



# Mark Scheme (Final)

## January 2026

International Advanced Level in Statistics

S2 WST02\_01A

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## General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

## EDEXCEL IAL MATHEMATICS

### General Instructions for Marking

1. The total number of marks for the paper is 75.
2. The Edexcel Mathematics mark schemes use the following types of marks:
  - **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
  - **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
  - **B** marks are unconditional accuracy marks (independent of M marks)

Marks should not be subdivided.

### 3. Abbreviations

These are some of the traditional marking abbreviations that will appear in the mark schemes and can be used if you are using the annotation facility on ePEN:

- bod – benefit of doubt
  - ft – follow through
    - the symbol  $\surd$  will be used for correct ft
  - cao – correct answer only
  - cso – correct solution only. There must be no errors in this part of the question to obtain this mark
  - isw – ignore subsequent working
  - awrt – answers which round to
  - SC – special case
  - oe – or equivalent (and appropriate)
  - d... or dep – dependent
  - indep – independent
  - dp – decimal places
  - sf – significant figures
  - \* – The answer is printed on the paper or ag- answer given
  - $\square$  or d... – The second mark is dependent on gaining the first mark
4. All A marks are 'correct answer only' (cao), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but manifestly absurd answers should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected. If you are using the annotation facility on ePEN, indicate this action by 'MR' in the body of the script.
6. If a candidate makes more than one attempt at any question:
  - a) If all but one attempt is crossed out, mark the attempt which is NOT crossed out.
  - b) If either all attempts are crossed out or none are crossed out, mark all the attempts and score the highest single attempt.
7. Ignore wrong working or incorrect statements following a correct answer.

1. A shop sells rods of nominal length 200 cm. The rods are bought from a manufacturer who uses a machine to cut rods of length  $L$  cm, where  $L \sim N(\mu, 0.2^2)$

The value of  $\mu$  is such that there is only a 5% chance that the rod, selected at random from those supplied to the shop, will have a length less than 200 cm.

- (a) Find the value of  $\mu$  to one decimal place.

(3)

A customer buys a random sample of 8 of these rods.

- (b) Find the probability that at least 3 of these rods will have a length less than 200 cm.

(3)

Another customer buys a random sample of 60 of these rods.

- (c) Using a suitable approximation, find the probability that more than 5 of these rods will have length less than 200 cm.

(3)

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**(Total for Question 1 is 9 marks)**

Question Number	Scheme		Marks
1(a)	$\frac{200 - \mu}{\sqrt{0.04}} = -1.6449$		M1 A1
	$\mu = 200.3$		A1
			(3)
(b)	$X \sim B(8, 0.05)$		B1
	$P(X \geq 3) = 1 - P(X \leq 2) = 1 - 0.9942$		M1
	$= 0.0058$	awrt 0.0058	A1
		(3)	
(c)	$Y \sim \text{Po}(3)$		B1
	$P(Y > 5) = 1 - P(Y \leq 5) = 1 - 0.9161$		M1
	$= 0.0839$	awrt 0.0839	A1
		(3)	
<b>Notes</b>			<b>Total 9</b>
1(a)	<b>M1</b>	$\pm \frac{200 - \mu}{\sqrt{0.04}} = \pm z$ value, where $ z  > 1$	
	<b>A1</b>	For a correct equation with compatible $z$ value and $z = 1.6449$ or better	
	<b>A1</b>	200.3 Condone awrt 200.3 <b>NB</b> M1A0A1 is possible	
(b)	<b>B1</b>	Writing or using $B(8, 0.05)$ May be implied by e.g. 0.9428 or 0.9996 or 0.0571 or 0.0004 or awrt 0.0058	
	<b>M1</b>	Writing or using $1 - P(X \leq 2)$	
	<b>A1</b>	Awrt 0.0058	
(c)	<b>B1</b>	Writing or using $\text{Po}(3)$ May be implied by e.g. 0.8153 or 0.9665 or 0.1847 or 0.0335 or awrt 0.0839	
	<b>M1</b>	Writing or using $1 - P(Y \leq 5)$	
	<b>A1</b>	Awrt 0.0839	

