

Show all work clearly and in order, and circle your final answers. Justify your answers algebraically whenever possible. Please write down all relevant mathematics. You have 20 minutes.

1.

| x | y |
|---|---|
| 1 | 4 |
| 2 | 5 |
| 3 | 9 |

Use the formulas

$$a = \frac{N \cdot \sum xy - \sum x \cdot \sum y}{N \cdot \sum x^2 - (\sum x)^2}$$

$$b = \frac{\sum y - a \sum x}{N}$$

to find the equation of the straight line that minimizes the least-squares error for the data points in the chart. Then use the equation to predict the value at $x = 5$.

$$N = 3$$

$$\sum xy = 4 \cdot 1 + 5 \cdot 2 + 9 \cdot 3 = 41 + 10 + 27 = 81$$

$$\sum x = 6$$

$$\sum x^2 = 1 + 4 + 9 = 14$$

$$\sum y = 18$$

$$a = \frac{3 \cdot 81 - 6 \cdot 18}{3 \cdot 14 - 36} = \frac{243 - 108}{42 - 36} = \frac{135}{6} = 22.5$$

$$b = \frac{18 - (22.5)6}{3} = \frac{18 - 135}{3} = \frac{-117}{3} = -39$$

2. Evaluate:

$$\int \frac{e^{\sqrt{x}}}{\sqrt{x}} dx$$

$$u = \sqrt{x}$$

$$du = \frac{1}{2\sqrt{x}} dx$$

$$\frac{1}{\sqrt{x}} dx = 2 du$$

$$\int \frac{e^{\sqrt{x}}}{\sqrt{x}} dx = 2 \int e^u du = 2e^u + C$$

$$= 2e^{\sqrt{x}} + C$$

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to find the equation of the straight line that minimizes the least-squares error for the data points in the chart. Then use the equation to predict the value at $x = 4$.

$$a = 2.5$$

$$\text{at } x = 4,$$

$$b = 1$$

$$y = (2.5)(4) + 1 = 11$$

2. Evaluate:

$$\int \frac{\ln(x)}{x} dx$$

$$u = \ln(x)$$

$$du = \frac{1}{x} dx$$

$$\int u du = \frac{u^2}{2} + c = \frac{(\ln(x))^2}{2} + c$$

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$$a = \frac{N \cdot \sum xy - \sum x \cdot \sum y}{N \cdot \sum x^2 - (\sum x)^2}$$

$$b = \frac{\sum y - a \sum x}{N}$$

to find the equation of the straight line that minimizes the least-squares error for the data points in the chart. Then use the equation to predict the value at $x = 6$.

$$a = 2.5$$

$$b = 1$$

$$\text{at } x = 6,$$

$$y = (2.5)(6) + 1 = 15 + 1 = 16$$

2. Evaluate:

$$\int \frac{\sqrt{\ln(x)}}{x} dx$$

$$u = \ln x$$

$$du = \frac{1}{x} dx$$

$$\int \frac{\sqrt{\ln(x)}}{x} dx = \int \sqrt{u} du = \frac{2}{3} u^{3/2} + C = \frac{2}{3} (\ln(x))^{3/2} + C.$$