Exam Practice

1

Akash is investigating the daily mean temperature in the UK in June 2015.

He decides to take a sample of the first 12 days from June 2015 for Camborne from the large data set.

The results are shown below:

$$10.7, 13.2, 12.2, 12.0, 12.1, 11.1, 11.2, 11.7, 11.6, 11.6, 14.6, 15.6$$

(a)
Akash decides to use the variable t to represent the values in his sample of daily mean temperatures.

State, with a reason, whether t is a discrete or continuous variable.

(1)

(b)

Given that $\sum t = 147.3$ and $\sum t^2 = 1832.23$.

Find the mean and standard deviation of t.

(3)

(c)
The mean temperature for 13 June is recorded as $14.1°C$

State what effect, if any, adding this value to the data set would have on the mean value of t.

(1)

(d)
Suggest how Akash could make better use of the large data set for his investigation

(1)

2

(a)
In terms of probability, explain what is meant by the following statements:

i) "event Q and event R are independent"

ii) "event R and event S are mutually exclusive"

(2)

(b)

Given that the events A and B are independent and that $P(A) = \frac{3}{8}$ and

$P(A \cup B) = \frac{1}{2}$:

Find $P(B)$

(4)

(c)
Using your answer to part b, find $P(A' \cap B)$

(2)

(d)
Find $P(B'|A)$

(2)

3
Clare models the daily rainfall, X, measured in mm, for the month of October 2015 in the UK using $X \sim N\left(6.51, 1.7^2\right)$

(a)
Calculate the probability that X is less than 6.8 mm.

(1)

(b)
Calculate the probability that X is greater than one standard deviation above the mean.

(2)

(c)
To the nearest number of days, find the expected number of days in October where the UK daily rainfall is more than one standard deviation above the mean.

(2)

(d)
At the end of 2017, Clare believes that mean daily rainfall for the UK in October is now more than 6.51 mm.

She takes a random sample of 64 days and finds that their mean daily rainfall is 6.89 mm.

Stating your hypotheses clearly, carry out a test of Clare's belief at the 5% level of significance.

(6)

4

Tanya and Peter are conducting an experiment in which a group of children repeatedly attempt to throw a ball into a basket a short distance away. For each child, the random variable H represents the number of times the ball lands in the basket in their first 8 throws.

(a)

Tanya models the probability distribution of H as $H \sim B(8, 0.2)$

State two assumptions that Tanya must make in order to use her model .

(2)

(b)

Using Tanya's model, find $P(H \geq 3)$

(2)

(c)

Peter is interested in counting the number of throws required for a child to get their ball into the basket.

He uses the random variable F to represent the number of the throw (from 1 to 8) which first lands in the basket.

Using the same assumptions as for Tanya's model, find $P(F = 4)$

(2)

(d)

Peter assumes that none of the children will require more than 8 attempts before they throw a ball into the basket for the first time.

He models the distribution of probabilities for different values of F as
$P(F = n) = 0.09 + (n - 1) \cdot a$ where a is a constant

Find the value of a

(4)

(e)

Using Peter's model, find $P(F = 4)$

(1)

5

(a)

Briefly describe the difference in appearance between a scatter graph that shows strong positive correlation between y and x and a scatter graph that shows strong negative correlation between y and x.

(1)

(b)

The product moment correlation coefficient, r, is calculated for a sample of mean temperature values and maximum relative humidity values in Hurn over a 20-day period in 2015.

The value of r is found to be 0.3260, correct to 4 decimal places.

Give an interpretation of the value of r in context

(1)

(c)

Stating your hypotheses clearly, perform a hypothesis test at the 10% level of significance, to test the claim that the correlation coefficient between daily mean temperature and daily maximum relative humidity in Hurn in 2015 is non-zero.

(4)

(d)

Caleb is investigating the 24-hour total rainfall, $t\ \mathrm{mm}$, and the daily mean pressure, $P\ \mathrm{hPa}$, in Perth on several rainy days in July 2015.

He takes a sample of the data where t is non-zero and codes the pressure data using the formula $c = P - 1000$.

Caleb calculates the equation of the linear regression line of t on c to be $t = 37 - 1.15c$

Find the equation of the linear regression line of t on P, giving your answer in its simplest form.

