Suvat A level Edexcel Past Papers Answers

01.

Question	Scheme	Marks	AOs
a.	Use of $\mathbf{v} = \mathbf{u} + at$: $(10.5\mathbf{i} - 0.9\mathbf{j}) = 0.6\mathbf{j} + 15\mathbf{a}$	M1	3.1b
	$\mathbf{a} = (0.7\mathbf{i} - 0.1\mathbf{j})$ m s^{-2} Given answer	A1	1.1b
		(2)	
b.	Use of $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$	M1	3.1b
	$\mathbf{r} = 0.6\mathbf{j}\,t + \frac{1}{2}(0.7\mathbf{i} - 0.1\mathbf{j})\,t^2$	A1	1.1b
		(2)	
c.	Equating the **i** and **j** components of **r**	M1	3.1b
	$\frac{1}{2} \leftarrow 0.7\,t^2 = 0.6\,t - \frac{1}{2} \leftarrow 0.1\,t^2$	A1ft	1.1b
	$t = 1.5$	A1	1.1b
		(3)	
d.	Use of $\mathbf{v} = \mathbf{u} + at$: $\mathbf{v} = 0.6\mathbf{j} + (0.7\mathbf{i} - 0.1\mathbf{j})\,t$	M1	3.1b
	Equating the **i** and **j** components of **v**	M1	3.1b
	$t = 0.75$	A1 ft	1.1b
		(3)	
			(10 marks)

Notes:

(a)
M1: for use of $\mathbf{v} = \mathbf{u} + at$
A1: for given answer correctly obtained

(b)
M1: for use of $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$
A1: for a correct expression for **r** in terms of t

(c)
M1: for equating the **i** and **j** components of their **r**
A1ft: for a correct equation following their **r**
A1: for $t = 1.5$

(d)
M1: for use of $\mathbf{v} = \mathbf{u} + at$ for a general t
M1: for equating the **i** and **j** components of their **v**
A1ft: for $t = 0.75$, or a correct follow through answer from an incorrect equation

02.

Question	Scheme	Marks	AOs
a.	Use of $\mathbf{r} = \mathbf{u}t + \frac{1}{2}\mathbf{a}t^2$: $(7\mathbf{i} - 10\mathbf{j}) = 2(2\mathbf{i} - 3\mathbf{j}) + \frac{1}{2}\mathbf{a}2^2$	M1	3.1b
	$\mathbf{a} = (1.5\mathbf{i} - 2\mathbf{j})$	A1	1.1b
	$\lvert\mathbf{a}\rvert = \sqrt{1.5^2 + (-2)^2}$	M1	1.1b
	$= 2.5$ m s^{-2} * GIVEN ANSWER	A1*	2.1
		(4)	
b.	Use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t = (2\mathbf{i} - 3\mathbf{j}) + 2(1.5\mathbf{i} - 2\mathbf{j})$	M1	3.1b
	$= (5\mathbf{i} - 7\mathbf{j})$	A1	1.1b
	$\mathbf{v} = (5\mathbf{i} - 7\mathbf{j}) + t(4\mathbf{i} + 8.8\mathbf{j}) = (5 + 4t)\mathbf{i} + (8.8t - 7)\mathbf{j}$ and $(5 + 4t) = (8.8t - 7)$	M1	3.1b
	$t = 2.5$ (s)	A1	1.1b
		(4)	

(8 marks)

.

Notes: Allow column vectors throughout

(a)

No credit for individual component calculations

M1: Using a complete method to obtain the acceleration. **N.B.** Equation, in **a** only, could be obtained by two integrations

ALTERNATIVE

M1: Use velocity at half-time ($t = 1$) = Average velocity over time period

So at $t = 1$, $\mathbf{v} = \frac{1}{2}(7\mathbf{i} - 10\mathbf{j})$ so $\mathbf{a} = \frac{1}{2}(7\mathbf{i} - 10\mathbf{j}) - (2\mathbf{i} - 3\mathbf{j})$

N.B. could see $(7\mathbf{i} - 10\mathbf{j}) = (4\mathbf{i} - 6\mathbf{j}) + 2\mathbf{a}$ as first line of working

A1: Correct **a** vector

M1: Attempt to find magnitude of their **a** using form $\sqrt{a^2 + b^2}$

A1*: Correct GIVEN ANSWER obtained correctly

. **(b)**

M1: Using a complete method to obtain the velocity at A e.g.by use of $\mathbf{v} = \mathbf{u} + \mathbf{a}t$ with $t = 2$ and $\mathbf{u} = 2\mathbf{i} - 3\mathbf{j}$ and their $\mathbf{a}$

