AS Level / Year 1
Paper 2 (Edexcel Version)

Version 1

Question	Scheme	Marks
1		
(a)	Okta(s) Correct unit	B1 **(1)**
(b)	enumerate the data points Point 1 *and* describes how enumerated list will be used to obtain a sample of data points	B1
	explains how to deal with repeats Point 2	B1
	explains how to obtain a sample of size 30 Point 3	B1 **(3)**
(c)	smaller amount of data to process / analyse Correct reason	B1 **(1)**
		5

Question 1 Notes

(b) Point 1: must include **both** ideas. If the candidate suggests the use of random numbers to obtain a sample, they must explain how the random numbers can be generated, i.e. use of a calculator/spreadsheet

Point 2: states clearly that repeats will be ignored

Point 3: i.e. continue until 30 different numbers have been selected and their corresponding data points

(c) Ignore words such as 'small' – sentence must be comparative. Must be qualified by a suitable reason, i.e. the idea that a smaller amount of data is useful for processing/analysing/oe

Accept a valid alternative that is comparative and thorough. Ignore references to this being 'cheaper' and 'quicker' unless this is qualified. For example,

'there is a smaller amount of data which means it is quicker to process' scores B1

'there is a smaller amount of data so it is quicker' scores B0

Question	Scheme	Marks
2		
(a)	experience is the explanatory variable / the explanatory variable should go on the first row / salary is the response variable / the response variable should go on the second row — A correct explanation	B1 **(1)**
(b)	Mean = £41875 — Correct mean	B1
	Standard deviation $= \sqrt{\frac{19000^2 + ... + 80000^2}{8} - (41875)^2}$ $= 200021.472...$ $= £20021$ — Attempts to find the standard deviation **(SEE NOTES)**	M1A1 **(3)**
(c)	{41875 + 20021.472… ~ 61896, so the outlier is} £80000 — Correct outlier	B1 **(1)**
(d/i)	e.g. it is a piece of data and we should consider all of the data — Reason	B1 **(1)**
(d/ii)	e.g. it is an extreme value and could unduly influence analysis or it could be a mistake — Reason	B1 **(1)**
(e)	$P = 24000 + 3400(9)$ $= £54600$ — Substitutes 9 into the regression line	M1A1 **(2)**
(f)	Unreliable, because 9 years lies outside the {regression line's} data range — Unreliable + reason	B1 **(1)**
		10

	Question 2 Notes
	(a) Accept any of the statements (or reasonable variations of them – use your judgment) (b) 1st M1 – must show correct SD calculation. The '…' used in the mark scheme is to preserve space only but candidates **MUST** show squaring all of the terms to get the M1. Answers only score 3/3 Answers should be to 3 sf. (c) Correct salary. Condone 'the salary corresponding to 10 years of experience' oe (d) (i) a correct reason to include the outlier (ii) a correct reason to exclude the outlier. Ignore 'it is an extreme value' without qualification (e) M1 – substitutes 9 into the regression line A1 – correct answer Answer should be to 3 sf but do **NOT** penalise 3 sf twice in this question. (f) Unreliable + explanation. Ignore 'extrapolation is dangerous' without qualification. There needs to be a specific acknowledgment that 9 years lies outside of the regression line's data set for the B1.

Question	Scheme		Marks
3			
(a)	{Let X be the r.v., "number of customers in the sample that spend at least £20", then} $X \sim B(35, 0.6)$	Uses a binomial distribution with $n = 35$ and $p = 0.6$ {see notes for alternatives}	M1
	$P(X > 18) = P(X \geq 19) = 0.8065...$	awrt correct probability (standard form not necessary)	A1 **(2)**
(b)	72 (weighted) squares in total, so $\frac{35}{72}$ represents 1 customer	Seen or implied	M1
	46 (weighted) squares representing customers spending at least £20, so $\frac{35}{72} \times 46$	Seen or implied	M1
	$= 22.361...$, so <u>22 customers</u>	Either 22 or 23 customers	A1 **(3)**
(c) Way 1	$H_0 : p = 0.6,\ H_1 : p \neq 0.6$	Both hypotheses correctly stated	B1
	Expected value is 21, so consider the upper tail:		
	$P(X \geq 22) = 1 - P(X \leq 21) = 0.4361...$ **OR** $P(X \geq 23) = 1 - P(X \leq 22) = 0.3057...$	Considers the upper tail **AND** finds the probability of X being greater than 21 **or** 22 ft their (b)	M1A1
	Insufficient evidence of reject H_0 / not significant / accept H_0	A correct statement ft their probability. **Ignore comparisons**	dM1
	No evidence to support that the probability that a **customer spends** at least £20 has changed	**cso** fully correct solution and contextual conclusion containing the words 'customer spends'	A1 **(5)**

