

A level Applied Paper Mark Scheme- MathsFlex Tutoring

Section A- Statistics

1.

1a	$\frac{134}{184} = 0.72826...$ awrt 0.728	B1
1bi	$P(X \geq 5) = 1 - P(X \leq 4)$ $= 1 - 0.076485...$	M1
	awrt 0.924	A1
1bii	$184 \times P(X = 6) = 56.15505...$	M1
	awrt 56.2	A1
1c	Part a and part bi are not similar and the expected number of 6s do not match with the number of 6s found in the data set so Hamza's model is not supported.	B1ft
1d	$\frac{32}{38} = 0.84210...$ awrt 0.842	B1
1e	Any one of - there is a greater probability of high cloud cover if the previous day had high cloud cover - independence does not hold	B1
	...therefore Hamza's binomial model may not be suitable	dB1

2.

a	$[68 - 7.5 =] 60.5$	B1
b	$[35.5 - 15.5 =] 20$	B1
c	$\left[\mu \text{ or } \bar{x} = \frac{783}{29} \right]$ $= 27$	B1
d	$\sigma = \sqrt{\frac{27304.25}{29} - 27^2}$	M1
	$\sigma = 14.578... \text{ awrt } 14.6$	A1
e	$\mu + 3\sigma = 27 + 3 \times 14.578... \text{ awrt } 70.73... \text{ so no outliers}$	B1ft
f	Median increases implies both values must be > 26.5	M1
	Mean is the same means that $a + b = 54$	M1
	So possible values are: eg $a = 27$ and $b = 27$	A1
g	Both values will be less than 1 standard deviation from the mean and so the standard deviation of all 31 values will be smaller.	

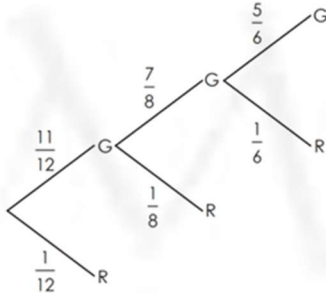
3.

a	$H_0: \rho = 0 \quad H_1: \rho < 0$	B1
	Critical value: 0.6215	M1
	$r > -0.6215$ so not a significant result and there is not enough evidence of a negative correlation between w and t	A1
b	As temperature increases people spend more time on the beach and less time shopping	B1
c	Since r is not close to -1, it is not consistent with the suggestion	B1
d	t will be the explanatory variable since sales are likely to depend on the temperature	B1
e	Every degree rise in temperature leads to a drop in weekly earnings of £103	B1

4.

a	$\frac{43.21 - 45}{\sigma} = -0.95417...$	M1
	$\sigma = 1.87598...$	A1
	$P(D > k) = 0.48$ or $P(D < k) = 0.52$	B1
	$\frac{k - 45}{1.875...} = 0.050153...$	M1
	$k = \text{awrt } 45.09$	A1
b	$[Y \sim B(100, 0.35) \rightarrow] W \sim N(35, 22.75)$	B1
	$P(Y < 50) \approx P(W < 49.5)$ $\left[= P\left(Z < \frac{49.5 - 35}{\sqrt{22.75}}\right) \right]$	M1
	awrt 0.999	A1
c	$H_0: \mu = 45 \quad H_1: \mu < 45$	B1
	$[\bar{D} \sim] N\left(45, \frac{1.14^2}{40}\right)$	M1
	$P(\bar{D} < 44.67) = 0.033566...$	A1
	$0.033566 < 0.05$ reject H_0	M1
	There is sufficient evidence to support Sally's belief	A1

5.

a		B1 dB1
b	$\frac{11}{12} \times \frac{7}{8} \times \frac{5}{6}$	M1
	$= \frac{385}{576}$	A1
c	$\frac{11}{12} \times \frac{1}{8} + \frac{11}{12} \times \frac{7}{8} \times \frac{1}{6}$	M1
	$= \frac{143}{576}$	A1
d	$P(\text{Red from B} \mid \text{Red selected}) = \frac{\frac{11}{12} \times \frac{1}{8}}{\frac{1}{12} + \frac{11}{12} \times \frac{1}{8} + \frac{11}{12} \times \frac{7}{8} \times \frac{1}{6}}$	M1
	$= \frac{66}{191}$	A1

6.

a	$P(L > 18) = 0.65542\dots$	B1
b	$P(L > 23 \mid L > 18) = \frac{P(L > 23)}{P(L > 18)}$	M1
	$= \frac{0.27425\dots}{0.65542\dots}$	A1ft
	$= 0.41843\dots$	A1
	For calculator to work require $(0.41843)^5 = 0.012812\dots$	dM1
	awrt 0.0128	A1

Mechanics Section B

1.