OR: by use of $\mathbf{s} = \mathbf{v}t - \frac{1}{2}\mathbf{a}t^2$

OR: by integrating their $\mathbf{a}$, with addition of $\mathbf{C} = 2\mathbf{i} - 3\mathbf{j}$, and putting $t = 2$

A1: correct vector

M1: Complete method to find equation in t only

.

e.g. by using $\mathbf{v} = \mathbf{u} + \mathbf{a}t$, with their $\mathbf{u}$ and equating $\mathbf{i}$ and $\mathbf{j}$ components
OR: by integrating $(4\mathbf{i} + 8.8\mathbf{j})$, with addition of a constant, and equating $\mathbf{i}$ and $\mathbf{j}$ components.
N.B. Must be equating $\mathbf{i}$ and $\mathbf{j}$ components of a velocity vector and must be their velocity at A, to give an equation in t only for this M mark
A1: 2.5 (s)

03.

Question	Scheme	Marks	AO
a.	Differentiate $\mathbf{v}$	M1	1.1a
	$(\mathbf{a} =) 6\mathbf{i} - \frac{15}{2}t^{\frac{1}{2}}\mathbf{j}$	A1	1.1b
	$= 6\mathbf{i} - 15\mathbf{j}$ (m s^{-2})	A1	1.1b
		(3)	
b.	Integrate $\mathbf{v}$	M1	1.1a
	$(\mathbf{r} =)(\mathbf{r}_0) + 3t^2\mathbf{i} - 2t^{\frac{5}{2}}\mathbf{j}$	A1	1.1b
	$= (-20\mathbf{i} + 20\mathbf{j}) + (48\mathbf{i} - 64\mathbf{j}) = 28\mathbf{i} - 44\mathbf{j}$ (m)	A1	2.2a
		(3)	
		(6)	

	Marks	Notes
		N.B. Accept column vectors throughout and condone missing brackets in working but they must be there in final answers
a.	M1	Use of $\mathbf{a}=\frac{d\mathbf{v}}{dt}$ with attempt to differentiate (both powers decreasing by 1) M0 if **i**'s and **j**'s omitted and they don't recover
	A1	Correct differentiation in any form
	A1	Correct and simplified. Ignore subsequent working (ISW) if they go on and find the magnitude.
b.	M1	Use of $\mathbf{r}=\int \mathbf{v}dt$ with attempt to integrate (both powers increasing by 1) M0 if **i**'s and **j**'s omitted and they don't recover
	A1	Correct integration in any form. Condone $\mathbf{r}_0$ not present
	A1	Correct and simplified.

04.

	Question	Scheme	Marks	AOs
a.		Use of $\mathbf{v}=\mathbf{u}+\mathbf{a}t$ or integrate to give: $\mathbf{v}=(-2\mathbf{i}+2\mathbf{j})+2(4\mathbf{i}-5\mathbf{j})$	M1	3.1a
		$(6\mathbf{i}-8\mathbf{j})\,(\text{m s}^{-1})$	A1	1.1b
			(2)	
b.		Solve problem through use of $\mathbf{r}=\mathbf{u}t+\frac{1}{2}\mathbf{a}t^2$ or integration (M0 if $\mathbf{u}=\mathbf{0}$) **Or** any other complete method e.g use $\mathbf{v}=\mathbf{u}+\mathbf{a}T$ and $\mathbf{r}=\frac{(\mathbf{u}+\mathbf{v})T}{2}$:	M1	3.1a
		$-4.5\mathbf{j}=2t\mathbf{j}-\frac{1}{2}t^2 5\mathbf{j}$ (**j** terms only)	A1	1.1b
		The first two marks could be implied if they go straight to an algebraic equation.		

	Attempt to equate **j** components to give equation in T only $(-4.5 = 2T - \frac{5}{2}T^2)$	M1	2.1
	$T = 1.8$	A1	1.1b
		(4)	
c.	Solve problem by substituting <u>their</u> T value (M0 if $T < 0$) into the **i** component equation to give an equation in λ only: $\lambda = -2T + \frac{1}{2}T^2 \times 4$	M1	3.1a
	$\lambda = 2.9$ or 2.88 or $\frac{72}{25}$ oe	A1	1.1b
		(2)	

Notes: Accept column vectors throughout **(8 marks)**

a.	M1	For any complete method to give a **v** expression with correct no. of terms with $t = 2$ used, so if integrating, must see the initial velocity as the constant. Allow sign errors.
	A1	Cao isw if they go on to find the speed.
b.	M1	For any complete method to give a vector expression for **j** component of displacement in t (or T) only, using $\mathbf{a} = (4\mathbf{i} - 5\mathbf{j})$, so if integrating, RHS of equation must have the correct structure. Allow sign errors.
	A1	Correct **j** vector equation in t or T. Ignore **i** terms.
	M1	Must have earned 1st M mark.