2. The random variable  $X \sim B(10, p)$

(a) (i) Write down an expression for  $P(X = 3)$  in terms of  $p$

(ii) Find the value of  $p$  such that  $P(X = 3)$  is 16 times the value of  $P(X = 7)$

(4)

The random variable  $Y \sim \text{Po}(\lambda)$

(b) Find the value of  $\lambda$  such that  $P(Y = 3)$  is 5 times the value of  $P(Y = 5)$

(3)

The random variable  $W \sim B(n, 0.4)$

(c) Find the value of  $n$  and the value of  $\alpha$  such that  $W$  can be approximated by the normal distribution,  $N(32, \alpha)$

(3)

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(Total for Question 2 is 10 marks)

Question Number	Scheme		Marks
2(a)(i)	$120(p)^3(1-p)^7$		B1
(ii)	$[^{10}C_3](p)^3(1-p)^7 = [^{10}C_7]16(p)^7(1-p)^3$ or their (a) = $[^{10}C_7]16(p)^7(1-p)^3$		M1
	$(1-p)^4 = 16(p)^4 \Rightarrow (1-p) = 2(p)$ or $15p^4 + 4p^3 - 6p^2 + 4p - 1 = 0$ oe		M1
	$p = \frac{1}{3}$		A1
			(4)
(b)	$\frac{e^{-\lambda} \lambda^3}{3!} = 5 \frac{e^{-\lambda} \lambda^5}{5!}$		M1
	$4 = \lambda^2$		M1
	$\lambda = 2$		A1
			(3)
(c)	$np = 32$		M1
	$n = 80$		A1
	$\alpha = 19.2$		A1
			(3)
<b>Notes</b>			<b>Total 10</b>
(a)(i)	<b>B1</b>	Allow equivalent expressions e.g. $^{10}C_3(p)^3(1-p)^7$	
(ii)	<b>M1</b>	correct equation ft their (a)(i) (condone missing binomial coefficients) but 16 must be on the correct side.	
	<b>M1</b>	Attempt to solve their equation as far as a linear equation in $p$ or a correct quartic equation May be implied by $3p^2 + 2p - 1 = 0$ oe Implied by $p = \frac{1}{3}$ If 16 is on the wrong side then their correct quartic is $15p^4 - 64p^3 + 96p^2 - 64p + 16 = 0$ oe Implied by $p = \frac{2}{3}$	
	<b>A1</b>	For $\frac{1}{3}$ or an exact equivalent (condone 0.333 or better). If other roots shown they must be rejected. Allow 3/3 for correct answer only in (ii)	
(b)	<b>M1</b>	correct equation	
	<b>M1</b>	attempt to solve their equation as far as $\lambda^2 = k$ or $\lambda = \sqrt{k}$ .	
	<b>A1</b>	for $\lambda = 2$ only	
(c)	<b>M1</b>	Writing or using of $np = 32$ Allow any value of $p$ provided $0 < p < 1$ Implied by $n = 80$	
	<b>A1</b>	$n = 80$	
	<b>A1</b>	$\alpha = 19.2$ NB M1A0A1 is possible	

3. The continuous random variable  $X$  has cumulative distribution function given by

$$F(x) = \begin{cases} 0 & x < 0 \\ \frac{1}{6}x(x+1) & 0 \leq x \leq 2 \\ 1 & x > 2 \end{cases}$$

- (a) Find the value of  $a$  such that  $P(X > a) = 0.4$   
Give your answer to 3 significant figures.

