$ $\therefore \sigma = 0.$ $\therefore \mu = 8.2$	$.175\sigma = 8.5$ and $\mu - 1.282\sigma = 8.1$ $\sigma = 0.4$ 1628(0) $5 - 1.175 \times 0.1628 = 8.3087$ $1 + 1.282 \times 0.1628$	M1 A1 A1	[6]					
7	At max he $0 = 30^2 - $ $\therefore h = 451$	$2 \times 10 \times h$	M1 A1 A1		Use of an appropriate ' <i>suvat</i> ' equation Correct equation. Correct outcome. Allow $g = 9.8$ , giving $h = 45.918$		-		
	On return $-30 = 30$	to ground level $-10 \times t$	M1		Correct <i>'suvat</i> '	t use of a second equation. Allow	appropriate any valid		
	$\therefore t = 6 \text{ set}$	c	A1	[5]	Correc	method, e.g. (time to max ht) $\times$ 2. Correct outcome. Allow $g = 9.8$ , giving $t = 6.122$			

Pre-U - May/June 20149794038 (i) $\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_5 + \mathbf{F}_4 = 0$ $\therefore (51 - 8) + (-31 - 4)) + (61 + 6j) + \mathbf{F}_4 = 0$ $\therefore \mathbf{F}_4 = (-31 + 6j)$ M1Sum of 4 forces set equal to 0 o.e.(ii) $ \mathbf{F}_4  = \sqrt{(-3)^2 + 6^2}$ $= 10 N$ M1Use of Pythagoras. R (i).Use of Pythagoras. R (ii). $\theta = invtan \left(\frac{6}{-8}\right)$ $= 143(.13)^{e}$ M1Correct use of inverse tan (or cos or sin).9 (i)Diagram showing weight, normal contact force and friction, and no othersB1[1](iii)Resolve perpendicular to slope: $M = mg \cos \theta$ B1[1]N2L used & resolve down slope: $ma = mg \sin \theta - \mu mg \cos \theta$ B1[1]N2L used & resolve down slope: $ma = mg \sin \theta - \mu mg \cos \theta$ B1Limiting friction only. Attempt to eliminate N and F, and ca.a.0.(iii) $\mathbf{f} = \frac{1}{2}(-3t^2)(4t)$ B1[1]10 (i) $v = \int (22 - 6t)dt$ $= 12t - 3t^2(+c)$ M1Set up integral for v. c.a.0. following use of ministor $\mathbf{G} = \mathbf{G}^{-1}$ (iii) $\mathbf{x} = \frac{1}{9}(s - 48 - 48 = 0 \mathrm{ms}^{-1}$ M1Correct integral of c's v, including limits (which may appear or be dealt with later). Correct integration. f c's v. c.a.o. following use of limits or explored transform a definite integral.(iii) $\mathbf{w} = 0, 6t^2 - t^3 = 0$ M1Correct integration f c's v. c.a.o. following use of limits or explored transform a definite integral.(iii) $\mathbf{w} = 4, v = 48 - 48 = 0 \mathrm{ms}^{-1}$ M1Correct integral of c's v, including limits (which may appear or be dealt with later). Correct integration. f c's v	Page 4		Mark Scheme	Syllabus Paper					
$\therefore$ (Si - 8j) + (-3i - 4j) + (6i + 6j) + F4 = 0 $\therefore$ F4 = (-8i + 6j)A1[2]c.a.o.(ii) $F_4 = \sqrt{(-8)^2 + 6^2}$ $= 10N$ M1Use of Pythagoras. ft (i).Use of Pythagoras. ft (i). $\theta = inv tan \left(\frac{6}{-8}\right)$ $= 143(.13)^{\circ}$ M1Correct use of inverse tan (or cos or sin). ft (i), but not c's magnitude. Must have a clear reference direction. Allow as etch as evidence if convincing.9(i)Diagram showing weight, normal contact force and friction, and no othersB1[1](ii)Resolve perpendicular to slope: $N = mg \cos \theta$ $\therefore ma = mg \sin \theta - \mu mg \cos \theta$ B1Fquation of motion with 3 terms, and at least 2 correct. Condone consistent sin/cos error.(iii)Resolve perpendicular to slope: $N = mg \cos \theta - \mu mg \cos \theta$ B1Limiting friction only. $\therefore$ $a = g (sin \theta - \mu mg \cos \thetaA1[5]c.a.o.(iii)f + 2 \tan \theta then the particle will not move.B1I110(i)v = \int_0^1 (12 - 6t) dt= 12t - 3t^2 (+c)v = 0 when t = 0 c = 0When t = 4, v = 48 - 48 = 0  \text{ms}^{-1}M1(iii)x = \int_0^1 (12t - 3t^2) dt= (96 - 64) - (0) = 32  \text{m}M1Correct integration. ft c's v.c.a.o. following use of limits or explicit treatment of "c".(iii)When x = 0, 6t^2 - t^2 = 0(t \neq 0 : , t = 6 \sec et)M1Equation for x = 0, ft c's expression for "c" (=0).(iii)When x = 0, 6t^2 - t^2 = 0t = 6 + 0 - (0) = 32  \text{m}A1[3]Equation for x = 0, ft c's expression of consideration of "c" (=0).(iiii)When x = 0, 6t^2 - t^2 = 0t = 6 + 0 - (t) = 32 $			Pre-U – May/June 2	9794 03					