(c) Way 2	$H_0 : p = 0.6,\ H_1 : p \neq 0.6$	Both hypotheses correctly stated	B1
	$P(X \geq 27) = 0.0259...$, $P(X \geq 28) = 0.0101...$ $P(X \leq 14) = 0.0132...$, $P(X \leq 14) = 0.0300...$ So CR is $(X \leq 14) \cup (X \geq 28)$	One of these statements leading to a critical region. **ACCEPT** solutions that only give the upper tail of the CR	M1A1
	22/23 is outside of the critical region, so insufficient evidence to reject H_0 / not significant / accept H_0	A correct statement ft their CR	dM1
	No evidence to support that the probability that a **customer spends** at least £20 has changed	**cso** fully correct solution and contextual conclusion containing the words 'customer spends'	A1 **(5)**
			10

Question 3 Notes

(a) M1 : Uses the binomial distribution (35, 0.6). No need to define a random variable etc..

ALTERNATIVE: uses a binomial distribution $Y \sim (35, 0.4)$ **AND** finds $P(X < 17)$

A1 : awrt **0.807**

(b) 1st M1: finds number of customers represented by 1 square (oe)

2nd M1: attempts to find number of customers that spent more than £20

A1 : 22 or 23 customers **Accept either BUT NOT BOTH**

(c) B1: states the hypotheses correctly

1st M1 A1: finds probabilities or (upper) critical region

2nd M1: correct statement ft their probabilities/CR. **IGNORE** comparisons to the significance level as this is not enough on its own to gain the M1

2nd A1: **cso** a fully correct solution with no omissions/errors seen and a contextual conclusion that contains the words 'customer spends'

Question	Scheme	Marks
4		
Way 1	{Let x be $P(A)$ and y be $P(B)$}	
	By independence, $xy = 0.06$ and $(1-x)(1-y) = 0.51$ See notes	M1B1
	$\Rightarrow 1 + 0.06 - x - \dfrac{0.06}{x} = 0.51$ Eliminates y and rearranges to form a 3TQ $\Rightarrow 0.55x - x^2 - 0.06 = 0$	dM1
	$\Rightarrow x = \dfrac{-0.55 \pm \sqrt{0.55^2 - 4(-1)(-0.06)}}{2(-1)}$ Method to solve their 3TQ $\Rightarrow x = 0.4$ or 0.15	dM1A1
	$\max\{P(\text{not } A)\} = 1 - \min\{P(A)\}$ Maximum value of P (not A) $= 0.85$	A1 **(6)**
Way 2	{Let x be $P(A)$ and y be $P(B)$}	
	By independence, $xy = 0.06$ and $(1-x)(1-y) = 0.51$ See notes	M1B1
	$\Rightarrow 1 + 0.06 - \dfrac{0.06}{y} - y = 0.51$ Eliminates x and rearranges to form a 3TQ $\Rightarrow 0.55y - y^2 - 0.06 = 0$	
	$\Rightarrow y = \dfrac{-0.55 \pm \sqrt{0.55^2 - 4(-1)(-0.06)}}{2(-1)}$ Method to solve their 3TQ $\Rightarrow y = 0.4$ or 0.15	dM1A1
	$\Rightarrow x = 0.4$ or 0.15 Uses their y to find x	dM1
	$\max\{P(\text{not } A)\} = 1 - \min\{P(A)\}$ Maximum value of P (not A) $= 0.85$	A1 **(6)**
		6

	Question 4 Notes

Way 1:

1st M1 – writes down both equations. Allow the use of different symbols etc. provided it is clear what they are (or it becomes clear)

B1 – **clearly** states that **both** equations are implied by independence. If candidate says/implies that only one of the equations is a result of independence, award B0

2nd M1 – dependent on 1st M1. Solves simultaneous equations to eliminate y (P(B)) and attempts to form a 3TQ

3rd M1 – dependent on both previous M marks. Solves the 3TQ by an appropriate method, i.e. use of the formula/factorising/completing the square.

