Jan 05

Q 1		mark		
(i)	Differentiate $\mathbf{v} = 2t\,\mathbf{i} + (5 - 4t)\,\mathbf{j}$ Differentiate $\mathbf{a} = 2\,\mathbf{i} - 4\,\mathbf{j}$	M1 A1 M1 F1	At least 1 cpt correct Award for RHS seen Do not award if **i** and **j** lost in **v.** At least 1 cpt correct. FT FT from **their** 2 component **v**	4
(ii)	$\mathbf{F} + 12\,\mathbf{j} = 4(2\,\mathbf{i} - 4\,\mathbf{j})$ $\mathbf{F} = 8\,\mathbf{i} - 28\,\mathbf{j}$	M1 A1 A1	N2L. Allow $\mathbf{F} = m\mathbf{a}$. No extra forces. Allow 12**j** omitted Allow wrong signs otherwise correct with **their** vector **a**. cao	3
	total	7		

4761 **Mark Scheme** **June 2005**

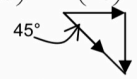
Q 5		mark		Sub
(i)	$x = 2 \Rightarrow t = 4$ $t = 4 \Rightarrow y = 16 - 1 = 15$	B1 F1	cao FT **their** t and y. Accept 15 **j**	2
(ii)	$x = \frac{1}{2}t$ and $y = t^2 - 1$ Eliminating t gives $y = \left((2x)^2 - 1\right) = 4x^2 - 1$	M1 E1	Attempt at elimination of expressions for x and y in terms of t Accept seeing $(2x)^2\text{-}1 = 4x^2 - 1$	2
(iii)	**either** We require $\frac{dy}{dx} = 1$ so $8x = 1$ $x = \frac{1}{8}$ and the point is $\left(\frac{1}{8}, -\frac{15}{16}\right)$ **or** Differentiate to find **v** equate **i** and **j** cpts so $t = \frac{1}{4}$ and the point is $\left(\frac{1}{8}, -\frac{15}{16}\right)$	 M1 B1 A1 M1 M1 A1	 This may be implied Differentiating correctly to obtain $8x$ Equating the **i** and **j** cpts of **their v**	3
	total	7		

Jan 06

Q 5		mark		Sub
(i)	$9\mathbf{i}$ m s^{-2}; $(9\mathbf{i} - 12\mathbf{j})$ m s^{-2}	B1	Award for either. Accept no units. (isw e.g. finding magnitudes)	1
(ii)	N2L $\mathbf{F} = 4(9\mathbf{i} - 12\mathbf{j}) = (36\mathbf{i} - 48\mathbf{j})$ N	B1	Accept factored form. isw. FT **a**(3). Accept 60 N or **their** $4\lvert\mathbf{a}\rvert$	1
(iii)	$\mathbf{v} = \int \begin{pmatrix} 9 \\ -4t \end{pmatrix} dt = \begin{pmatrix} 9t + C \\ -2t^2 + D \end{pmatrix}$ Using $\mathbf{v} = 4\mathbf{i} + 2\mathbf{j}$ when $t = 1$ $\begin{pmatrix} 4 \\ 2 \end{pmatrix} = \begin{pmatrix} 9 + C \\ -2 + D \end{pmatrix}$ $\Rightarrow C = -5, D = 4$ so $\mathbf{v} = (9t - 5)\mathbf{i} + (4 - 2t^2)\mathbf{j}$	M1 A1 M1 A1	Integration. At least one term correct. Neglect arbitrary constant(s) Sub at $t = 1$ to find arb const(s) Any form	4
				6

4761 **Mark Scheme** **June 2006**

Q 4		mark		Sub
(i)	**either** Need **j** cpt 0 so $18t^2 - 1 = 0$	M1	Need not solve	
	$\Rightarrow t^2 = \frac{1}{18}$. Only one root as $t > 0$	E1	Must establish only one of the two roots is valid	
	or Establish sign change in **j** cpt Establish only one root	B1 B1		2
(ii)	$\mathbf{v} = 3\mathbf{i} + 36t\mathbf{j}$	M1 A1	Differentiate. Allow **i** or **j** omitted	
	Need **i** cpt 0 and this never happens	E1	Clear explanation. Accept '**i** cpt always there' or equiv	3
(iii)	$x = 3t$ and $y = 18t^2 - 1$ Eliminate t to give	B1	Award for these two expressions seen.	
	$y = 18\left(\frac{x}{3}\right)^2 - 1$	M1	t properly eliminated. Accept any form and brackets missing	
	so $y = 2x^2 - 1$	A1	cao	3 8