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i. $\mathbf{F}_{4} = (-8\mathbf{i} + 6\mathbf{j})$ A1[2]c.a.o.(ii) $ \mathbf{F}_{4}  = \sqrt{(-8)^{2} + 6^{2}}$ $= 10 N$ M1Use of Pythagoras. ft (i). $\theta = inv tan \left(\frac{6}{-8}\right)$ $= 143(.13)^{\circ}$ M1Correct use of inverse tan (or cos or sin).9(i)Diagram showing weight, normal contact force and friction, and no othersB1[1](ii)Resolve perpendicular to slope: $M = mg \sin \theta - F$ B1[1]Friction law: $F = \mu N$ $\therefore ma = mg \sin \theta - \mu mg \cos \theta$ B1[1](iii)If $\mu > \tan \theta$ then the particle will not move.B1[1]10(i) $v = \int (12 - 6f) dt$ $= 12t - 3t^{2} (tc)$ B1[1]10(i) $x = \int_{0}^{1} (12t - 3t^{2}) dt$ $when t = 4, v = 48 - 48 = 0  \mathrm{ms}^{-1}M1Set up integral for v.Correct integration. Condone omissionof "c"."" "dealt with explicitly.c.a.o. following use of fimits orexplicit treatment of "c".(iii)x = \int_{0}^{1} (12t - 3t^{2}) dtwhen t = 0, 6t^{2} - t^{3} = 0M1Correct integral of c's v, includinglimits (which may appear or be dealtwith later).A1(iii)x = \int_{0}^{1} (12t - 3t^{2}) dt= (96 - 64) - (0) = 32 mM1Correct integral of c's v.c.a.o. following use of finits orexplicit treatment of "c".Correct integration. Condone omission ofexplicit treatment of "c".(iii)When x = 0, 6t^{2} - t^{3} = 0when x = 0, 6t^{2} - t^{3} = 0M1Equation for x = 0, ft c's sepressionfor x = 0, ft c's sepression forconsideration of "c" (=0).Solved and non-accer solution chosen.$	8 (1)	1 2 5 1		M1		Sum of 4 forces set equal to <b>0</b> o.e.			
(ii) $ \mathbf{F}_{a}  = \sqrt{(-8)^{2} + 6^{2}}$ M1Use of Pythagoras. $\theta = inv \tan\left(\frac{6}{-8}\right)$ M1Correct use of inverse tan (or cos or sin). $= 143(13)^{\circ}$ A1[4](ii)Diagram showing weight, normal contact force and friction, and no othersB1(iii)N=mg cos $\theta$ N2L used & resolve down slope:B1 $ma = mg \sin \theta - F$ B1Friction law: $F = \mu N$ $ma = mg \sin \theta - \mu$ mg cos $\theta$ $\therefore a = g(\sin \theta - \mu \cos \theta)$ (iii)If $\mu > \tan \theta$ then the particle will not move.B1[1](iii) $r = (12 - 6t)dt$ $= 12t - 3t^{2} (+c)$ $= 0$ when $t = 0$ ; $c = 0$ $when t = 4, v = 48 - 48 = 0 \text{ ms}^{-1}(iii)x = \int_{0}^{4} (12t - 5t^{2})dt(iii)x = \int_{0}^{4} (12t - 3t^{2})dt(iii)x = \int_{0}^{4} (12t - 3t^{2})dt(iiii)x = \int_{0}^{4} (12t - 3t^{2}) dt(iiii)x = 0, 6t^{2} - t^{2} = 0(iiii)x = 0, 6t^{2} - t^{2} = 0(iiii)x = 0, 6t^{2} - t^{2} = 0(iiii)x = 0, 6t^{2} - t^{2} = 0(iiiii)x = 0, 6t^{2} - t^{2} = 0(iiiiii)x = 0, 6t^{2} - t^{2} = 0(iiiiii)x = 0, 6t^{2} - t^{2} = 0(iiiiiiii)x = 0, 6t^{2} - t^{2} = 0(iiiiiiiii)x = 0, 6t^{2} - t^{2} =$		$\therefore \mathbf{F}_4 = (-8\mathbf{i} + 6\mathbf{j})$		A1	[2]	c.a.o.			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $									
$ \begin{array}{c c} \theta = inv \tan\left(\frac{6}{-8}\right) \\ = 143(.13)^{\circ} \end{array} \qquad $	(ii)	$\left \mathbf{F}_{4}\right  = \sqrt{(-1)^{2}}$	$(8)^2 + 6^2$	M1		Use of Pythagoras.			
$= 143(.13)^{\circ}$ $= 121 - 3f^{\circ}$ $= 12t - 3f^{\circ} (+c)$ $= 12t - 3f^{\circ} $				A1		ft (i).			