(3)

(b) Use calculus to find

- (i)  $E(X)$   
(ii)  $\text{Var}(X)$

*(Solutions relying on calculator technology are not acceptable.)*

(8)

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**(Total for Question 3 is 11 marks)**

Question Number	Scheme		Marks
3(a)	$\frac{1}{6}a(a+1) = 0.6$		M1
	$a^2 + a - 3.6 = 0$ So $a = \frac{-1 \pm \sqrt{1+4 \times 3.6}}{2}$		M1
	$= 1.462\dots$	awrt 1.46	A1
			(3)
(b)(i)	$[f(x) = \frac{d}{dx} F(x) =] \frac{1}{3}x + \frac{1}{6}$		M1A1
	$[E(X) =] \int_0^2 x(\frac{1}{3}x + \frac{1}{6}) dx$		M1
	$= [\frac{x^3}{9} + \frac{x^2}{12}]_0^2$		A1
	$= \frac{11}{9}$	awrt 1.22	A1
(ii)	$[Var(X) =] \int_0^2 x^2(\frac{1}{3}x + \frac{1}{6}) dx - (\frac{11}{9})^2$		M1
	$= [\frac{x^4}{12} + \frac{x^3}{18}]_0^2 - (\frac{11}{9})^2$		A1ft
	$= \frac{23}{81}$	awrt 0.284	A1
			(8)
<b>Notes</b>			<b>Total 11</b>
(a)	<b>M1</b>	putting $F(x) = 0.6$ or $1 - 0.4$	
	<b>M1</b>	attempting either completing the square or quadratic formula (one slip allowed) (condone + instead of $\pm$ ) Must set $F(a) = 0.6$ or $F(a) = 0.4$ to score this mark May be implied by awrt 1.46 or awrt -2.46 (if set = 0.4 then may be implied by awrt 1.13 or awrt -2.13)	
	<b>A1</b>	awrt 1.46 (must reject other root if stated)	
(b)(i)	<b>M1</b>	attempting to differentiate $F(x)$ at least one $x^n \rightarrow x^{n-1}$ May be seen in part a	
	<b>A1</b>	Ca0	
	<b>M1</b>	attempting $\int_0^2 xf(x) dx$ at least one $x^n \rightarrow x^{n+1}$ using their $f(x)$ which must be a changed function from $F(x)$ . No need for limits	
	<b>A1</b>	For $\frac{x^3}{9} + \frac{x^2}{12}$ (may be unsimplified) Ignore limits	
	<b>A1</b>	Awrt 1.22	
(ii)	<b>M1</b>	M1 attempting $\int x^2 f(x) dx$ at least one $x^n \rightarrow x^{n+1}$ using their $f(x)$ which must be a changed function from $F(x)$ . Ignore limits.	
	<b>A1ft</b>	For $\frac{x^4}{12} + \frac{x^3}{18} - \mu^2$ (may be unsimplified) Ft their $E(X)$ . Ignore limits. The subtraction may be seen after the evaluation of $E(X^2)$	
	<b>A1</b>	Awrt 0.284	

4. A company claims that 35% of its peas germinate. In order to test this claim Ann decides to plant 15 of these peas and record the number which germinate.
- (a) (i) State suitable hypotheses for a two tailed test of this claim.
- (ii) Using a 5% level of significance, find an appropriate critical region for this test. The probability in each of the tails should be as close to 2.5% as possible. (4)
- (b) Ann found that 8 of the 15 peas germinated. State whether or not the company's claim is supported. Give a reason for your answer. (2)
- (c) State the actual significance level of this test. (1)

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**(Total for Question 4 is 7 marks)**

