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# AS Level / Year 1 Paper 2 (Edexcel Version)

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Version 1

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Question	Scheme	Marks
<b>1</b>		
(a)	Okta(s) <span style="float: right;">Correct unit</span>	B1 <b>(1)</b>
(b)	enumerate the data points <span style="float: right;">Point 1</span> <i>and</i> describes how enumerated list will be used to obtain a sample of data points	B1
	explains how to deal with repeats <span style="float: right;">Point 2</span>	B1
	explains how to obtain a sample of size 30 <span style="float: right;">Point 3</span>	B1
(c)	smaller amount of data to process / analyse <span style="float: right;">Correct reason</span>	B1 <b>(1)</b>
		<b>5</b>

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

## Question 2 Notes

(a) Accept any of the statements (or reasonable variations of them – use your judgment)

(b) 1<sup>st</sup> 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’ or

(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	
<b>3</b>			
(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
	$P(X > 18) = P(X \geq 19) = 0.8065\dots$	awrt correct probability (standard form not necessary)	A1 <b>(2)</b>
(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</u> customers	Either 22 or 23 customers	A1 <b>(3)</b>
(c)	$H_0 : p = 0.6, H_1 : p \neq 0.6$	Both hypotheses correctly stated	B1
Way 1	Expected value is 21, so consider the upper tail:		
	$P(X \geq 22) = 1 - P(X \leq 21) = 0.4361\dots$ <b>OR</b> $P(X \geq 23) = 1 - P(X \leq 22) = 0.3057\dots$	Considers the upper tail <b>AND</b> finds the probability of $X$ being greater than 21 <b>or</b> 22 ft their (b)	M1A1
	Insufficient evidence of reject $H_0$ / not significant / accept $H_0$	A correct statement ft their probability. <b>Ignore comparisons</b>	dM1
	No evidence to support that the probability that a <b>customer spends</b> at least £20 has changed	<b>eso</b> fully correct solution and contextual conclusion containing the words ‘customer spends’	A1 <b>(5)</b>

(c) Way 2	$H_0 : p = 0.6, H_1 : p \neq 0.6$	Both hypotheses correctly stated	B1
	$P(X \geq 27) = 0.0259\dots, P(X \geq 28) = 0.0101\dots$ $P(X \leq 14) = 0.0132\dots, P(X \leq 14) = 0.0300\dots$ So CR is $(X \leq 14) \cup (X \geq 28)$	One of these statements leading to a critical region. <b>ACCEPT</b> 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 <b>customer spends</b> at least £20 has changed	<b>cs0</b> fully correct solution and contextual conclusion containing the words 'customer spends'	A1 <b>(5)</b>
			<b>10</b>

### 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) 1<sup>st</sup> M1: finds number of customers represented by 1 square (oe)

2<sup>nd</sup> 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

1<sup>st</sup> M1 A1: finds probabilities or (upper) critical region

2<sup>nd</sup> 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

2<sup>nd</sup> A1: **cs0** a fully correct solution with no omissions/errors seen and a contextual conclusion that contains the words 'customer spends'

Question	Scheme	Marks
<b>4</b>		
Way 1	{Let $x$ be $P(A)$ and $y$ be $P(B)$ }	
	<b>By independence,</b> $xy = 0.06$ and $(1-x)(1-y) = 0.51$ See notes	M1B1
	$\Rightarrow 1 + 0.06 - x - \frac{0.06}{x} = 0.51$ Eliminates $y$ and rearranges to form a 3TQ $\Rightarrow 0.55x - x^2 - 0.06 = 0$	dM1
	$\Rightarrow x = \frac{-0.55 \pm \sqrt{0.55^2 - 4(-1)(-0.06)}}{2(-1)}$ 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 $P(\text{not } A)$ $= 0.85$	A1 <b>(6)</b>
Way 2	{Let $x$ be $P(A)$ and $y$ be $P(B)$ }	
	<b>By independence,</b> $xy = 0.06$ and $(1-x)(1-y) = 0.51$ See notes	M1B1
	$\Rightarrow 1 + 0.06 - \frac{0.06}{y} - y = 0.51$ Eliminates $x$ and rearranges to form a 3TQ $\Rightarrow 0.55y - y^2 - 0.06 = 0$	
	$\Rightarrow y = \frac{-0.55 \pm \sqrt{0.55^2 - 4(-1)(-0.06)}}{2(-1)}$ 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 $P(\text{not } A)$ $= 0.85$	A1 <b>(6)</b>
		<b>6</b>

## Question 4 Notes

### Way 1:

1<sup>st</sup> 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

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

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

1<sup>st</sup> A1 – correct values of  $P(A)$

2<sup>nd</sup> A1 – correct MAXIMUM value of  $P(\text{not } A)$ . Quoting both values without clearly stating which is maximum is A0.

