Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.
Consider the function \( f(x) = \log_a(x - 1) \) where \( a > 1 \).

(a) On the axes below, sketch the graph of \( f(x) \), labelling important features. (3 marks)

(See graph)

<table>
<thead>
<tr>
<th>Specific behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ asymptote at ( x = 1 )</td>
</tr>
<tr>
<td>✓ gives correct shape</td>
</tr>
<tr>
<td>✓ ( x )-int at ( x = 2 )</td>
</tr>
</tbody>
</table>

(b) Determine the value of \( m \) if \( f(m) = 1 \). (2 marks)

(See graph)

<table>
<thead>
<tr>
<th>Specific behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ equates ( f(m) ) to 1</td>
</tr>
<tr>
<td>✓ solves for ( m )</td>
</tr>
</tbody>
</table>

\[
1 = \log_a (m - 1) \\
m - 1 = a \\
m = a + 1
\]
(c) Determine the coordinates of the $x$-intercept of $f(x + b) + c$, where $b$ and $c$ are positive real constants. (3 marks)

Solution

\[
\begin{align*}
0 &= \log_a (x - 1 + b) + c \\
-c &= \log_a (x - 1 + b) \\
\frac{a^c}{a} &= x - 1 + b \\
x &= a^{-c} + 1 - b
\end{align*}
\]
coordinates are: \( (a^{-c} + 1 - b, 0) \)

Specific behaviours

✓ equates new function to zero
✓ solves for $x$
✓ states coordinates
The concentration, $C$, of a drug in the blood of a patient $t$ hours after the initial dose can be modelled by the equation below.

$$C = 4e^{-0.05t} \text{ mg/L}$$

Patients requiring this drug are said to be in crisis if the concentration of the drug in their blood falls below 2.5 mg/L.

A patient is given a dose of the drug at 9 am.

(a) What was the concentration in the patient’s blood immediately following the initial dose? (1 mark)

**Solution**

Initial dose when $t = 0$

$C(0) = 4 \text{ mg/L}$

**Specific behaviours**

✓ determines concentration, including the unit

(b) What is the concentration of the drug in the patient’s blood at 11.30 am? (2 marks)

**Solution**

$C = 4e^{-0.05(2.5)}$

$C = 3.53 \text{ mg/L}$

**Specific behaviours**

✓ substitutes $t = 2.5$
✓ calculates concentration

(c) Find the rate of change of $C$ at 1 pm. (2 marks)

**Solution**

$$\frac{dC}{dt} = -0.2e^{-0.05t}$$

$$\left.\frac{dC}{dt}\right|_{t=4} = -0.164 \text{ mg/L/hour}$$

**Specific behaviours**

✓ finds derivative of $C$ wrt $t$
✓ calculates rate of change when $t = 4$
(d) What is the latest time the patient can receive another dose of the drug if they are to avoid being in crisis? (3 marks)

Solution

\[ 2.5 = 4e^{-0.05t} \]

\[ t = 9.4 \text{ hours} \]

Latest time = 6:24 pm (6:25 too late)

Specific behaviours

✓ substitutes \( C = 2.5 \)
✓ solves for \( t \)
✓ states latest time
Question 10 (7 marks)

The following function is a probability density function on the given interval:

\[ f(x) = \begin{cases} ax^2(x-2) & \text{for } 0 \leq x \leq 2, \\ 0 & \text{otherwise} \end{cases} \]

(a) Find the value of \( a \). (3 marks)

Solution

If pdf on domain then \( \int_{0}^{2} f(x) \, dx = 1 \)

\[
\int_{0}^{2} f(x) \, dx = 1
\]

\[
\int_{0}^{2} ax^2(x-2) \, dx = -\frac{4a}{3}
\]

\[
\therefore -\frac{4a}{3} = 1
\]

\[
\therefore a = -\frac{3}{4}
\]

Specific behaviours

✓ uses integration for domain \( =1 \)
✓ calculates integration
✓ finds \( a \)

(b) Find the probability that \( x \geq 1.2 \). (2 marks)

Solution

\[
\int_{1.2}^{2} \frac{-3x^2(x-2)}{4} \, dx
\]

\[
= 0.5248
\]

Specific behaviours

✓ uses correct integral
✓ calculates probability

(c) Find the median of the distribution. (2 marks)