Q 6		mark		sub
(i)	$t = 2.5 \Rightarrow \mathbf{v} = \begin{pmatrix} -5 \\ 10 \end{pmatrix} + 2.5\begin{pmatrix} 6 \\ -8 \end{pmatrix} = \begin{pmatrix} 10 \\ -10 \end{pmatrix}$  speed is $\sqrt{10^2 + 10^2} = 14.14...$ so 14.1 m s^{-1} (3 s. f.)	B1 E1 F1	Need not be in vector form Accept diag and/or correct derivation of just $\pm 45°$ FT **their v**	3
(ii)	$\mathbf{s} = 2.5\begin{pmatrix} -5 \\ 10 \end{pmatrix} + \frac{1}{2} \times 2.5^2 \times \begin{pmatrix} 6 \\ -8 \end{pmatrix}$ $= \begin{pmatrix} 6.25 \\ 0 \end{pmatrix}$ so 090°	M1 A1 A1 A1	Consideration of **s** (const accn or integration) Correct sub into *uvast* with **u** and **a.** (If integration used it must be correct but allow no arb constant) cao. CWO.	4
				7

Jun 07

Q6				
(i)	$(-\mathbf{i} + 16\mathbf{j} + 72\mathbf{k}) + (-80\mathbf{k}) = 8\mathbf{a}$ $\mathbf{a} = \left(-\frac{1}{8}\mathbf{i} + 2\mathbf{j} - \mathbf{k}\right)$ m s^{-2}	M1 E1	Use of N2L. All forces present. Need at least the **k** term clearly derived	2
(ii)	$\mathbf{r} = 4(\mathbf{i} - 4\mathbf{j} + 3\mathbf{k}) + 0.5 \times 16\left(-\frac{1}{8}\mathbf{i} + 2\mathbf{j} - \mathbf{k}\right)$ $= 3\mathbf{i} + 4\mathbf{k}$	M1 A1 A1	Use of appropriate **uvas***t* or integration (twice) Correct substitution (or limits if integrated)	3
(iii)	$\sqrt{3^2 + 4^2} = 5$ so 5 m	B1	FT **their** (ii) even if it not a displacement. Allow surd form	1
(iv)	$\arctan\frac{4}{3}$ $= 53.130\ldots$ so 53.1° (3 s. f.)	M1 A1	Accept $\arctan\frac{3}{4}$. FT **their** (ii) even if not a displacement. Condone sign errors. (May use arcsin4/5 or equivalent. FT **their** (ii) and (iii) even if not displacement. Condone sign errors) cao	2
				8

Jan 08

2 (i)	$\begin{pmatrix}6\\9\end{pmatrix}=1.5\mathbf{a}$ giving $\mathbf{a}=\begin{pmatrix}4\\6\end{pmatrix}$ so $\begin{pmatrix}4\\6\end{pmatrix}$ m s^{-2}	M1 A1	Use of N2L with an attempt to find **a**. Condone spurious notation. Must be a vector in proper form. Penalise only once in paper.	2
(ii)	Angle is $\arctan\left(\frac{6}{4}\right)$ = 56.309… so 56.3° (3 s. f.)	M1 F1	Use of arctan with **their** $\frac{6}{4}$ or $\frac{4}{6}$ or equiv. May use **F**. FT **their a** provided both cpts are +ve and non-zero.	2
(iii)	Using $\mathbf{s}=t\mathbf{u}+0.5t^2\mathbf{a}$ we have $\mathbf{s}=2\begin{pmatrix}-2\\3\end{pmatrix}+0.5\times4\begin{pmatrix}4\\6\end{pmatrix}$ so $\begin{pmatrix}4\\18\end{pmatrix}$ m	M1 A1 A1 7	Appropriate single ***uvast*** (or equivalent sequence of ***uvast***). If integration used twice condone omission of **r**(0) but not **v**(0). FT **their a** only cao. isw for magnitude subsequently found. Vector must be in proper form (penalise only once in paper).	3