(1)

(e)

Zeta thinks that an exponential model will be a better fit for the data and she draws a scatter graph with values of $\ln(t)$ on the vertical axis and $P - 1000$ on the horizontal axis. She then draws in a line of best fit which has a gradient of -0.3 and passes through the point $(0, 6.2)$.

Given that Zeta's exponential model has the form $t = k \cdot b^{P-1000}$, use the information about her line of best fit to find appropriate values for k and b, correct to 3 significant figures.

(5)

Submit final answers

Exam Practice

1

Akash is investigating the daily mean temperature in the UK in June 2015.

He decides to take a sample of the first 12 days from June 2015 for Camborne from the large data set.

The results are shown below:

$$10.7, 13.2, 12.2, 12.0, 12.1, 11.1, 11.2, 11.7, 11.6, 11.6, 14.6, 15.6$$

(a)

Akash decides to use the variable t to represent the values in his sample of daily mean temperatures.

State, with a reason, whether t is a discrete or continuous variable.

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(1)**
Up to 1 mark for: • B1: The daily mean temperatures are not restricted to being separate, distinct values. Therefore t is a continuous variable. [A correct conclusion with a reasonable justification] **Additional Explanation:** The daily mean temperatures could take any value within a range of temperatures. Therefore t is a continuous variable.	0 **(1)**

(b)

Given that $\sum t = 147.3$ and $\sum t^2 = 1832.23$.

Find the mean and standard deviation of t.

(3)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(3)**
Up to 3 marks for: • B1: Mean of $t = \sum \frac{t}{12} = \frac{147.3}{12} = 12.275$ (12.3 to 3sf) [Divides total of t values by 12 to obtain correct value as above] • M1: Standard deviation of t: $= \sqrt{\frac{\sum t^2}{12} - \left(\frac{\sum t}{12}\right)^2}$ [Uses an appropriate formula for standard deviation] • A1: $= \sqrt{\frac{1832.23}{12} - 12.275^2} = 1.4178$ (1.42 to 3 s.f.)] [Substitutes values to obtain the correct result as above]	0 **(3)**

(c)

The mean temperature for 13 June is recorded as $14.1°C$

State what effect, if any, adding this value to the data set would have on the mean value of t.

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(1)**
Up to 1 mark for: • B1: The mean value of t will increase because 14.1 is greater than the mean of the original 12 sampled values (12.3) [Compares new value to previous mean and states correct outcome] **Additional Explanation:** If the extra value is greater than the mean of the 12 original values then the overall mean value of t will increase. If the extra value is less than the mean of the 12 original values then the overall mean value of t will decrease. If the extra value is equal to the mean of the 12 original values then the overall mean value of t will stay the same.	0 **(1)**

(d)
Suggest how Akash could make better use of the large data set for his investigation

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(1)**

Answer	Mark
Up to 1 mark for: • B1: Increase the number of data values and sample locations to be more representative of the UK as a whole. [More data values from Camborne and elsewhere] **Additional Explanation:** Akash could use more data from Camborne in June 2015 and also from elsewhere around the UK. This would make his sample more representative of the whole of the UK and therefore his mean and standard deviation values would be more accurate approximations of the mean and standard deviation values for the whole of the UK.	0 **(1)**

Answers saved!

Save marks and mark next question >

Exam Practice

2

(a)
In terms of probability, explain what is meant by the following statements:

i) "event Q and event R are independent"

ii) "event R and event S are mutually exclusive"

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(2)**

Answer	Mark
Up to 2 marks for: • B1: i) Events Q and R are independent if the probability of event R is unchanged when event Q happens and vice versa. Alternatives: $P(R\|Q) = P(R)$ or $P(Q \cap R) = P(Q) \cdot P(R)$ [i) Independent: Refers to probability of an event not changing when another event occurs or uses an equivalent probability statement as in the alternatives above] • B1: ii) Events R and S are mutually exclusive if it is not possible for both events to occur at the same time. Alternatives: $P(R \cap S) = 0$ or $P(R \cup S) = P(R) + P(S)$ [ii) Mutually Exclusive: Refers to it not being possible for the events to happen at the same time or uses an equivalent probability statement as in the alternatives above]	0 **(2)**