		Equate **j** components to give equation in T (allow t) only (no **j**'s) which has come from a displacement. Equation must be a 3 term quadratic in T.
	A1	cao
c.	M1	Must have earned 1st M mark in (b) Complete method - must have an equation in λ only (no **i**'s) which has come from an appropriate displacement.. (e.g M0 if $\mathbf{a} = \mathbf{0}$ has been used) Expression for λ must be a quadratic in T
	A1	cao

05.

Question	Scheme	Marks	AOs
a .	Use of $\mathbf{v}=\mathbf{u}+\mathbf{a}t$ with $t=2$: $\mathbf{v}=4\mathbf{i}+2(2\mathbf{i}-3\mathbf{j})$ **OR integration:** $\mathbf{v}=(2\mathbf{i}-3\mathbf{j})t+4\mathbf{i}$, with $t=2$	M1	3.1a
	$\mathbf{v}=8\mathbf{i}-6\mathbf{j}$	A1	1.1b
		(2)	
b.	Use of $\mathbf{r}=\mathbf{u}t+\frac{1}{2}\mathbf{a}t^2$ at $t=3$: $(\mathbf{i}+\mathbf{j})+\left[3\times4\mathbf{i}+\frac{1}{2}\times(2\mathbf{i}-3\mathbf{j})\times3^2\right]$ **OR**: find $\mathbf{v}$ at $t=3$: $4\mathbf{i}+3(2\mathbf{i}-3\mathbf{j})=(10\mathbf{i}-9\mathbf{j})$ then use $\mathbf{r}=\frac{1}{2}(\mathbf{u}+\mathbf{v})t$ $(\mathbf{i}+\mathbf{j})+\left[\frac{1}{2}[4\mathbf{i}+(10\mathbf{i}-9\mathbf{j})]\times3\right]$ or $\mathbf{r}=\mathbf{v}t-\frac{1}{2}\mathbf{a}t^2$ $(\mathbf{i}+\mathbf{j})+\left[3\times(10\mathbf{i}-9\mathbf{j})-\frac{1}{2}\times(2\mathbf{i}-3\mathbf{j})\times3^2\right]$ **OR integration:** $\mathbf{r}=(\mathbf{i}+\mathbf{j})+\left[(2\mathbf{i}-3\mathbf{j})\frac{1}{2}t^2+4t\mathbf{i}\right]$, with $t=3$	M1	3.1a
	$\mathbf{r}=22\mathbf{i}-12.5\mathbf{j}$	A1	2.2a
		(2)	

(4 marks)

Notes: Accept column vectors throughout

a.	M1	Complete method to find **v**, using **ruva***t* or integration (M0 if **i** and/or **j** is missing)
	A1	Apply isw if they also find the speed
b.	M1	Complete method to find the p.v. but this mark can be scored if they omit $(\mathbf{i}+\mathbf{j})$ i.e. the M1 is for the expression in the square bracket If they integrate, the M1 is earned once the expression in the square bracket is seen with $t=3$ (M0 if **i** and/or **j** is missing)
	A1	cao

06.

	Question	Scheme	Marks	AOs
a.		16 (m s^{-1}) seen as the answer	B1	1.1b
			(1)	
b.		$s=\frac{1}{2}\times3.2\times5^2$ **OR** $s=\frac{(0+16)}{2}\times5$ **OR** $s=(16\times5)-\frac{1}{2}\times3.2\times5^2$ **OR** $16^2=2\times3.2\times s$ **OR** from a *v*-*t* graph, $s=\frac{1}{2}\times5\times16$	M1	3.1b
		$s = 40$ (m)	A1	1.1b
			(2)	
				(3 marks)

Notes

a.	B1	cao. Must be positive. Ignore any working.		
b.	M1	Complete method to find an equation in *s* only, possibly using their '16' Allow 'reversed motion': use of $s=vt-\frac{1}{2}at^2$ with $v=0$ i.e. $s=-\frac{1}{2}\times3.2\times5^2$ can score M1 and $s=-40$ so distance is 40 (m) can score the A1		
	A1	cao. Must be positive.		
		N.B. correct answer only, in (b), can score both marks.		