1st A1 – correct values of P(A)

2nd A1 – correct MAXIMUM value of P(not A). Quoting both values without clearly stating which is maximum is A0.

Way 2:

1st M1 – writes down both equations. Allow the use of different symbols etc. provided it is clear what they are (or it becomes clear)

B1 – **clearly** states that **both** equations are implied by independence. If candidate says/implies that only one of the equations is a result of independence, award B0

2nd M1 – dependent on previous M mark. Solves the 3TQ by an appropriate method, i.e. use of the formula/factorising/completing the square.

1st A1 – correct values of P(A)

3rd M1 – dependent on both previous M marks. Uses their value of $P(B)$ to find $P(A)$

2nd A1 – correct MAXIMUM value of P(not A). Quoting both values without clearly stating which is maximum is A0.

ALTERNATIVES:

Defining x as P(not A) etc. is OK – simply adapt the scheme accordingly using the guiding principles:

- not marks for finding anything to do with B until it is made clear that it is being used to find information about A

Special case: Some candidates may see the symmetry of the problem and max(not B) = max(not A). In this case, marks **CAN** be awarded for finding information about B provided this is made clear before.

Special case: Trial and error based solutions alone score 0 marks unless they show that the values of A and B work.

Question	Scheme	Marks
5		
	$R(\uparrow): 2-3p-q=0$ Uses N2L $R(\leftarrow): q-4-p-6=3(5) \Rightarrow q-p=25$	M1A1
	Adding the equations, $2-3p-p=25 \Rightarrow p=...$ Attempts to solve the equations simultaneously	dM1
	$p=-\frac{23}{4}$ Correct value of p	A1
	$\Rightarrow q=-\frac{23}{4}+25=\frac{77}{4}$ Correct value of q	A1
		5

Question 5 Notes

1st M1 – attempts to use N2L to form **ONE** equation. The equation should be dimensionally correct, have the correct number of terms, but you can condone a sign error, i.e. failing to distribute a negative sign. If candidates have two equations, consider the 'best' one for this mark

1st A1 – **BOTH** equations correct oe

2nd M1 – attempts to solve the equations simultaneously using any method. Dependent on the 1st M1.

2nd A1 – correct value of p

3rd A1 – correct value of q

Special case: Assuming that q = weight and $3g$ N scores no marks (other downward forces may be at work).

Question	Scheme		Marks
6			
(a)	$a = \frac{v-u}{t} = \frac{-26}{2.5} = -10.4$	Finds the acceleration of the particle as it moves upwards	M1A1
	$\Rightarrow -2g - R = 2(-10.4)$ $\Rightarrow R = 1.2 \ \{\text{N}\}$	Uses N2L to find R	dM1A1 **(4)**
(b)	$v^2 = u^2 + 2as \Rightarrow s = \frac{0^2 - 26^2}{2(-10.4)} = 32.5 \ \{\text{m}\}$	Uses kinematics formula	M1A1 **(2)**
(c)	As the particle moves upwards, R and the particle's weight both act downwards		
	As the particle moves downwards, <u>R acts upwards</u> and the particle's <u>weight acts downwards</u> ; so the <u>resultant force is different</u> {compared to when the particle moves upwards}	Both points, see notes for guidance	B1B1 **(2)**
(d)	As the particle descends, $2g - R = 2a \Rightarrow a = \frac{2g - 1.2}{2} = 9.2$	Uses N2L to find downward acceleration ft their R	M1
	$s = ut + \frac{1}{2}at^2 \Rightarrow t = \sqrt{\frac{2(32.5)}{9.2}}$	Uses kinematics formula to find t ft their a and s	dM1
	$t = 2.575...$	Correct t ft their R and s	A1ft
	In total, the particle spends 5.1 s in the air (2 sf)	Correct total time in the air	A1 **(4)**
			12