(b)

Given that the events A and B are independent and that $P(A) = \frac{3}{8}$ and

$P(A \cup B) = \frac{1}{2}$:

Find $P(B)$

(4)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(4)**

Answer	Mark
Up to 4 marks for: • M1: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ [Uses correct formula for union with all 4 terms. May be implied.] • B1: $P(A \cup B) = P(A) + P(B) - P(A) \cdot P(B)$ [Uses independence of A and B. $P(B \vert A) = P(B)$ or $P(A \cap B) = P(A) \cdot P(B)$ seen anywhere in part b).] • M1: $\frac{1}{2} = \frac{3}{8} + P(B) - \frac{3}{8}P(B)$ leading to $P(B) = ...$ [Substitutes values and rearranges to find a value for $P(B)$] • A1: $P(B) = \frac{1}{5}$ [Obtains correct answer as above]	0 **(4)**

(c)

Using your answer to part b, find $P(A' \cap B)$

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**
Up to 2 marks for: • M1: $P(A' \cap B) = P(A') \cdot P(B)$ [Uses independence of A’ and B as above or an equivalent equation.] • A1: $P(A' \cap B) = \left(1 - \frac{3}{8}\right) \cdot \left(\frac{1}{5}\right) = \frac{5}{8} \cdot \frac{1}{5} = \frac{1}{8}$ [Substitutes values to obtain the required probability. Follow through on their $P(B)$.]	0 **(2)**

(d)

Find $P(B' \vert A)$

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**
Up to 2 marks for: • M1: $P(B'\|A) = \frac{P(B' \cap A)}{P(A)}$ [Uses an appropriate conditional probability equation as above or equivalent.] • A1: $P(B'\|A) = \frac{\left(1-\frac{1}{5}\right)\cdot\frac{3}{8}}{\frac{3}{8}} = \left(1-\frac{1}{5}\right) = \frac{4}{5}$ [Substitutes correct values to obtain result as above. No follow through here.]	0 **(2)**

Answers saved!

Save marks and mark next question >

Exam Practice

3

Clare models the daily rainfall, X, measured in mm, for the month of October 2015 in the UK using

$X \sim N\left(6.51, 1.7^2\right)$

(a)

Calculate the probability that X is less than 6.8 mm.

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(1)**
Up to 1 mark for: • B1: $P(X < 6.8) = 0.5677$ (4dp) [Use of calculator with Normal CD] **Additional Explanation:** Calculator Mode: Normal CD Lower: -10 or another appropriate low value Upper: 6.8 σ: 1.7 μ: 6.51 $P(X < 6.8) = 0.5677$ (4dp)	0 **(1)**

(b)

Calculate the probability that X is greater than one standard deviation above the mean.

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**
Up to 2 marks for: • M1: $P(X > 6.51 + 1.7) = P(X > 8.21)$ [Use of calculator with Normal CD and lower value of $6.51 + 1.7 = 8.21$] • A1: $P(X > 6.51 + 1.7) = 0.1587$ (4dp) [Obtains correct value as above.] **Additional Explanation:** Calculator Mode: Normal CD Lower: Mean value $+$ standard deviation $= 6.51 + 1.7$ Upper: 20 or another appropriate high value σ: 1.7 μ: 6.51 $P(X > 6.51 + 1.7) = P(X > 8.21) = 0.1587$ (4dp).	0 **(2)**

(c)
To the nearest number of days, find the expected number of days in October where the UK daily rainfall is more than one standard deviation above the mean.

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**

Answer	Mark
Up to 2 marks for: • M1: $31 \cdot P(X > 8.21) = 31(0.1587)$ or $31 \cdot$ [Their answer to b)] [Multiplies their answer to part b) by 31] • A1: $31(0.1587) = 4.9197 = 5$ days (to nearest number of days) [Rounds correctly to the nearest number of days as above] The probability that a particular day's rainfall is greater than one standard deviation above the mean is 0.1587. There are 31 days in October so the expected number of days with this level of rainfall can be estimated by $31 \cdot 0.1587 = 4.9197$. Therefore there will be approximately 5 days in October where the daily rainfall is greater than one standard deviation above the mean.	0 **(2)**

(d)

At the end of 2017, Clare believes that mean daily rainfall for the UK in October is now more than 6.51 mm.