Question Number	Scheme		Marks
4(a)(i) (ii)	$H_0 : p = 0.35 \quad H_1 : p \neq 0.35$		B1
	B(15,0.35)		M1
	CR $X \leq 1 \cup X \geq 10$		A1A1
			(4)
(b)	8 is not in CR/Do not reject $H_0$ /Not significant		M1
	There is evidence that the Company's <b>claim</b> is true		A1ft
			(2)
(c)	$0.0142 + 0.0124 = 0.0266$		B1
			(1)
<b>Notes</b>			<b>Total 7</b>
(a)(i)	<b>B1</b>	Both hypotheses correct. Must be attached to $H_0$ and $H_1$ . Must be in terms of $p$ or $\pi$ Allow seen in (ii) if no answer given in (i)	
(ii)	<b>M1</b>	Writing or using B(15,0.35) May be seen in (i) May be implied by e.g. $P(X \leq 1) = 0.0142$ or $P(X \leq 9) = 0.9876$ or $X \leq 1$ <b>and</b> $X \geq 10$ oe	
	<b>A1</b>	$X \leq 1$ (Allow any letter) (accept $X < 2$ ) Allow $0 \leq X \leq 1$ but $P(X \leq 1)$ is A0	
	<b>A1</b>	$X \geq 10$ (Allow any letter) (accept $X > 9$ ) Allow $10 \leq X \leq 15$ but $P(X \geq 10)$ is A0	
(b)	<b>M1</b>	For a non contextual statement that matches their CR. If they write their CR as $P(X \geq 10)$ take this to mean $X \geq 10$ Allow calculation of $P(X \geq 8) = 0.1132$ or $P(X \leq 8) = 0.9578$ and not significant/do not reject $H_0$ Do not allow contradictory non contextual statements e.g. 8 is not in the CR so significant This may be implied by a correct contextual statement on its own	
	<b>A1ft</b>	For a correct contextual conclusion for their CR. Must mention claim or peas and germinate e.g. there is evidence that 35% (oe) of <b>peas germinate</b>	
(c)	<b>B1</b>	For 0.0266 or awrt 0.0266 (cal gives 0.02662196...) May be seen in part (b)	

5. A string of length 40 cm is cut into 2 pieces at a random point.  
The continuous random variable  $L$  represents the length of the longer piece of string.

(a) Write down the distribution of  $L$  (2)

(b) Find the probability that the length of the longer piece of string is 28 cm to the nearest cm. (2)

Each piece of string is used to form the perimeter of a square.

(c) Calculate the probability that the area of the larger square is less than  $64 \text{ cm}^2$  (3)

(d) Calculate the probability that the difference in area between the two squares is greater than  $81 \text{ cm}^2$  (4)

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(Total for Question 5 is 11 marks)

Question Number	Scheme		Marks
5(a)	$L \sim U[20,40]$ or $f(l) = \begin{cases} \frac{1}{20} & 20 \leq l \leq 40 \\ 0 & \text{otherwise} \end{cases}$		B1dB1 (2)
(b)	$P(27.5 < L < 28.5) = \frac{28.5 - 27.5}{40 - 20} = \frac{1}{20}$ oe		M1A1 (2)
(c)	$\left(\frac{L}{4}\right)^2 < 64 = \left(\frac{L}{4}\right) < 8$		M1
	$P(L < 32) = \frac{32 - 20}{40 - 20} = 0.6$ oe		M1A1 (3)
(d)	$\left(\frac{L}{4}\right)^2 - \left(\frac{40-L}{4}\right)^2 > 81 \Rightarrow \left(\frac{-1600 + 80L}{16}\right) > 81$		M1
	$L > 36.2$		A1
	$P(L > "36.2") = \frac{40 - "36.2"}{40 - 20} = 0.19$ oe or $1 - \frac{36.2 - 20}{40 - 20} = 0.19$ oe		M1A1 (4)
<b>Notes</b>			<b>Total 11</b>
(a)	<b>B1</b>	For U[niform] or rectangular or $f(l) = \frac{1}{20}$	
	<b>dB1</b>	Dep on 1 <sup>st</sup> B1 For [20, 40] or correct pdf fully specified. Must be seen in part (a)	
(b)	<b>M1</b>	for finding $P(27.5 < L < 28.5)$ from a uniform distribution. May be implied by $\frac{1}{20}$	
	<b>A1</b>	Oe	
(c)	<b>M1</b>	for a correct expression for the area and comparison with 64 (allow equation or inequality) (may be implied by 32)	
	<b>M1</b>	using $P(L < 32)$ with uniform distribution. May be implied by 0.6 oe	
	<b>A1</b>	Oe	
(d)	<b>M1</b>	a correct expression to find the difference between the two areas and comparison with 81 (allow equation or inequality) (may be implied by 36.2 oe) Condone $\left(\frac{40-L}{4}\right)^2 - \left(\frac{L}{4}\right)^2 > 81$	
	<b>A1</b>	Oe e.g. $\frac{181}{5}$ (allow equation or inequality)	
	<b>M1</b>	using $P(L > "36.2")$ or $1 - P(L < "36.2")$ with uniform distribution. Ft their 36.2	
	<b>A1</b>	Oe	

