Tracking Test 3 Part B

(37 marks: 44 minutes)

1. From the large data set, the daily maximum gust (knots) is measured at Hurn throughout May and June 2015. The data is summarised in the table.

Daily maximum gust, g (knots)	Frequency
$10 \leqslant g < 15$	3
$15 \leqslant g < 18$	9
$18 \leqslant g < 20$	9
$20 \leqslant g < 25$	20
$25 \leqslant g < 30$	9
$30 \leqslant g < 50$	7

In a histogram of this data the bar representing the $10 \leq g < 15$ class is 2.5cm wide and 1.8cm high.

(a) Give a reason to support the use of a histogram to represent this data

(1)

(b) Calculate the width and height of the bar representing the $18 \leq g < 20$ class

(3)

(c) The summary statistics are:

$$\sum fx = 1334.5 \qquad \sum fx^2 = 34299.25 \qquad n = 57$$

Use linear interpolation to find an estimate for the number of days the maximum gust was within one standard deviation of the mean. **(6)**

2.

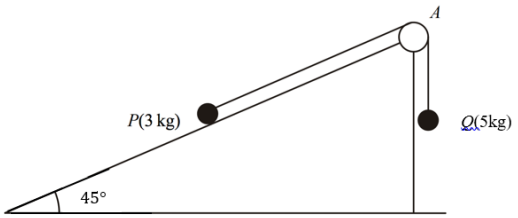
A, B, C and D are the points (2, −5, −8), (1, −7, −3), (0, 15, −10) and (2, 19, −20) respectively.

a Find $\overrightarrow{AB}$ and $\overrightarrow{DC}$, giving your answers in the form $p\mathbf{i} + q\mathbf{j} + r\mathbf{k}$. **(2)**

b Show that the lines AB and DC are parallel and that $\overrightarrow{DC} = 2\overrightarrow{AB}$. **(3)**

c Hence describe the quadrilateral $ABCD$. **(1)**

3.



The diagram above shows two particles P and Q, of mass 3 kg and 5 kg respectively, connected by a light inextensible string. Initially P is held at rest on a rough plane inclined at 45° to the horizontal. The string passes over a small smooth light pulley A fixed at the top of the plane. The part of the string from P to A is parallel to a line of greatest slope of the plane. The particle Q hangs freely below A. The coefficient between P and the slope is 0.1.The system is released from rest with the string taut.

(a) Show that the acceleration of Q is 3.27 ms^{-2} and find the tension in the string.

(8)

(b) State where in your calculations you have used the information that the string is inextensible.

(1)

(c) Find the magnitude of the force exerted on the pulley.

(2)

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4. At time t=0, two walkers, A and B, have position vectors relative to a fixed origin given by $\begin{pmatrix} 4 \\ -6 \end{pmatrix} km$ and $\begin{pmatrix} 18 \\ 12 \end{pmatrix} km$ respectively.

A walks with velocity $\begin{pmatrix} 1.5 \\ 2 \end{pmatrix} kmh^{-1}$and B walks with velocity $\begin{pmatrix} -2 \\ -2.5 \end{pmatrix} kmh^{-1}$.

(a) Show that the two walkers will meet.

(4)

(b) Work out the position vector of the point where they meet.

(2)

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5. The table shows the probability distribution of a discrete random variable, Y.

y	1	2	3	4
P(Y=y)	$\alpha + \frac{1}{6}$	$\alpha - \frac{1}{8}$	α	2α

Find $P(1 < Y < 4)$

(4)

END OF PART B

Mark Scheme

1.(a)	The maximum gust is continuous data and the data is given in a grouped frequency table	B1
(b)		
	Height: f.d.=9/2 So height = 4.5*3=**13.5cm** width=2*0.5=**1cm**	M1 A1 A1
(c)		
	evidence of correct formula used Mean **23.4** sd **7.32**	M1 B1 B1 both awrt
	Min value = 16.0906… $*\frac{16.090\ldots-15}{3}\times 9 = 3.27$ ... plus all the bottom 3 are out of range, so 6.27… further than one standard deviation below Max value = 30.73391… So $*\frac{50-30.733\ldots}{20}\times 7 = 6.74$ ... further than one standard deviation above	A calculation like this with sensible numbers, for M1 A1 if either * expression is fully correct
	So 57-3.27…-3-6.74… **approx. equal to 44 days**	A1 44 days **(10 marks)**

2.

a $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$

$= (\mathbf{i} - 7\mathbf{j} - 3\mathbf{k}) - (2\mathbf{i} - 5\mathbf{j} - 8\mathbf{k})$

$= -\mathbf{i} - 2\mathbf{j} + 5\mathbf{k}$ M1

$\overrightarrow{DC} = \overrightarrow{OC} - \overrightarrow{OD}$

$= (15\mathbf{j} - 10\mathbf{k}) - (2\mathbf{i} + 19\mathbf{j} - 20\mathbf{k})$ A1

$= -2\mathbf{i} - 4\mathbf{j} + 10\mathbf{k}$

b $2\overrightarrow{AB} = 2(-\mathbf{i} - 2\mathbf{j} + 5\mathbf{k})$ M1

$= -2\mathbf{i} - 4\mathbf{j} + 10\mathbf{k} = \overrightarrow{DC}$ A1

So AB is parallel to DC and half as long. A1cso, no need to mention length

c There are two unequal parallel sides, so $ABCD$ is a trapezium. B1

3

a	N2L Q $\quad 5g - T = 5a$ N2L P $\quad T - 3gsin45° - 0.1(3gcos45°) = 3a$ $F_{max} = \mu R$ $5g - 3gsin45° - 0.1(3gcos45°) = 8a$ $a = 3.27ms^{-2}$ $*$ $T = 5g - 5a$ (eg) $T = 32.7N$		M1A1 M1A1 M1 M1 A1 A1
b	The (magnitudes of the) accelerations of P and Q are equal		B1
c	$F = 2Tcos\alpha$ $F = 2 \times (their 32.7)cos22.5$ $F = 60.4N$		M1 A1 (11 marks)

4.

a	A: $\quad r = \begin{pmatrix} 4 + 1.5t \\ -6 + 2t \end{pmatrix}$ B: $\quad p = \begin{pmatrix} 18 - 2t \\ 12 - 2.5t \end{pmatrix}$ Equating i *or* j components and substituting into other equation to check $t = 4$ *hours* $\therefore$ *walkers meet*	Using s+ut	M1 M1 A1 A1
b	When $t = 4$ both position vectors are $\begin{pmatrix} 10 \\ 2 \end{pmatrix}$km	May be seen in part a	M1 A1

5.

a	$\alpha + \frac{1}{6} + \alpha - \frac{1}{8} + 3\alpha = 1$ $\alpha = \frac{23}{120}$ $P(2 \leq Y \leq 3) = \frac{31}{120}$		M1 A1 M1 A1