She takes a random sample of 64 days and finds that their mean daily rainfall is 6.89 mm.

Stating your hypotheses clearly, carry out a test of Clare's belief at the 5% level of significance.

(6)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(6)**

Answer	Mark
Up to 6 marks for: • B1: $H_0 : \mu = 6.51, H_1 : \mu > 6.51$ [Correct statement of both hypotheses] • M1: Sampling distribution for mean of $X \sim N\left(6.51, \frac{1.7^2}{64}\right)$ [States the correct sampling distribution for the mean of X.] • M1: $P($Mean of $X > 6.89) = \ldots$ [Use of calculator with Normal CD, lower value of 6.89 and $\sigma = \frac{1.7}{\sqrt{64}}$] • A1: $P($Mean of $X > 6.89) = 0.0369$ [Obtains correct value as above] • M1: $0.0369 < 0.05$. Therefore the results are significant. [Compares probability to 0.05 and comments on results.] • A1: There is sufficient evidence at the 5% level to reject H_0. The test supports Clare's belief that the mean daily rainfall for the UK in October has increased. [Correct conclusion in context as above.] **Additional Explanation:** $X \sim N\left(6.51, 1.7^2\right)$ and therefore the sampling distribution for the mean of X will be: $N\left(6.51, \frac{1.7^2}{64}\right)$ Calculator Mode: Normal CD Lower: 6.89 Upper: 20 or another appropriate high value σ: $\frac{1.7}{\sqrt{64}}$ μ: 6.51 $P($Mean of $X > 6.89) = 0.0369$ This probability value is less than the 5% significance level of the test. Therefore the hypothesis test supports Clare's belief that the mean daily rainfall for the UK in October has increased.	0 **(6)**

Answers saved!

Save marks and mark next question >

Exam Practice

4

Tanya and Peter are conducting an experiment in which a group of children repeatedly attempt to throw a ball into a basket a short distance away. For each child, the random variable H represents the number of times the ball lands in the basket in their first 8 throws.

(a)

Tanya models the probability distribution of H as $H \sim B(8, 0.2)$

State two assumptions that Tanya must make in order to use her model .

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(2)**
Up to 2 marks for: • B1: The probability that a ball lands in the basket is always 0.2 [Statement as above or equivalent] • B1: Each throw is independent [Statement as above or equivalent]	0 **(2)**

(b)

Using Tanya's model, find $P(H \geq 3)$

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**
Up to 2 marks for: • B1: $P(H \leq 2) = 0.7969$ [Obtains correct value for $P(H \leq 2)$ as above. Probably using Binomial CD. May be implied.] • B1: $P(H \geq 3) = 1 - P(H \leq 2) = 1 - 0.7969 = 0.2031$ [Obtains correct final probability for $P(H \geq 3)$ as above. $P(H \geq 3) = 0.2031$ is enough to earn both marks.] **Additional Explanation:** $H \sim B(8, 0.2)$ Calculator Mode: Binomial CD x: 2 N: 8 p: 0.2 $P(H \leq 2) = 0.7969$ (4dp). Therefore $P(H \geq 3) = 1 - P(H \leq 2) = 1 - 0.7969 = 0.2031$	0 **(2)**

(c)

Peter is interested in counting the number of throws required for a child to get their ball into the basket.

He uses the random variable F to represent the number of the throw (from 1 to 8) which first lands in the basket.

Using the same assumptions as for Tanya's model, find $P(F = 4)$

(2)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(2)**
Up to 2 marks for: • M1: $P(F=4)=0.8^3 \cdot 0.2$ [Calculates the probability of three misses and one success] • A1: $P(F=4)=\frac{64}{625}=0.1024$ (0.102 to 3sf) [Obtains correct answer as above] **Additional Explanation:** To land in the basket on the 4th throw, the child must have missed the basket with their first three attempts. $P(F=4)=P(\text{Miss}) \cdot P(\text{Miss}) \cdot P(\text{Miss}) \cdot P(\text{Ball lands in basket})$ $P(F=4)=(0.8)(0.8)(0.8)(0.2)=\frac{64}{625}=0.1024$ (0.102 to 3sf)	0 **(2)**

(d)

Peter assumes that none of the children will require more than 8 attempts before they throw a ball into the basket for the first time.