6. The continuous random variable  $X$  has probability density function  $f(x)$  given by

$$f(x) = \begin{cases} \frac{1}{20}x^3 & 0 \leq x \leq 2 \\ \frac{1}{10}(6-x) & 2 < x \leq 6 \\ 0 & \text{otherwise} \end{cases}$$

(a) Sketch the graph of  $f(x)$  for all values of  $x$  (3)

(b) Write down the mode of  $X$  (1)

(c) Show that  $P(X > 2) = 0.8$  (2)

(d) Define fully the cumulative distribution function  $F(x)$  (4)

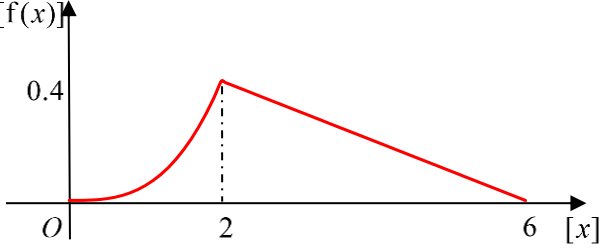
Given that  $P(X < a \mid X > 2) = \frac{5}{8}$

(e) find the value of  $F(a)$  (2)

(f) Hence, or otherwise, find the value of  $a$ . Give your answer to 3 significant figures. (3)

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**(Total for Question 6 is 15 marks)**

Question Number	Scheme	Marks
6(a)		B1B1B1 (3)
(b)	[Mode] = 2	B1 (1)
(c)	$[P(X > 2)] = \int_2^6 \frac{1}{10}(6-x)dx \text{ or } \frac{1}{2}(6-2)(0.4) \text{ oe or } 1 - \int_0^2 \frac{1}{20}x^3 dx$ $= 0.8^*$	M1 A1* (2)
(d)	$\left[ F(x) = \int_0^x \frac{1}{20}t^3 dt = \right] \frac{1}{80}x^4, 0 \leq x \leq 2$ $[2 < x \leq 6, F(x) = ] \int_0^2 \frac{1}{20}t^3 dt + \int_2^x \frac{1}{10}(6-t)dt = 0.2 + \frac{1}{10} \left[ 6t - \frac{1}{2}t^2 \right]_2^x \text{ or}$ $\int \frac{1}{10}(6-x)dx = \frac{1}{10} \left( 6x - \frac{x^2}{2} \right) + c \text{ or } -\frac{1}{20}(6-x)^2 \text{ with } F(2) = 0.2 \text{ or } F(6) = 1$ $F(x) = \begin{cases} 0, & x < 0 \\ \frac{1}{80}x^4, & 0 \leq x \leq 2 \\ \frac{1}{10} \left( 6x - \frac{1}{2}x^2 - 8 \right), & 2 < x \leq 6 \\ 1, & x > 6 \end{cases}$	B1 M1 A1B1 (4)
(e)	$\left[ P(X < a   X > 2) = \frac{5}{8} \Rightarrow F(a) = \right] \frac{5}{8}(0.8) + "0.2"; = 0.7 \text{ or } 0.5 + "0.2"; = 0.7$	M1A1 (2)
(f)	$\frac{1}{10} \left( 6a - \frac{1}{2}a^2 - 8 \right) = \frac{7}{10} \text{ or } 1 - \frac{1}{20}(6-a)^2 = \frac{7}{10} \text{ or } \frac{1}{2}(6-a) \times \frac{1}{10}(6-a) = 1 - "0.7" \text{ or}$ $\frac{(6-a)^2}{4^2} = \frac{1 - "0.7"}{0.8}$ $\left[ a^2 - 12a + 30 = 0 \Rightarrow \right] a = \frac{12 \pm \sqrt{12^2 - 4(1)(30)}}{2} \text{ or } \left[ (6-a)^2 = 6 \Rightarrow \right] a = 6 \pm \sqrt{6}$ $\left[ a = 3.5505102... \Rightarrow \right] a = 3.55 \text{ (3 sf)}$	M1 dM1 A1 (3)
<b>Notes</b>		<b>Total 15</b>