Solution

Solve \( \int_{0}^{m} f(x) \, dx = 0.5 \) over domain \( 0 \leq x \leq 2 \)

\[
\int_{0}^{m} f(x) \, dx = -\frac{3m^4}{16} + \frac{m^3}{2}
\]

for median:

\[
\frac{-\frac{3m^4}{16} + \frac{m^3}{2}}{2} = 0.5
\]

\[
m = 1.2285
\]

Specific behaviours

✓ uses correct integral
✓ determines \( m = 1.2285 \)
Question 11 (8 marks)

Ava is flying a drone in a large open space at a constant height of 5 metres above the ground. She flies the drone due north so that it passes directly over her head and then, sometime later, reverses its direction and flies the drone due south so it passes directly over her again. With \( t = 0 \) defined as the moment when the drone first flies directly above Ava’s head, the velocity of the drone, at time \( t \) seconds, is given by:

\[
v = 2 \sin \left( \frac{t}{3} + \frac{\pi}{6} \right) \text{ m/s} \quad 0 \leq t \leq 16.
\]

(a) Determine \( x(t) \), the displacement of the drone at \( t \) seconds, where \( x(0) = 0 \). (3 marks)

**Solution**

\[
\int 2 \sin \left( \frac{t}{3} + \frac{\pi}{6} \right) \, dt = -6 \cos \left( \frac{t}{3} + \frac{\pi}{6} \right) + C
\]

Solve: \(-6 \cos \left( \frac{0}{3} + \frac{\pi}{6} \right) + C = 0\)

\[
C = 3\sqrt{3} \quad \text{OR} \quad 5.196152423
\]

\[
\therefore x(t) = -6 \cos \left( \frac{t}{3} + \frac{\pi}{6} \right) + 5.196 \quad \text{OR} \quad x(t) = -6 \cos \left( \frac{t}{3} + \frac{\pi}{6} \right) + 3\sqrt{3}
\]

**Specific behaviours**

✓ integrates \( v(t) \) to determine cosine expression
✓ recognises \( x(t) \) involves a constant term and equates \( x(0) \) to 0
✓ solves for \( C \) and states \( x(t) \)

(b) Where is the drone in relation to the pilot after 16 seconds? (2 marks)

**Solution**

\[
x(16) = -6 \cos \left( \frac{16}{3} + \frac{\pi}{6} \right) + 3\sqrt{3}
\]

\[
= -0.266975
\]

The drone is 0.27 m (27 cm) due south of the pilot.

**Specific behaviours**

✓ evaluates displacement at \( t = 16 \)
✓ interprets solution
Question 11 (continued)

(c) At a particular time, the drone is heading due south and it is decelerating at 0.5 m/s². How far has the drone travelled from its initial position directly above Ava’s head until this particular time? (3 marks)

Solution

\[ a(t) = \frac{2}{3} \cos \left( \frac{t + \pi}{6} \right) \]

\[ -0.5 = \frac{2}{3} \cos \left( \frac{t + \pi}{6} \right) \]

\[ t = 5.6858 \text{ or } 10.0222 \]

heading south at \( t = 10.0222 \)

Distance travelled:

\[ \text{distance travelled} = \int_{0}^{10.0222} 2 \sin \left( \frac{t + \pi}{6} \right) \, dt \]

\[ = 12.696 \]

The drone has travelled 12.696 metres.

Specific behaviours

✓ equates derivative to \(-0.5 \text{ m/s}^2\)
✓ recognises 10.02 s is when the drone is heading south
✓ determines distance travelled
Question 12 (19 marks)

The manager of the mail distribution centre in an organisation estimates that the weight, \( x \) (kg), of parcels that are posted is normally distributed, with mean 3 kg and standard deviation 1 kg.

(a) What percentage of parcels weigh more than 3.7 kg? (2 marks)

Solution

\[ X \sim N(3, 1) \]

\[ P(X > 3.7) = 0.24196 \]

24.2\% are greater than 3.7 kg.