He models the distribution of probabilities for different values of F as
$P(F=n)=0.09+(n-1) \cdot a$ where a is a constant

Find the value of a

(4)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer
Total

Answer

Up to 4 marks for:

- M1: $P(F \leq 8) = P(F=1) + P(F=2) + \ldots + P(F=8)$
  [Attempts sum of all eight terms]
- A1: $P(F \leq 8) = 0.09(8) + (0+1+\ldots+7) \cdot a$ or equivalent
  [A correct, unsimplified, expression as above]
- M1: $P(F \leq 8) = 1$ or $0.72 + 28a = 1$ leading to $a = \ldots$
  [Sets sum of terms equal to 1 and solves for a]
- A1: $a = 0.01$
  [Correct value as above]

Additional Explanation:

It is assumed that 8 attempts are the most that will be required for each child to land their ball in the basket.

Therefore every child will land their ball in the basket within their first 8 attempts. Therefor $P(F \leq 8)$ is equal to 1.

$$P(F \leq 8) = P(F=1) + P(F=2) + \ldots + P(F=8) = 0.09(8) + (0+1+\ldots+7$$

The formula for each term's probability contains 0.09 so this part gets added together 8 times.

The amount that a is multiplied by in each term is increasing by 1 each time.

When all 8 terms are added, the sum of an arithmetic progression is the result.

Set $0.09(8) + (0+1+\ldots+7) \cdot a = 1$ and then attempt to solve for a.

$$0.72 + 28a = 1$$

$$28a = 0.28$$

Finally, $a = 0.01$.

(e)

Using Peter's model, find $P(F=4)$

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(1)**

Answer	Mark
Up to 1 mark for: • B1: $P(F=4)=0.09+(4-1)\cdot 0.01=0.09+0.03=0.12$ [Correct value only] We can now substitute the value of $a=0.01$ into the formula for $P(F=n)$. Therefore $P(F=n)=0.09+(n-1)\cdot 0.01=0.09+0.01n-0.01=0.08+0.01n$ Then $P(F=4)=0.08+0.01(4)=0.08+0.04=0.12$	0 **(1)**

Answers saved!

Save marks and mark next question >

Exam Practice

5

(a)
Briefly describe the difference in appearance between a scatter graph that shows strong positive correlation between y and x and a scatter graph that shows strong negative correlation between y and x.

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	**Mark**
Total	0 **(1)**

Answer	Mark
Up to 1 mark for: • B1: Strong positive correlation $\Rightarrow$ positive linear trend. Strong negative correlation $\Rightarrow$ negative linear trend. [Refers to positive linear trend or positive gradient of the trend line for the scatter graph with strong positive correlation.] Alternative: B1: Refers to negative linear trend or negative gradient of the trend line for the scatter graph with strong negative correlation. **Additional Explanation:** The scatter graph with strong positive correlation will have an underlying positive linear trend of y increasing as x increases (the line of best fit would have a positive gradient). The scatter graph with strong negative correlation will have a general negative linear trend of y decreasing as x increases (the line of best fit would have a negative gradient).	0 **(1)**

(b)

The product moment correlation coefficient, r, is calculated for a sample of mean temperature values and maximum relative humidity values in Hurn over a 20-day period in 2015.

The value of r is found to be 0.3260, correct to 4 decimal places.

Give an interpretation of the value of r in context

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(1)**
Up to 1 mark for: • B1: There is a (weak) positive linear relationship between mean temperature and maximum relative humidity. [Correct interpretation as above]	0 **(1)**

(c)

Stating your hypotheses clearly, perform a hypothesis test at the 10% level of significance, to test the claim that the correlation coefficient between daily mean temperature and daily maximum relative humidity in Hurn in 2015 is non-zero.

