A Level
Maths

Bronze Set A, Paper 3 (Edexcel version)

2018 © crashMATHS Limited

<table>
<tr><th>Question</th><th>Solution</th><th>Partial Marks</th><th>Guidance</th></tr>
<tr><td>1 (a)</td><td>
<table>
<tr><th>w</th><th>$P(W = w)$</th></tr>
<tr><td>0</td><td>1/13</td></tr>
<tr><td>1</td><td>1/13</td></tr>
<tr><td>2</td><td>1/13</td></tr>
<tr><td>3</td><td>1/13</td></tr>
<tr><td>4</td><td>1/13</td></tr>
<tr><td>5</td><td>1/13</td></tr>
<tr><td>6</td><td>1/13</td></tr>
<tr><td>7</td><td>1/13</td></tr>
<tr><td>8</td><td>1/13</td></tr>
<tr><td>9</td><td>1/13</td></tr>
<tr><td>10</td><td>1/13</td></tr>
<tr><td>11</td><td>1/13</td></tr>
<tr><td>12</td><td>1/13</td></tr>
</table>
</td><td>B1

B1

[2]</td><td>Probability distribution table with $0 \le W \le 12$ with a probability given to each value of W and total probabilities = 1
Fully correct distribution table with probability for each W = 1/13. Accept 0.0769 or better

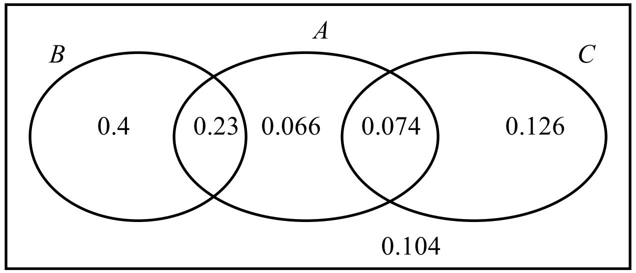
ALT (probability distribution function)
$P(W = w) = \begin{cases} \frac{1}{13} & 0 \le w \le 12 \\ 0 & \text{o/w} \end{cases}$ is 2/2.
Allow omission of ‘0 otherwise’ for 2/2
1st B1 for probability function with $0 \le W \le 12$ and a probability given to each W and total probabilities = 1
2nd B1 for fully correct probability distribution function

[Condone sloppy notation, e.g. capital W for small w, $P(W)$ instead of $P(W = w)$, etc.]</td></tr>
<tr><td>1 (b)</td><td>$P(2 < W \le 7) = \frac{5}{13}$</td><td>B1
[1]</td><td>Correct probability. Accept 0.385 or better</td></tr>
<tr><td>1 (c)</td><td>Not suitable since probability of each Beaufort number is not (close to being) equal</td><td>B1
[1]</td><td>Comment that the model is not suitable with some explanation about the Beaufort numbers not being equally likely
Allow illustrations of this point, e.g. ‘some/most probabilities are 0, which is not (close to) 1/13’, ‘$P(W = 3) \ne P(W = 4)$’, etc.’</td></tr>
<tr><td>1 (d)</td><td>High (average) wind speeds suggests close to sea, so not Beijing… lower temperature so suggest Perth</td><td>B1
[1]</td><td>Suggests Perth with reasons
Allow Perth with reasoning just based on high wind speeds</td></tr>
<tr><td>2 (a)</td><td>2.51, 2.20, 2.00, 1.80, 1.11</td><td>B1
[1]</td><td>Correct values to 2 dp. Accept 2 and 1.8</td></tr>
</table>