Specific behaviours

✓ states weight required greater than 3.7 kg
✓ obtains the correct percentage

(b) Twenty parcels are received for posting. What is the probability that at least half of them weigh more than 3.7 kg? (3 marks)

Solution

Let the random variable \( M \) denote the number of parcels that weigh more than 3.7 kg. Then \( M \sim \text{Bin}(20, 0.24196) \).

\[ P(M \geq 10) = 0.01095 \]

Specific behaviours

✓ states the distribution as binomial
✓ determines the correct parameters of the distribution
✓ obtains the correct probability

The cost of postage, ($) \( y \), depends on the weight of a parcel as follows:

• a cost of $5 for parcels below 1 kg
• a variable cost of $1.50 for every kilogram or part thereof above 1 kg to a maximum of 4 kg
• a cost of $12 for parcels above 4 kg.

(c) Complete the probability distribution table for \( Y \). (4 marks)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( P(Y = y) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x \leq 1 )</td>
<td>$5</td>
<td>0.02275 (accept 0.02140)</td>
</tr>
<tr>
<td>( 1 &lt; x \leq 2 )</td>
<td>$6.50</td>
<td>0.13591</td>
</tr>
<tr>
<td>( 2 &lt; x \leq 3 )</td>
<td>$8</td>
<td>0.34134</td>
</tr>
<tr>
<td>( 3 &lt; x \leq 4 )</td>
<td>$9.50</td>
<td>0.34134</td>
</tr>
<tr>
<td>( x &gt; 4 )</td>
<td>$12</td>
<td>0.15866</td>
</tr>
</tbody>
</table>

Solution

See table

Specific behaviours

✓ obtains two correct values of \( y \)
✓ obtains the other two correct values of \( y \)
✓ obtains two correct probabilities
✓ obtains the remaining correct probabilities
Question 12 (continued)

(d) Calculate the mean cost of postage per parcel. (2 marks)

Solution

\[ E(Y) = 5 \times 0.02275 + 6.5 \times 0.13591 + 8 \times 0.34134 + 9.50 \times 0.34134 + 12 \times 0.15866 \]
\[ = 8.874535 \]
That is, $8.87 is the mean cost of postage per parcel.

Specific behaviours

✓ obtains the correct expression for the mean
✓ obtains the correct value of the mean

(e) Calculate the standard deviation of the cost of postage per parcel. (3 marks)

Solution

\[ \sigma^2 = (5 - 8.87)^2 \times 0.02275 + (6.5 - 8.87)^2 \times 0.13591 + (8 - 8.87)^2 \times 0.34134 \]
\[ + (9.5 - 8.87)^2 \times 0.34134 + (12 - 8.87)^2 \times 0.15866 \]
\[ = 3.052310889 \]
\[ \therefore \sigma = 1.7470864 \]

Specific behaviours

✓ substitutes into variance formula correctly
✓ calculates the variance correctly
✓ calculates the standard deviation correctly

(f) If the cost of postage is increased by 20% and a surcharge of $1 is added for all parcels, what will be the mean and standard deviation of the new cost? (3 marks)

Solution

The mean will increase by 20% to \[1.2 \times 8.874535 + 1 = 11.64944\].
The standard deviation increases by 20% to \[1.2 \times 1.747086 = 2.096504\].

Specific behaviours

✓ states new values will need to be multiplied by 1.2
✓ correctly determines mean
✓ correctly determines standard deviation

(g) Show one reason why the given normal distribution is not a good model for the weight of the parcels? (2 marks)

Solution

\[ P(Y < 0) = 0.001349898 \]
There is a non-zero (small) probability that the weight can be negative, which is not possible.

Specific behaviours

✓ calculates the probability of a weight below 0
✓ explains that negative weights are not possible here
The proportion of caravans on the road being towed by vehicles that have the incorrect towing capacity is \( p \).

(a) Show, using calculus, that to maximise the margin of error a value of \( \hat{p} = 0.5 \) should be used. Note: As \( z \) and \( n \) are constants, the standard error formula can be reduced to \( E = \sqrt{\hat{p}(1 - \hat{p})} \). (3 marks)

**Solution**

\[
E = \sqrt{\hat{p}(1 - \hat{p})} \\
\frac{dE}{d\hat{p}} = \frac{(1 - 2\hat{p})}{2\hat{p}(1 - \hat{p})} \\
0 = 1 - 2\hat{p} \\
\hat{p} = 0.5 \\
\frac{d^2E}{d\hat{p}^2}\bigg|_{\hat{p}=0.5} = -2 \Rightarrow \text{maximum}
\]