(4)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer	Mark
Total	0 **(4)**
Up to 4 marks for: • B1: $H_0 : \rho = 0, H_1 : \rho \neq 0$ [Correct statement of both hypotheses.] • B1: $20 - 2 = 18$ degrees of freedom [Correct number of degrees of freedom seen or used.] • M1: Test statistic 0.3260 is less than the 10% critical value 0.378 [Uses tables or a calculator to obtain the appropriate critical value and compare it with the test statistics] • A1: There is insufficient evidence at the 10% level to reject H_0. Therefore the claim is not supported. [Correct conclusion in context as above.] **Additional Explanation:** $H_0 : \rho = 0, H_1 : \rho \neq 0$. This is a 2-tailed test at the 10% level. There are 20 pairs of data values so there are $20 - 2 = 18$ degrees of freedom. We now look up the appropriate critical value in our tables. The 10% critical value for a 2-tailed test with 18 degrees of freedom is 0.378. As the test statistic (0.3260) is less than the critical value (0.378), we can conclude that the result of the test is not significant and there is insufficient evidence to support the claim that the correlation coefficient between daily mean temperature and daily maximum relative humidity is non-zero.	0 **(4)**

(d)

Caleb is investigating the 24-hour total rainfall, t mm, and the daily mean pressure, P hPa, in Perth on several rainy days in July 2015.

He takes a sample of the data where t is non-zero and codes the pressure data using the formula $c = P - 1000$.

Caleb calculates the equation of the linear regression line of t on c to be $t = 37 - 1.15c$

Find the equation of the linear regression line of t on P, giving your answer in its simplest form.

(1)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer
Total
Up to 1 mark for: • B1: $t = 37 - 1.15c = 37 - 1.15(P - 1000) = 37 - 1.15P + 1150 = 1187 - 1.1$ [Substitutes to obtain correct equation as above.]

(e)

Zeta thinks that an exponential model will be a better fit for the data and she draws a scatter graph with values of $\ln(t)$ on the vertical axis and $P - 1000$ on the horizontal axis. She then draws in a line of best fit which has a gradient of -0.3 and passes through the point $(0, 6.2)$.

Given that Zeta's exponential model has the form $t = k \cdot b^{P-1000}$, use the information about her line of best fit to find appropriate values for k and b, correct to 3 significant figures.

(5)

Mark Scheme

Mark your work by selecting the marks you scored on the right hand side.

Answer
Total

Answer

Up to 5 marks for:

- B1: Substitutes -0.3 and $(0, 6.2)$ into $t = k \cdot b^{P-1000}$ leading to
  $\ln(t) = -0.3(P - 1000) + 6.2$
  [Correct equation with substituted values as above.]
- M1:
  $\ln(t) = \ln\left(k \cdot b^{P-1000}\right) = \ln(k) + \ln\left(b^{P-1000}\right) = \ln(k) + (P - 1000)\ln$
  [Uses laws of logarithms to rewrite $\ln(t) = \ln\left(k \cdot b^{P-1000}\right)$ as
  $\ln(k) + (P - 1000)\ln(b)$]
- M1: $\ln(k) + (P - 1000)\ln(b) = -0.3(P - 1000) + 6.2$. Therefore
  $\ln(k) = 6.2$ and $\ln(b) = -0.3$
  [Compare coefficients leading to values for $\ln(k)$ and $\ln(b)$]
- A1: $k = e^{6.2} = 493$ (3sf)
  [Correct value of k to 3sf]
- A1: $b = e^{-0.3} = 0.741$ (3sf)
  [Correct value of b to 3sf]
  If both final values are correct but not rounded to 3sf, award A1A0.

Additional Explanation:

The model uses the formula $t = k \cdot b^{P-1000}$.

From line of best fit, $\ln(t) = -0.3(P - 1000) + 6.2$

Using log laws on the exponential model formula,
$\ln(t) = \ln\left(k \cdot b^{P-1000}\right) = \ln(k) + \ln\left(b^{P-1000}\right) = \ln(k) + (P - 1000)\ln(b)$.

Next we equate the two expressions:
$\ln(k) + (P - 1000)\ln(b) = -0.3(P - 1000) + 6.2$.

Comparing coefficients leads to $\ln(k) = 6.2$ and $\ln(b) = -0.3$.

Therefore $k = e^{6.2} = 493$ (3sf) and $b = e^{-0.3} = 0.741$ (3sf).

Answers saved!

Save marks and finish exam practice