a	Differentiate $\mathbf{v}$	M1
	$(\mathbf{a} =) 4\mathbf{i} - \frac{35}{2}t^2\mathbf{j}$	A1
	When $t = 4$, $\mathbf{a} = 4\mathbf{i} - 140\mathbf{j}$	A1
b	Integrate $\mathbf{v}$	M1
	$(\mathbf{r} =)(\mathbf{r}_0) + 2t^2\mathbf{i} - 2t^2\mathbf{j}$	A1
	When $t = 4$, $\mathbf{r} = (-30\mathbf{i} + 20\mathbf{j}) + (32\mathbf{i} - 256\mathbf{j})$ $= 2\mathbf{i} - 236\mathbf{j}$ (m)	A1

2.

a	Moments about A (or any other complete method)	M1
	$T \times 2a \sin \alpha = Mga + 4Mgx$	A1
	$T = \frac{Mg(a + 4x)}{2a \times \frac{4}{5}}$ $= \frac{5Mg(a + 4x)}{8a}$	A1
b	$\frac{5Mg(a + 4x)}{8a} \cos \alpha = 3Mg$	M1
	$x = \frac{27a}{20}$	A1
c	Resolve vertically	M1
	$R \sin \beta = Mg + 4Mg - \frac{5Mg \left(a + 4 \times \frac{27a}{20} \right)}{8a} \sin \alpha$	A1ft
	$R \sin \beta = \frac{21Mg}{5}$	A1
	$\tan \beta = \frac{21Mg}{15Mg}$	M1
	$\tan \beta = \frac{7}{5}$	A1
d	$\frac{5Mg(a + 4x)}{8a} \leq 5Mg$	M1
	$x \leq \frac{7a}{4}$	A1
	For rope not to break, block cannot be more than $\frac{7a}{4}$ away from A	A1

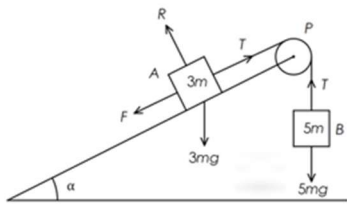
3.

a	Horizontal speed = $50\cos 45^\circ (= 25\sqrt{2})$	B1
	Vertical velocity at $t = 4$	M1
	$50\sin 45^\circ - 4g (= -3.84\dots)$	A1
	direction of travel = $\tan^{-1}\left(\pm \frac{3.84\dots}{25\sqrt{2}}\right)$	M1
	speed = $\sqrt{(25\sqrt{2})^2 + (3.84\dots)^2}$	M1
	36 or 36.6 ms^{-1} at 6° or 6.2° to the horizontal oe	A1
b	Using sum of horizontal distances = 150 at $t = 4$	M1
	$(u\cos \theta) \times 4 + (50\cos 45^\circ) \times 4 = 150$	A1
	Vertical distances equal	M1
	$\Rightarrow (50\sin 45^\circ) - 0.5 \times g \times 16 = (u\sin \theta) - 0.5 \times g \times 16$ $\Rightarrow 50\sin 45^\circ = u\sin \theta$	A1
	Solving for both θ and u	M1
	$\theta = 87^\circ$ or better (86.528681...) $u = 35\text{ms}^{-1}$ or better (35.420327...)	A1
c	It does not take account of the fact that they are not particles (moving freely under gravity) It does not take account of the size(s) of the balls It does not take account of the spin of the balls It does not take account of the wind a is not exactly 9.8 ms^{-2}	B1

4.

a	Use of $\mathbf{v} = \mathbf{u} + \mathbf{at}$ or integrate to give: $\mathbf{v} = (-3\mathbf{i} + \mathbf{j}) + 3(6\mathbf{i} - 5\mathbf{j})$	M1
	$(12\mathbf{i} - 14\mathbf{j}) \text{ (ms}^{-1}\text{)}$	A1
b	Solve problem through use of $\mathbf{r} = \mathbf{ut} + \frac{1}{2}\mathbf{at}^2$ Or any other complete method	M1
	$-3.5\mathbf{j} = t\mathbf{j} - \frac{1}{2}t^2 5\mathbf{j}$	A1
	Attempt to equate $\mathbf{j}$ components to give equation in T only $\left(-3.5 = T - \frac{5}{2}T^2\right)$	M1
	$T = 1.4$	A1
c	Solve problem by substituting their T value into the $\mathbf{i}$ component equation to give an equation in λ only:	M1
	$\lambda = -3T + \frac{1}{2}T^2 \times 6$ $\lambda = 1.68 \text{ oe}$	A1

5.

		
a	$R = 3mg \cos \alpha$	B1
	$F = \frac{1}{2}R$	B1
	Equation of motion for A:	M1
	$T - F - 3mg \sin \alpha = 3ma$	A1
	Equation of motion for B:	M1
	$5mg - T = 5ma$	A1
	Complete strategy to find an equation in T , m and g only.	M1
	$T = \frac{15mg}{4}$ from correct working	A1
b	$(F_{\max} =) \frac{6mg}{5} < \frac{9mg}{5}$	M1
	... so A will move down the slope	A1
c	- extensible string - weight of string - friction at pulley eg rough pulley - allow for the dimensions of the blocks eg "Do not model blocks as particles"; "(include) air resistance"; "include rotational effects of forces on blocks ie spin"	B1 B1