**Specific behaviours**

✓ differentiates \( E \) wrt \( \hat{p} \)  
✓ equates derivative to zero and solves for \( \hat{p} \)  
✓ uses second derivative or sign test to confirm maximum

(b) A consulting firm wants to determine \( p \) within 8% with 99% confidence. How many towing vehicles should be tested at a random check? (3 marks)

**Solution**

Use \( \hat{p} = 0.5 \)  
\[ z \text{ value for 99\%} = 2.576 \]

\[
E \text{ for sample proportion } E = z \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}} \\
\text{and } E = 0.08 \\
0.08 = 2.576 \sqrt{\frac{0.5(1 - 0.5)}{n}} \\
\Rightarrow n = 259.21 \\
\text{Hence 260 vehicles should be tested.}
\]

**Specific behaviours**

✓ uses \( \hat{p} = 0.5 \) and \( z \) value  
✓ equates standard error to 0.08  
✓ solves for \( n \) and rounds up to 260
Question 13 (continued)

(c) Six months later, the consulting firm carries out a random sampling of towing vehicles. A 99% confidence interval calculated for the proportion of vehicles with incorrect towing capacity is \((0.342, 0.558)\). Determine the number of vehicles in the sample that have an incorrect towing capacity. (4 marks)

<table>
<thead>
<tr>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p = \frac{0.342 + 0.558}{2} = 0.45 )</td>
</tr>
<tr>
<td>( E = 0.558 - 0.45 = 0.108 )</td>
</tr>
<tr>
<td>( E = z \sqrt{\frac{p(1-p)}{n}} )</td>
</tr>
<tr>
<td>( 0.108 = 2.576 \sqrt{\frac{0.45(1-0.45)}{n}} )</td>
</tr>
<tr>
<td>( n = 141 )</td>
</tr>
<tr>
<td>Number of vehicles with incorrect towing capacity = ( np )</td>
</tr>
<tr>
<td>( = 141 \times 0.45 )</td>
</tr>
<tr>
<td>( \approx 63 )</td>
</tr>
</tbody>
</table>

Specific behaviours

✓ finds correct \( p \)
✓ finds correct \( E \)
✓ finds number in sample
✓ finds number of vehicles with incorrect towing capacity
Question 14 (5 marks)

(a) The table below examines the values of \( \frac{a^h - 1}{h} \) for various values of \( a \) as \( h \) approaches zero. Complete the table, rounding your values to five decimal places. (2 marks)

<table>
<thead>
<tr>
<th>( h )</th>
<th>( a = 2.60 )</th>
<th>( a = 2.70 )</th>
<th>( a = 2.72 )</th>
<th>( a = 2.80 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1.00265</td>
<td>1.04425</td>
<td>1.05241</td>
<td>1.08449</td>
</tr>
<tr>
<td>0.001</td>
<td>0.95597</td>
<td>0.99375</td>
<td>1.00113</td>
<td>1.03015</td>
</tr>
<tr>
<td>0.00001</td>
<td>0.95552</td>
<td>0.99326</td>
<td>1.00064</td>
<td>1.02962</td>
</tr>
</tbody>
</table>

Solution

See table

Specific behaviours
✓ correctly completes three table values
✓ correctly completes all entries and rounds to 5dp

It can be shown that
\[
\frac{d}{dx}(a^x) = a^x \lim_{h \to 0} \left( \frac{a^h - 1}{h} \right).
\]

(b) What is the exact value of \( a \) for which \( \frac{d}{dx}(a^x) = a^x \)? Explain how the above definition and the table in part (a) support your answer. (3 marks)

Solution

\( a = e \approx 2.71828 \)

When \( a = e \) the table shows that the value of \( \lim_{h \to 0} \left( \frac{a^h - 1}{h} \right) \) is 1.

It follows then from the definition that
\[
\frac{d}{dx}(e^x) = e^x \times 1
= e^x.
\]

Specific behaviours
✓ states \( a = e \) or 2.71828
✓ explains table result
✓ explains significance of table result for part (b)
Question 15 (5 marks)

The population of mosquitos, $P$ (in thousands), in an artificial lake in a housing estate is measured at the beginning of the year. The population after $t$ months is given by the function, $P(t) = t^3 + at^2 + bt + 2$, $0 \leq t \leq 12$.