(a)	<b>B1</b>	Correct shape with correct curvature. Must start at the $x$ -axis
	<b>B1</b>	Straight line with negative gradient. Must end at the $x$ -axis
	<b>B1</b>	2, 6 and 0.4 labelled in the correct place
(b)	<b>B1</b>	Cao
(c)	<b>M1</b>	A correct expression for $P(X > 2)$
	<b>A1*</b>	Answer is given so no incorrect working can be seen
(d)	<b>B1</b>	2 <sup>nd</sup> line of $F(x)$ with correct limits. Condone use of $<$ rather than $\leq$
	<b>M1</b>	For a complete method to find $F(x)$ for $2 < x < 6$ <b>Either</b> attempt to integrate (at least one $t^n \rightarrow t^{n+1}$ ) both parts of $f(t)$ with correct limits <b>or</b> with $+ c/d$ <b>and</b> uses $F(2) = 0.2$ or $F(6) = 1$
	<b>A1</b>	3 <sup>rd</sup> line of $F(x)$ with correct limits May be written as $1 - \frac{1}{20}(6-x)^2$ Condone use of $\leq$ rather than $<$
	<b>B1</b>	1 <sup>st</sup> and 4 <sup>th</sup> line of $F(x)$ with correct limits (Allow otherwise for one of these two limits) Condone use of $\leq$ rather than $<$ or $\geq$ rather than $>$
(e)	<b>M1</b>	For $[F(a)] = \frac{5}{8}(0.8) + \text{their } F(2)$ oe or $0.5 + \text{their } F(2) = [F(a)]$ oe May be implied by $F(a) = 0.7$
	<b>A1</b>	0.7 oe
(f)	<b>M1</b>	Setting the 3 <sup>rd</sup> line of their $F(x)$ equal to their answer to part (e) or finding the area of the right hand triangle and setting $= 1 - \text{their part (e)}$ or using the square of ratio of areas equal to the ratio of sides
	<b>dM1</b>	Dep on 1 <sup>st</sup> M1 for solving a 3TQ (If the 3TQ is incorrect then working must be shown)
	<b>A1</b>	For 3.55 (Allow awrt 3.55)

7. Members of a conservation group record the number of sightings of a rare animal. The number of sightings follows a Poisson distribution with a rate of 1 every 2 months.
- (a) Find the smallest value of  $n$  such that the probability that there are at least  $n$  sightings in 2 months is less than 0.05 (2)
- (b) Find the smallest number of months,  $m$ , such that the probability of no sightings in  $m$  months is less than 0.05 (2)
- (c) Find the probability that there is at least 1 sighting per month in each of 3 consecutive months. (3)
- (d) Find the probability that the number of sightings in an 8 month period is equal to the expected number of sightings for that period. (2)
- (e) Given that there were 4 sightings in a 4 month period, find the probability that there were more sightings in the last 2 months than in the first 2 months. (3)

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(Total for Question 7 is 12 marks)