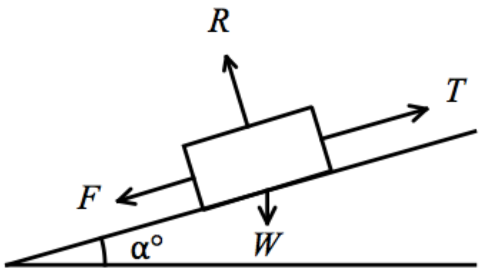
2 (b) (i)	e.g. linear association of two variables	B1 [1]	A correct statement Allow between x and y
2 (b) (ii)	–0.997	B1 [1]	Correct product moment correlation coefficient. Awrt –0.997
2 (c)	There is an almost perfect (negative) correlation with data in the form **log*n* against *t*** which suggests an exponential (decay) curve	B1 [1]	Any genuine explanation that states that the **coded** data shares a strong/almost perfect correlation and so an exponential model is suitable
2 (d)	$\log n = -0.152t + 2.656$ $\Rightarrow n = 10^{-0.152t+2.656}$ $\Rightarrow n = 10^{2.656}10^{-0.152t}$ * $\Rightarrow n = 453(0.705)^t$	M1* M1(dep*) A1 [3]	Replaces x with t and y with $\log n$ Raises both sides to the power of 10 Obtains $n = pq^t$ with p and q evaluated to 3 significant figures or better
3 (a)	Opportunity (or convenience) sampling	B1 [1]	Cao
3 (b)	Number of small squares is 150 So no. of people per small square is $\frac{45}{150} = 0.3$ So mean is $= \frac{15(6)+45(18)+67.5(9)+82.5(3)+135(9)}{45}$ $= 66$	M1* A1 M1(dep*) A1 [3]	Attempts to count squares **and** use 45 to obtain a measure of scale A correct measure of scale Method to find the mean using their measure of scale. Need to see midpoints multiplied by the frequencies (ft their measure of scale) all divided by 45. If sum of their frequencies ≠ 45, then M0 Correct mean ISW
3 (c)	Susan's data has an outlier and this will affect the mean and standard deviation (but not the median and IQR)	B1 [1]	Two things needed for the mark here: mention that Susan's data has outliers **AND** a comment that this affects the mean and sd Allow 'data is skewed and skewness affects mean and standard deviation' Accept reverse argument, i.e. median and IQR not affected by outliers etc. Accept extreme values/anomalies for 'outliers'

3 (d)	Susan's data has a higher median and lower IQR, so suggest (on average) students spend longer doing homework at Susan's school	B1* B1(dep*) **[2]**	Susan's data has higher median **and** lower IQR. Accept illustration of these points if not explicitly stated Suggests Susan's school Ignore references to outliers and lowest/highest values etc.
3 (e)	Susan used the whole school while Chris only used a sample (of 45 students)	B1 **[1]**	Comparison of sample sizes. No explanations needed Allow 'Susan used a census of the school while Chris used a sample'
4 (a)	$P(>50)=0.804 \Rightarrow P\left(Z>\frac{50-\mu}{\sigma}\right)=0.804$ $\Rightarrow \frac{50-\mu}{\sigma}=-0.856$ $P(<40)=0.11 \Rightarrow \frac{40-\mu}{\sigma}=-1.227$ $\sigma=27.0$ $\mu=73.1$	B1 M1* M1(dep*) A1 **[4]**	± 0.856 seen and ± 1.227 seen An equation with a z value, μ and σ Do not allow $\sqrt{\sigma}$ or σ^2 Sensible attempt to eliminate variables and solve for μ and σ Correct values of μ and σ. Awrt 27.0 and 73.1
4 (b)	$P(<102)=0.858$ Adam scored better than 85.8% of students that took the test so he will be admitted into the university	B1 B1ft **[2]**	Correct probability Correct conclusion ft their probability No need for a lengthy explanation: e.g. '0.858 > 0.7 so yes / Adam will be admitted' is OK
4 (c)	$H_0: \mu=160, \quad H_1: \mu<160$ $\bar{M} \sim N\left(160, \frac{50^2}{12}\right)$ $P(\bar{M}<140)=0.083$ $0.083>0.05$, so reject H_1 or insignificant There is insufficient evidence to suggest that the **mean mark** obtained by students in the test **has decreased** / **is less than 160**	B1 M1 A1 A1 A1 **[5]**	Hypotheses stated correctly Uses correct model for the mean mark Correct probability (allow z = awrt –1.39 or CR as awrt $\bar{M}<136$) Correct comparison and conclusion (allow –1.39 < –1.65 or 136 < 140) Correct conclusion in context meaning 'mean mark' and 'decreased' or '160'