4761 **Mark Scheme** **June 2008**

Q 3		mark	comment	sub
(i)	**F** = $5\begin{pmatrix}-1\\2\end{pmatrix}=\begin{pmatrix}-5\\10\end{pmatrix}$ so $\begin{pmatrix}-5\\10\end{pmatrix}$ N	M1 A1	Penalise spurious notation by 1 mark at most once in paper Use of N2L in vector form Ignore units. [Award 2 for answer seen] [SC1 for $\sqrt{125}$ or equiv seen]	2
(ii)	$\mathbf{s}=\begin{pmatrix}-2\\3\end{pmatrix}+4\begin{pmatrix}4\\5\end{pmatrix}+\frac{1}{2}\times4^2\times\begin{pmatrix}-1\\2\end{pmatrix}$ $\mathbf{s}=\begin{pmatrix}6\\39\end{pmatrix}$ so $\begin{pmatrix}6\\39\end{pmatrix}$ m	M1 A1 B1	Use of $\mathbf{s}=t\mathbf{u}+0.5t^2\mathbf{a}$ or integration of **a**. Allow $\mathbf{s}_0$ omitted. If integrated need to consider **v** when t = 0 Correctly evaluated; accept $\mathbf{s}_0$ omitted. Correctly adding $\mathbf{s}_0$ to a vector (FT). Ignore units. [NB $\begin{pmatrix}8\\36\end{pmatrix}$ seen scores M1 A1]	3
		5		

Q8		Mark	Comment	Sub
(i)	$v_x = 8 - 4t$ $v_x = 0 \Leftrightarrow t = 2$ so at $t = 2$	M1 A1 F1	**either** Differentiating **or** Finding 'u' and 'a' from x and use of $v = u + at$ FT **their** $v_x = 0$	3
(ii)	$y = \int (3t^2 - 8t + 4)\, dt$ $= t^3 - 4t^2 + 4t + c$ $y = 3$ when $t = 1$ so $3 = 1 - 4 + 4 + c$ so $c = 3 - 1 = 2$ and $y = t^3 - 4t^2 + 4t + 2$	M1 A1 M1 E1	Integrating v_y with at least one correct integrated term. All correct. Accept no arbitrary constant. Clear evidence Clearly shown and stated	4
(iii)	We need $x = 0$ so $8t - 2t^2 = 0$ so $t = 0$ or $t = 4$ $t = 0$ gives $y = 2$ so 2 m $t = 4$ gives $y = 4^3 - 4^3 + 16 + 2 = 18$ so 18 m	M1 A1 A1 A1	May be implied. Must have both Condone 2**j** Condone 18**j**	4
(iv)	We need $v_x = v_y = 0$ From above, $v_x = 0$ only when $t = 2$ so evaluate $v_y(2)$ $v_y(2) = 0$ [$(t - 2)$ is a factor] so yes only at $t = 2$ At $t = 2$, the position is (8, 2) Distance is $\sqrt{8^2 + 2^2} = \sqrt{68}$ m (8.25 3 s.f.)	M1 M1 A1 B1 B1	**either** Recognises $v_x = 0$ when $t = 2$ **or** Finds time(s) when $v_y = 0$ **or** States or implies $v_x = v_y = 0$ Considers $v_x = 0$ **and** $v_y = 0$ with **their** time(s) $t = 2$ recognised as only value (accept as evidence only $t = 2$ used below). For the last 2 marks, no credit lost for reference to $t = \frac{2}{3}$. May be implied FT from **their** position. Accept one position followed through correctly.	5
(v)	$t = 0$, 1 give (0, 2) and (6, 3)	B1 B1 B1	At least one value $0 \le t < 2$ correctly calc. This need not be plotted Must be x-y curve. Accept sketch. Ignore curve outside interval for t. Accept unlabelled axes. Condone use of line segments. At least three correct points **used** in x-y graph or sketch. General shape correct. Do not condone use of line segments.	3
		19		

Q 5		mark	comment	sub
(i)				
	$\mathbf{v} = \mathbf{i} + (3-2t)\mathbf{j}$	M1	Differentiating **r.** Allow 1 error. Could use const accn.	
		A1		
	v(4) = **i** – 5**j**	F1	Do not award if $\sqrt{26}$ is given as vel (accept if **v** given and *v* given as well called speed or magnitude).	
				3
(ii)				
	a = – 2**j**	B1	Diff **v.** FT **their v.** Award if – 2**j** seen & isw.	
	Using N2L **F** = $1.5\times$ (– 2**j**)	M1	Award for $1.5\times(\pm$ **their a** or $a)$ seen.	
	so – 3**j** N	A1	cao Do not award if final answer is not correct. [Award M1 A1 for – 3**j** WW]	
				3
(iii)				
	$x = 2+t$ and $y = 3t-t^2$	B1	Must have both but may be implied.	
	Substitute $t = x-2$			
	so $y = 3(x-2)-(x-2)^2$	B1	cao. isw. Must see the form *y* = ….	
	$[= (x-2)(5-x)]$			
				2
		8		