Question Number	Scheme		Marks
7(a)	$X \sim \text{Po}(1) \quad P(X \geq n) < 0.05 \quad \text{or} \quad P(X < n) > 0.95$		M1
	$n = 4$		A1
			(2)
(b)	$Y \sim \text{Po}(0.5m) \quad P(Y = 0) < 0.05 \quad \text{or} \quad e^{-\frac{1}{2}m} < 0.05$		M1
	$m = 6$		A1
			(2)
(c)	$W \sim \text{Po}(0.5) \quad \text{and} \quad P(W \geq 1)$		M1
	$[P(W \geq 1)]^3 = (1 - P(W = 0))^3 = (1 - 0.6065)^3 = 0.06093\dots$		awrt 0.0609
			M1A1 (3)
(d)	$S \sim \text{Po}(4)$		M1
	$P(S = 4) = 0.1953\dots$		awrt 0.195
			A1 (2)
(e)	$A \sim \text{Po}(1) \quad B \sim \text{Po}(2)$		
	$P(\text{sightings in last 2 months} > \text{sightings in first 2 months} \mid 4 \text{ sightings in 4 months}) =$ $\frac{P(A = 1) \times P(A = 3) + P(A = 0) \times P(A = 4)}{P(B = 4)} = \frac{e^{-1} \times \frac{e^{-1}}{3!} + e^{-1} \times \frac{e^{-1}}{4!}}{\frac{e^{-2} \times 2^4}{4!}}$		M1M1
	$= \frac{5}{16}$ oe		A1 (3)
ALT (e)	$X \sim B(4, 0.5)$		M1
	$P(X \leq 1) \text{ or } P(X \geq 3)$		M1
	$= \frac{5}{16}$ oe		A1
<b>Notes</b>			<b>Total 12</b>
(a)	<b>M1</b>	for writing or using $\text{Po}(1)$ <b>and</b> $P(X \geq n) < 0.05$ or $P(X < n) > 0.95$ or for $\text{Po}(1)$ <b>and</b> $[P(X \leq 2) =] 0.9197$ or $[P(X \leq 3) =] 0.9810$ or $[P(X > 2) =] 0.0803$ or $[P(X > 3) =] 0.019$	
	<b>A1</b>	Cao Answer only is 2/2	
(b)	<b>M1</b>	for $P(Y = 0) = 0.1353$ from $\text{Po}(2)$ <u>or</u> $P(Y = 0) = 0.0821$ from $\text{Po}(2.5)$ <u>or</u> $P(Y = 0) = 0.0498$ from $\text{Po}(3)$ or $e^{-\frac{1}{2}m} < 0.05$ (May be implied by $0.5m = \text{awrt } 3$ )	
	<b>A1</b>	Cao Answer only is 2/2	
(c)	<b>M1</b>	For writing or using $\text{Po}(0.5)$ <b>and</b> $P(W \geq 1)$	
	<b>M1</b>	for using $(1 - P(W = 0))^3$ Allow $W \sim \text{Po}(\lambda) \quad \lambda > 0$	
	<b>A1</b>	Awrt 0.0609	
(d)	<b>M1</b>	For use of $\text{Po}(4)$	
	<b>A1</b>	Awrt 0.195	
(e)	<b>M1</b>	For $P(A = 1) \times P(A = 3) [=0.02255\dots] + P(A = 0) \times P(A = 4) [=0.0056\dots]$ from $\text{Po}(1)$ or $0.0282\dots$ May be implied by awrt 0.312/0.313 or writing or using $B(4, 0.5)$	
	<b>M1</b>	For a conditional probability with $P(B = 4) [=0.0902\dots]$ on the denominator from $\text{Po}(2)$ provided this gives a probability. May be implied by awrt 0.312/0.313 or for writing or using $P(X \leq 1)$ or $P(X \geq 3)$ if $B(4, 0.5)$ stated	
	<b>A1</b>	Allow awrt 0.312/0.313	