5 (a)	$X \sim B(8, 0.29)$	B1 **[1]**	Correct distribution. Allow Bin for B
5 (b)	$P(X \geq 4) = 0.176$	B1 **[1]**	Awrt 0.176
5 (c)	$P(\geq 1) > 0.976 \Rightarrow 1 - P(=0) > 0.976$ $\Rightarrow P(=0) < 0.024$ $\binom{n}{0}(0.29)^0(1-0.29)^n < 0.024$ $\Rightarrow n \log 0.71 < \log 0.024$ $\Rightarrow n > 10.88...$ so least possible value of n is 11	M1* M1(dep*) A1 **[3]**	Sight of 1 – $P(X < 1) > 0.976$ (or better) Uses logs or trial and error to solve an inequality. Condone inequality sign errors if using logs Correct least possible value of n. If using logs, must see correct/convincing manipulation of inequality signs
5 (d)	Approximate the probability using N(96, 49.92) since n is large and p is close to 0.5 $P(\leq 87.5) = 0.114$	B1 B1 M1 A1 **[4]**	Sight or use of N(96, 49.92). May be implied Correct justification of approximation – both points needed Continuity correction (sight of 87.5 or 88.5) Obtains awrt 0.114. Final answer
6 (a)	$P(A \cap B) = P(A) + P(B) - P(A \cup B)$ $= 0.37 + 0.63 - 0.77$ $= 0.23$	B1 **[1]**	Correct probability
6 (b)	$P(A' \mid B') = \frac{P(A' \cap B')}{P(B')}$ $= \frac{1-0.77}{1-0.63}$ $= 0.6216...$	M1 A1 **[2]**	For stating the correct ratio **OR** the formula with at least one probability correct. M0 if assumes independence in numerator Correct probability. Awrt 0.612

6 (c)	$P(A \cap C) = 0.37 \times 0.2 = 0.074$	B1 **[1]**	Correct probability
6 (d)		B1 B1ft B1 B1 **[4]**	Box with B intersecting A and C intersecting A, but B not intersecting C Allow three intersecting regions in a box with 0 in the regions for B intersect C. Do not accept a blank entry for zero For 0.23 and 0.074 in correct places on their diagram ft their (c) For any two of 0.4, 0.066, 0.126 and 0.104 seen in the correct places on their diagram For all 4 values in 3rd B1 seen in the correct places on their diagram No labels on A, B and C can score B0 B1 B1 B1
6 (e)	$P(A \mid [B \cup C]') = \frac{P(A \cap [B \cup C]')}{P([B \cup C]')}$ $= \frac{0.066}{0.066 + 0.104}$ $= 0.3882...$	M1 A1 **[2]**	For stating the correct ratio **OR** the formula with at least one probability correct Correct probability. Awrt 0.388
7 (a)	If particle does not move, sum of forces is 0, so $1 - 3 + 4 + a = 0 \Rightarrow a = -2$ $2 + 3 - 1 + b = 0 \Rightarrow b = -4$	M1 A1 A1 **[3]**	States, uses or implies sum of forces must be 0 Correct value of a Correct value of b
7 (b)	$\boldsymbol{F}_1 + \boldsymbol{F}_2 + \boldsymbol{F}_3 = 2\mathbf{i} + 4\mathbf{j}$ $\boldsymbol{F} = m\boldsymbol{a}$, so $2\mathbf{i} + 4\mathbf{j} = 2\boldsymbol{a}$ $\Rightarrow \boldsymbol{a} = \mathbf{i} + 2\mathbf{j}$ $\Rightarrow \lvert \boldsymbol{a} \rvert = \sqrt{(1)^2 + (2)^2} = \sqrt{5}$ (m s^{-2})	B1 M1 M1 A1 **[4]**	Correct resultant force Attempts to use N2L with their resultant force to find $\boldsymbol{a}$ Method to find the magnitude of their $\boldsymbol{a}$ Correct magnitude, exact value or awrt 2.2 (m s^{-2})