The rate of growth of the population is initially increasing. It then slows to be momentarily stationary in mid-winter (at $t = 6$), then continues to increase again in the last half of the year.

Determine the values of $a$ and $b$.

<table>
<thead>
<tr>
<th>Solution</th>
</tr>
</thead>
</table>
| For HPI: $\begin{cases} P'(6) = 0 \\
| P''(6) = 0 \\
| P'(t) = 3t^2 + 2at + b \\
| P''(t) = 6t + 2a \\
| 0 = 108 + 12a + b \\
| 0 = 36 + 2a |
| solving gives: $a = -18$ \\
| $b = 108$ |

<table>
<thead>
<tr>
<th>Specific behaviours</th>
</tr>
</thead>
</table>
| ✓ determines first derivative \\
| ✓ determines second derivative \\
| ✓ equates first and second derivatives to zero when $t = 6$ \\
| ✓ determines the value of $a$ \\
| ✓ determines the value of $b$ |
Let \( f(x) \) be a function such that \( f(-2) = 4, f(-1) = 0, f(0) = -1, f(1) = 0 \) and \( f(3) = 2 \). Further, \( f'(x) < 0 \) for \(-2 \leq x < 0\), \( f'(0) = 0 \) and \( f'(x) > 0 \) for \(0 < x \leq 3\).

(a) Evaluate the following definite integrals:

(i) \[ \int_{0}^{3} f'(x) \, dx. \]

**Solution**

By the fundamental theorem of calculus

\[ \int_{0}^{3} f'(x) \, dx = [f(x)]_{0}^{3} = f(3) - f(0) = 2 - (-1) = 3. \]

**Specific behaviours**

✓ uses the fundamental theorem of calculus
✓ obtains the correct value for the integral

(ii) \[ \int_{-2}^{3} f'(x) \, dx. \]

**Solution**

By the fundamental theorem of calculus

\[ \int_{-2}^{3} f'(x) \, dx = [f(x)]_{-2}^{3} = f(3) - f(-2) = 2 - 4 = -2. \]

**Specific behaviours**

✓ uses the fundamental theorem of calculus
✓ obtains the correct value for the integral

(b) What is the area bounded by the graph of \( f'(x) \) and the \( x \) axis between \( x = -2 \) and \( x = 3 \)? Justify your answer.

**Solution**

Required area is \( A \).

\[ A = \int_{-2}^{3} |f'(x)| \, dx \]

Since \( f'(x) \) is positive for \( x > 0 \) and negative for \( x < 0 \), the area is

\[ A = \int_{0}^{3} f'(x) \, dx + \int_{-2}^{0} f'(x) \, dx = (2 - (-1)) + |1 - 4| = 8. \]

**Specific behaviours**

✓ writes the expression for area in terms of absolute value
✓ uses the intervals where \( f'(x) \) is positive and negative
✓ breaks the integral over the correct intervals
✓ calculates the correct value of the area
Tina believes that approximately 60% of the mangoes she produces on her farm are large. She takes a random sample of 500 mangoes from a day’s picking.

(a) Assuming Tina is correct and 60% of the mangoes her farm produces are large, what is the approximate probability distribution of the sample proportion of large mangoes in her sample? (3 marks)

Solution

\[
\hat{p} \sim N \left( 0.6, \frac{0.6 \times 0.4}{500} \right)
\]

That is,

\[
\hat{p} \sim N \left( 0.6, 0.02191^2 \right)
\]

Specific behaviours

✓ states the distribution as normal
✓ gives the correct value of the mean
✓ gives the correct value of the variance (or standard deviation)

(b) What is the probability that the sample proportion of large mangoes is less than 0.58? (2 marks)

Solution

\[
P(\hat{p} < 0.58) = P \left( Z < \frac{0.58 - 0.6}{\sqrt{0.6 \times 0.4/500}} \right) = P(Z < -0.9129) = 0.18066
\]

Specific behaviours

✓ calculates the z-value correctly
✓ obtains the correct probability

(c) Tina decides to select the mangoes for her sample as they pass along the conveyor belt to be sorted. Describe briefly how Tina should select her sample. (2 marks)

Solution

She should use a random number generator and pick the sample using the numbers she obtains.

Specific behaviours

✓ indicates some random mechanism
✓ indicates that the mangoes are selected accordingly

A random sample of 500 contains 250 large mangoes.