### Way 2:

1<sup>st</sup> 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

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

1<sup>st</sup> A1 – correct values of  $P(A)$

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

2<sup>nd</sup> A1 – correct MAXIMUM value of  $P(\text{not } A)$ . Quoting both values without clearly stating which is maximum is A0.

### **ALTERNATIVES:**

Defining  $x$  as  $P(\text{not } A)$  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  $\max(\text{not } B) = \max(\text{not } A)$ . 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
<b>5</b>		
	$R(\uparrow): 2 - 3p - q = 0$ $R(\leftarrow): q - 4 - p - 6 = 3(5) \Rightarrow q - p = 25$	Uses N2L M1A1
	Adding the equations, $2 - 3p - p = 25 \Rightarrow p = \dots$	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
		<b>5</b>
<b>Question 5 Notes</b>		
<p>1<sup>st</sup> M1 – attempts to use N2L to form <b>ONE</b> 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</p> <p>1<sup>st</sup> A1 – <b>BOTH</b> equations correct oe</p> <p>2<sup>nd</sup> M1 – attempts to solve the equations simultaneously using any method. Dependent on the 1<sup>st</sup> M1.</p> <p>2<sup>nd</sup> A1 – correct value of <math>p</math></p> <p>3<sup>rd</sup> A1 – correct value of <math>q</math></p> <p><b>Special case:</b> Assuming that <math>q = \text{weight}</math> and <math>3g</math> N scores no marks (other downward forces may be at work).</p>		

Question	Scheme	Marks
<b>6</b>		
(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 <b>(4)</b>
(b)	$v^2 = u^2 + 2as \Rightarrow s = \frac{0^2 - 26^2}{2(-10.4)} = 32.5 \text{ {m}}$	Uses kinematics formula M1A1 <b>(2)</b>
(c)	As the particle moves upwards, $R$ and the particle's weight both act downwards	
	As the particle moves downwards, $R$ acts upwards and the particle's weight acts downwards ; so the resultant force is different {compared to when the particle moves upwards}	Both points, see notes for guidance B1B1 <b>(2)</b>
(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
	$t = 2.575\dots$	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 <b>(4)</b>
		<b>12</b>

### Question 6 Notes

(a) 1<sup>st</sup> M1 - Attempts to find the acceleration of the particle using the correct formula. Condone sign errors.

1<sup>st</sup> A1 – correct acceleration (ignore sign)

2<sup>nd</sup> 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.

2<sup>nd</sup> 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) 1<sup>st</sup> 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.**

2<sup>nd</sup> 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 2<sup>nd</sup> B1 (even without explicitly using the term ‘resultant force’)

(d) 1<sup>st</sup> M1 – attempts to use N2L to find the downwards acceleration (**if equation given in (c), then award the M1**).

2<sup>nd</sup> M1 – uses the kinematics formula to find the time of the particle’s descent, ft their previous values.

1<sup>st</sup> A1ft – correct time the particle descends ft their previous values

2<sup>nd</sup> A1 – correct time the particle is in the air. Cao.

Question	Scheme	Marks
<b>7</b>		
(a)	For A: $T = 3am$	<u>Correct</u> equations of motion
(i/ii)	For B: $5mg - T = 5am$	M1
	$\Rightarrow a = \frac{5g}{8} \{m s^{-2}\}$	Correct acceleration and tension in terms of $m$ and $g$
	$\Rightarrow T = \frac{15mg}{8} \{N\}$	A1A1 <b>(3)</b>
(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
	Direction is at <u>45 degrees</u> away from the table	Correct direction
		B1 <b>(3)</b>
		<b>6</b>

#### Question 7 Notes

(a) 1<sup>st</sup> M1 – both equations of motions correct

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

(b) 1<sup>st</sup> M1 – attempts to find the resultant force on the pulley

1<sup>st</sup> A1 – correct resultant force on the pulley

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

Question	Scheme	Marks
<b>8</b>		
	$2^2 - 4k(4 - k) < 0$ $\Rightarrow 4k^2 - 16k + 4 < 0$	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
	$\text{distance travelled} = \int_2^3 (3t^2 + 2t + 1) dt = [t^3 + t^2 + t]_2^3$	See notes for criteria M1 A1ft
	$= (3^3 + 3^2 + 3) - (2^3 + 2^2 + 2)$ $= 25 \text{ {m}}$	Substitutes the limits in to find the correct total distance travelled dM1 A1
		<b>7</b>

#### Question 8 Notes

1<sup>st</sup> M1 – uses the discriminant to find an inequality in  $k$ .

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

1<sup>st</sup> A1 – correct **maximum** value of  $k$ .

3<sup>rd</sup> 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.**

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

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

5<sup>th</sup> 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)