8 (a)	(At $t = 0$, the particle is at the origin, so) $s = 0$ at $t = 0$ $\Rightarrow 0 = a(0)^3 + b(0)^2 + c(0) + d$, so $d = 0$ $v = 3at^2 + 2bt + c$ $v = 5$ at $t = 0$, so $5 = 3a(0)^2 + 2b(0) + c$, so $c = 5$ acceleration = $6at + 2b$ acceleration = 4 at $t = 0$, so $4 = 6a(0) + 2b$, so $b = 2$	B1 M1 A1 A1 **[4]**	Convincing proof that $d = 0$ Attempts to differentiate s wrt t and sets their $v = 5$ at $t = 0$ Correct value of c Correct value of b
8 (b)	$0 = 6a(2) + 2(2)$ so $a = -\frac{4}{12} = -\frac{1}{3}$	M1 A1ft **[2]**	Sets acceleration = 0 at $t = 2$ using their value of b Correct value of the constant a
8 (c)	$v = 0 \Rightarrow -t^2 + 4t + 5 = 0$ $\Rightarrow (-t + 5)(t + 1) = 0$ Since $t > 0$, we have $t = 5$	M1 A1 **[2]**	Sets their $v = 0$ (ft their values of a, b and c) and attempts to solve the resulting quadratic Correct value of t. Additional values of t is A0. Final answer
9	Considering the whole system and resolving gives: $T_U - 4g - 6g = (4 + 6)(3)$ $\Rightarrow T_U = 128$ N Considering B and resolving gives: $T_L - 6g = 6(3)$ $\Rightarrow T_L = 76.8$ N	M1 A1 M1 A1 **[4]**	Considers the system and resolves correctly to obtain a dimensionally correct equation with the correct number of terms Correct value of the tension in the upper string to 2 or 3 sf Considers B and resolves correctly to obtain a dimensionally correct equation with the correct number of terms Correct value of the tension in the lower string to 2 or 3 sf

9 ALT	Considering *B* and resolving gives: $T_L - 6g = 6(3)$ $\Rightarrow T_L = 76.8$ N Considering *A* and resolving gives: $T_U - T_L - 4g = 4(3)$ $\Rightarrow T_U = 128$ N	M1 A1 M1 A1 **[4]**	Considers *B* and resolves correctly to obtain a dimensionally correct equation with the correct number of terms Correct value of the tension in the lower string to 2 or 3 sf Considers *A* and resolves correctly to obtain a dimensionally correct equation with the correct number of terms Correct value of the tension in the upper string to 2 or 3 sf
10 (a)		B1 B1 **[2]**	Particle on an inclined plane with one force correctly shown Allow a box or a circle or other symbol for the particle Do not penalise candidates if they do not label α All four forces shown correctly on the diagram Allow common unambiguous letters/symbols/labels for each of the forces Allow the values of the forces instead of letters. If a clear letter/symbol/label is given and an incorrect value, then ignore the incorrect value and give the B1. If the incorrect value is given only, then B0
10 (b)	$R - 20g\cos\alpha = 0$ so $R = 20g\cos\alpha$ $100\cos\alpha - 0.3(20g\cos\alpha) - 20g\sin\alpha = 0$ $\Rightarrow 41.2\cos\alpha = 196\sin\alpha$ $\Rightarrow \tan\alpha = \frac{41.2}{196}$ $\alpha = 11.87...$,	M1* A1 B1ft M1* A1 M1(dep*) A1 **[7]**	Resolves perpendicular to the plane (dimensionally correct, correct no. of terms) obtaining 20*g*cosα or 20*g*sinα Correct resolution Use of friction = 0.3 × their normal reaction Resolves parallel to plane (usual criteria) with some value for the frictional force and obtaining 20*g*cosα or 20*g*sinα for component of the weight Correct resolution Rearranges equation to obtain a valid equation of the form tanα = *k* Correct value of α = 12 or 11.9 only