(d) On the basis of this data, estimate the proportion of large mangoes produced on the farm. (1 mark)

Solution

\[
\hat{p} = \frac{250}{500} = 0.5
\]

Specific behaviours

✓ calculates the correct sample proportion
(e) Calculate a 95% confidence interval for the proportion of large mangoes produced on the farm, rounded to four decimal places. (3 marks)

**Solution**

95% confidence interval = \(0.5 - 1.96 \times \sqrt{\frac{0.5 \times 0.5}{500}}, 0.5 + 1.96 \times \sqrt{\frac{0.5 \times 0.5}{500}}\)

= \(0.5 - 0.04383, 0.5 + 0.04383\)

= \(0.4562, 0.5438\)

**Specific behaviours**

✓ uses the correct value for the standard error
✓ uses the correct z-value interval
✓ calculates the confidence interval to 4 decimal places

(f) On the basis of your calculations, how would you respond to Tina’s belief that the proportion of large mangoes produced is at least 60%? Justify your response. (2 marks)

**Solution**

Since 0.6 is not contained in the 95% confidence interval, it is unlikely that Tina is correct.

**Specific behaviours**

✓ refers to 0.6 not being in the interval
✓ concluding that it is unlikely that Tina is correct

(g) What can Tina do to further test her belief? (1 mark)

**Solution**

Tina should take another random sample and obtain another 95% confidence interval.

**Specific behaviours**

✓ states answer
Question 18 (7 marks)

The ear has the remarkable ability to handle an enormous range of sound levels. In order to express levels of sound meaningfully in numbers that are more manageable, a logarithmic scale is used, rather than a linear scale. This scale is the decibel (dB) scale.

The sound intensity level, \( L \), is given by the formula below:

\[
L = 10 \log \left( \frac{I}{I_0} \right) \text{ dB}
\]

where \( I \) is the sound intensity and \( I_0 \) is the reference sound intensity. \( I \) and \( I_0 \) are measured in watt/m\(^2\).

(a) Listening to a sound intensity of 5 billion times that of the reference intensity \((I = 5 \times 10^9 I_0)\) for more than 30 minutes is considered unsafe. To what sound intensity level does this correspond? (2 marks)

**Solution**

\[
L = 10 \log \left( \frac{5 \times 10^9 I_0}{I_0} \right) \\
\approx 97 \text{ dB}
\]

**Specific behaviours**

✓ substitutes for \( L \)  
✓ calculates level

(b) The reference sound intensity, \( I_0 \), has a sound intensity level of 0 dB. If a household vacuum cleaner has a sound intensity, \( I = 1 \times 10^{-5} \) watt/m\(^2\) and this corresponds to a sound intensity level \( L = 70 \) dB, determine \( I_0 \). (2 marks)

**Solution**

\[
70 = 10 \log \left( \frac{1 \times 10^{-5}}{I_0} \right) \\
I_0 = \frac{1 \times 10^{-5}}{10^{-7}} = 1 \times 10^{-12} \text{ watt/m}^2
\]

**Specific behaviours**

✓ substitutes for \( L \) and \( I \)  
✓ determines \( I_0 \) including units
The average sound intensity level for rainfall is 50 dB and for heavy traffic 85 dB.

(c) How many times more intense is the sound of traffic than that of rainfall? (3 marks)

<table>
<thead>
<tr>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$50 = 10 \log \left( \frac{I_{\text{rain}}}{I_0} \right)$ $\Rightarrow I_{\text{rain}} = 10^5 \Rightarrow I_{\text{rain}} = 10^5 I_0$</td>
</tr>
<tr>
<td>$85 = 10 \log \left( \frac{I_{\text{traffic}}}{I_0} \right)$ $\Rightarrow I_{\text{traffic}} = 10^{8.5} \Rightarrow I_{\text{traffic}} = 10^{8.5} I_0$</td>
</tr>
<tr>
<td>$\therefore \frac{I_{\text{traffic}}}{I_{\text{rain}}} = \frac{10^{8.5}}{10^5} = 10^{3.5} \approx 3200$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specific behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ rearranges logarithmic equations to exponentials</td>
</tr>
<tr>
<td>✓ writes ratio and cancels $I_0$</td>
</tr>
<tr>
<td>✓ determines how many more times intense</td>
</tr>
</tbody>
</table>
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