	Question 6 Notes
(a) 1st M1 - Attempts to find the acceleration of the particle using the correct formula. Condone sign errors. 1st A1 – correct acceleration (ignore sign) 2nd M1 – Uses N2L to find *R*. Usual rules apply – equation must be dimensionally correct, containing the correct number of terms and condone one sign error. If candidate makes a real mess with their signs, award M0. 2nd A1 – correct *R*. Units not required. If candidates give a negative sign, award A0 (as this is not a magnitude). (b) M1- attempts to find maximum height reached by the particle above the ground. A1 – correct maximum distance (c) 1st B1 – states which forces act on the particle on the way down and their directions. **This can be obtained from a clear and labelled diagram**. 2nd B1 – must make a clear comment that the **resultant force** is different. Do not accept "the equation of motion is different" unless qualified. Ignore vague references to N2L as we require a clear understanding of what has changed (the resultant force). **Special case:** if candidates write down the **correct** equation of motion of the particle as it moves up and down and makes a clear comparison between the **resultant forces**, then award the 2nd B1 (even without explicitly using the term 'resultant force') (d) 1st M1 – attempts to use N2L to find the downwards acceleration (**if equation given in (c), then award the M1).** 2nd M1 – uses the kinematics formula to find the time of the particle's descent, ft their previous values. 1st A1ft – correct time the particle descends ft their previous values 2nd A1 – correct time the particle is in the air. Cao.	

Question	Scheme	Marks
7		
(a) (i/ii)	For A: $T = 3am$ For B: $5mg - T = 5am$ Correct equations of motion	M1
	$\Rightarrow a = \frac{5g}{8}$ $\{\text{m s}^{-2}\}$ $\Rightarrow T = \frac{15mg}{8}$ $\{\text{N}\}$ Correct acceleration and tension in terms of m and g	A1A1 **(3)**
(b)	$\sqrt{\left(\frac{15mg}{8}\right)^2 + \left(\frac{15mg}{8}\right)^2} = \frac{15mg\sqrt{2}}{8}$ Uses Pythagoras' or an equivalent method	M1A1
	Direction is at 45 degrees away from the table Correct direction	B1 **(3)**
		6

Question 7 Notes

(a) 1st M1 – both equations of motions correct

A1 ; A1 – correct tension ; correct acceleration **in terms of *m* and *g***

(b) 1st M1 – attempts to find the resultant force on the pulley

1st A1 – correct resultant force on the pulley

B1 – correct direction of the force. **Can be illustrated by a diagram.**

Question	Scheme	Marks
8		
	$2^2-4k(4-k)<0$ $\Rightarrow 4k^2-16k+4<0$ — Forms an inequality and attempts to solve it	M1 dM1
	$\Rightarrow 2-\sqrt{3}<k<2+\sqrt{3}\Rightarrow \max(k)=3$ — Correct maximum value of k	A1
	distance travelled $=\int_2^3\left(3t^2+2t+1\right)dt=\left[t^3+t^2+t\right]_2^3$ — See notes for criteria	M1 A1ft
	$=\left(3^3+3^2+3\right)-\left(2^3+2^2+2\right)$ $=25\ \{\text{m}\}$ — Substitutes the limits in to find the correct total distance travelled	dM1 A1
		7

Question 8 Notes

1st M1 – uses the discriminant to find an inequality in k.

2nd M1 – dependent on the 1st M1. Uses a correct method to solve their inequality in k.

1st A1 – correct **maximum** value of k.

3rd M1 – Award the mark for one of the following:

- integrates the velocity expression **with respect to time** with $k = 3$. **Ignore limits.**
- integrates the velocity expression **with respect to time** with their suitable* value of k. **Ignore limits**.
- integrates the velocity expression **with respect to time** in terms of k **and** substitutes a suitable value of k in at a later stage. **Ignore limits**.

4th A1 – correct integration ft their expression. Must have the 3rd M1 for this mark.

5th M1 – uses the correct limits and substitutes these in the right way around.

5th A1 – correct total distance travelled.

*A value of k is suitable if

- it is an integer
- it comes from a calculation that uses the fact that the particle is never at rest
- is clearly a maximum value from their calculation, i.e. do not accept a value of k if their calculation/set suggests that the value is actually a minimum (this could happen if candidates make a sign error)