11 (a)	$\angle ACD = \tan^{-1}\left(\frac{0.08}{0.12}\right) = 33.690...$ Taking moments about hinge: $0.12\left(72\sin(33.690...)\right) - 3gd = 0$ $\Rightarrow d = 0.163...$ So beam is 0.33 m	B1 M1 A1ft A1 A1 **[5]**	Correct implication on the centre of mass of the sign Takes moments about the hinge to produce a dim. correct equation with correct no. of terms. Allow 0.12(72) and sin/cos confusion for the M1 72 N term correct ft their angle $3g$ term correct Correct beam length
11 (b)	Resolving horizontally gives $R_H = 72\cos(33.690...) = 59.907...$ N Resolving vertically gives $R_V = 72\sin(33.690) - 3g$ so $R_V = 10.538...$ N $\sqrt{(59.907...)^2 + (10.538...)^2} = 60.827...$, hence magnitude of resultant force is 61 N	B1 M1 A1 M1 A1 **[5]**	**Allow credit for (b) for work seen in (a)** Correct angle, seen or implied Resolves vertically (usual conditions). Allow sin/cos confusion Correct vertical reaction at hinge – direction does not matter Uses Pythagoras Correct resultant force **NB:** candidates can do part (b) without part (a) and use this to do part (a). This is OK. Note that the M1 in (a) is for a complete method
12 (a)	$v^2 = u^2 + 2as \Rightarrow 0^2 = (U\sin\theta)^2 - 8g$ $\Rightarrow U = \sqrt{\frac{8g}{\sin^2\theta}} = \sqrt{\frac{8g}{(3/5)^2}} = 14.757...$, so U = 15 to 2 sf	M1 A1 A1 **[3]**	Attempts to use $v^2 = u^2 + 2as$ with at least three values correct. Ignore signs Correct equation. Allow $\sin\theta$ or 0.6 but not a wrong value Correct value of U given to 2 or 3 significant figures **ALT:** use of energy: $\frac{1}{2}m(U\sin\theta)^2 = mg(4)$ oe is M1 A1

12 (b)	$V_H = U\cos\theta = 14.757... \times \frac{4}{5} = 11.8058...$ m/s $V_V{}^2 = (14.757...\sin\theta)^2 - 2g(-20)$ So $V_V = (-)21.688...$ Then $\sqrt{V_H{}^2 + V_V{}^2} = 24.693...$, so $V = 25$ m/s to 2 sf	B1 M1 A1 M1 A1 **[5]**	Correct horizontal velocity of the ball Complete method to find the vertical velocity of the ball when it hits the ground, i.e. use of kinematics formulae or energy Correct magnitude of vertical velocity when the ball hits the ground Uses Pythagoras with their horizontal and vertical velocities Correct value of V to two or three significant figures
12 (c)	$-20 = (14.757...\sin\theta)t - \frac{1}{2}gt^2$ $\Rightarrow 4.9t^2 - (8.854...)t - 20 = 0$ So ball hits the ground 3.116… seconds after projection Range of the ball is $3.116... \times 11.805... = 36.791...$ m Dog must travel 36.791… m in less than 2.116… seconds, hence minimum speed is $\frac{36.791...}{2.116...} = 17.38...$ m/s	M1* A1 M1(dep*) A1 **[4]**	Complete method to find duration the ball is in the air. Can also use $v = u + at$. The method must be complete, so if they form a 3TQ, must see an attempt to solve it Correct duration of flight Method to calculate the range of the ball Correct minimum speed to two or three significant figures Condone small rounding errors through the working provided the final answer is correct to at least two significant figures