$= 143(.13)^{\circ}$ $= 121 - 3f^{\circ}$ $= 12t - 3f^{\circ} (+c)$ $= 12t - 3f^{\circ} $		$\theta = inv \tan \theta$	$n\left(\frac{-6}{8}\right)$	M1		Correct use of inverse tan (or cos or			
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and friction, and no othersB1(ii)Resolve perpendicular to slope: $N = mg \cos \theta$ B1N2L used & resolve down slope: $ma = mg \sin \theta - F$ B1Friction law: $F = \mu N$ B1 $\therefore ma = mg \sin \theta - \mu mg \cos \theta$ B1 $\therefore ma = mg \sin \theta - \mu mg \cos \theta$ B1 $\therefore a = g (\sin \theta - \mu \cos \theta)$ A1(ii)If $\mu > \tan \theta$ then the particle will not move.B1[1]II10 (i) $v = \int (12 - 6t) dt$ $= 12t - 3t^2 (+c)$ A1 $v = 0$ when $t = 0$ $c = 0$ When $t = 4$ , $v = 48 - 48 = 0  \mathrm{ms}^{-1}$ (iii) $x = \int_{0}^{4} (12t - 3t^{2}) dt$ $= (6t^{2} - t^{3}) \Big _{0}^{4}$ $= (96 - 64) - (0) = 32  \mathrm{m}$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ (iii)When $x = 0$ , $6t^{2} - t^{3} = 0$ M1(ii	9 (i)	Diagram 9	showing weight normal contact force	B1	[1]				
$N = mg \cos \theta$ N2L used & resolve down slope: $ma = mg \sin \theta - F$ B1 M1Equation of motion with 3 terms, and at least 2 correct. Condone consistent sin/cos error.Friction law: $F = \mu N$ $\therefore ma = mg \sin \theta - \mu cos \theta$ B1 M1Limiting friction only. Attempt to eliminate N and F, and cancel m. c. a.o.(iii)If $\mu > \tan \theta$ then the particle will not move.B1 [1][1]10 (i) $v = \int (12 - 6t)dt$ $= 12t - 3t^2 (+c)$ When $t = 4$ , $v = 48 - 48 = 0 \mathrm{ms}^{-1}$ M1 A1 A1 A1 A1Set up integral for v. Correct integral or v. Correct integration. Condone omission of "c". "c" dealt with explicitly. c. a.o. from correctly integrated a. Accept correct answer obtained from a definite integral.(ii) $x = \int_0^4 (12t - 3t^2) dt$ $= (96 - 64) - (0) = 32 \mathrm{m}$ M1 A1 A1 A1Correct integral of c's v, including limits (which may appear or be dealt with later). A1(iii)When $x = 0$ , $6t^2 - t^3 = 0$ M1 A1 A1Equation for $x = 0$ . ft c's expression for x in (ii) only if obtained by integration. Condone omission of consideration of "c" (=0). Solved and non-zero solution chosen.	(1)			21	[-]				
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$t \neq 0$ : $t = 6$ sec A1 Solved and non-zero solution chosen.						÷			
$v = 72 - 108 = -36 \text{ ms}^{-1}$		$t \neq 0 \therefore t =$							
		$\therefore v = 72$	$-108 = -36 \text{ ms}^{-1}$	A1	[3]	c.a.o.			

Page 5		Mark Scheme	Syllabus	Paper				
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11 (i)	N2L & Resolve vertically for either particle 0.3a = 0.3g - T 0.2a = T - 0.2g 0.5a = 0.1g = 1 $\therefore a = 2 \text{ ms}^{-2}$		M1 A1 A1 M1 A1		Accept use of $g = 9.8$ throughout. Eliminate either <i>T</i> or <i>a</i> . Correct value for one. c.a.o.			
	$\therefore T = 0.3 \times 10 - 0.3 \times 2 = 2.4 \text{ N}$			[6]	Correct value for the other. c.a.o.			
	ALTERNATIVE: N2L for whole system (0.3 + 0.2)a = 0.3g - 0.2g $\therefore a = 2 \text{ ms}^{-2}$ N2L & Resolve vertically for either particle 0.3a = 0.3g - T  or  0.2a = T - 0.2g $\therefore T = 2.4 \text{ N}$		M1 A1 A1 M1 A1 A1		Allow 1 error. All correct. c.a.o. All correct. ft c's <i>a</i> . c.a.o.			
(ii)	$v^2 = 0^2 + 2$ $\therefore v = 3 \text{ m}$	$+ 2 \times 2 \times 2.25 = 9$ $ms^{-1}$		[2]	Use of appropriate ' <i>suvat</i> ' equation. ft c's <i>a</i> .			
(iii)	$I = (0.3 \times 0.9 \text{ Ns})$		M1 A1	[2]	Use of Impulse = change in momentum. ft c's v, including units. Allow $-0.9$ and/or kgms <sup>-1</sup> .			
(iv)	$0.9 = P \times \therefore P = 180$		M1 A1	[2]	Use of Impulse = force $\times$ time, o.e. ft c's <i>I</i> . Allow $-180$ .			