DO NOT SHARE IN ANY FORM

Q1. Given (x_1, y_1), ..., (x_{n-1}, y_{n-1}), (x_n, y_n), a scientist is required to best fit the data to $y = ae^{bx}$. The scientist uses data transformation by taking the natural log of the model to avoid having to solve nonlinear equations to find the constants of the model. To find the constants of the model, the scientist is minimizing the following by using data transformation.

(A) $\sum_{i=1}^{n} \left(y_i - ae^{bx_i}\right)^2$

(B) $\sum_{i=1}^{n} \left(\ln(y_i) - \ln(a) - bx_i\right)^2$

(C) $\sum_{i=1}^{n} \left(y_i - \ln(a) - bx_i\right)^2$

(D) $\sum_{i=1}^{n} \left(\ln(y_i) - \ln(a) - b\ln(x_i)\right)^2$

Q2: As water is drained out of a bathtub, the volume of water, *V* and its depth in the tub, *h* change with time, *t*. Which of the following is true of *dV/dh* and *dV/dt* ?

(A) They must be equal.

(B) They must have opposite signs.

(C) Both must be negative.

(D) Both must be positive.

Q3: A given cubic equation has three roots. At least one root of the equation is known to be complex. The cubic equation has

(A) One real root and two complex roots.

(B) Two real roots and one complex root.

(C) Three complex roots.

(D) The number of complex roots and the number of real roots cannot be determined.

Q4. A scientist finds that regressing the $y$vs x data given below to the straight-line $y = a_0 + a_1 x$ results in a perfect fit.

x	1	3	11	20
y	3	7	23	?

The missing value for y at $x = 20$ most nearly is

(A) 1.000

(B) 2.000

(C) 40.00

(D) 41.00

Q5. The velocity, $v$of a rocket is given as a function of time,t by

$v = a_0 + a_1 t + a_2 t^2, 1 < t < 3$

and is based on the following v vs. t values

t	1	2	3
v	2.5	4	10

The set of equations that would solve for constants a_0, a_1, a_2 would be

(A) $\begin{bmatrix} 0 & 1 & 1 \\ 0 & 2 & 4 \\ 0 & 3 & 9 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ 4 \\ 10 \end{bmatrix}$

(B) $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 4 \\ 1 & 3 & 9 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ 4 \\ 10 \end{bmatrix}$

(C) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ 4 \\ 10 \end{bmatrix}$

(D) $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & 2 \\ 0 & 3 & 3 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} 2.5 \\ 4 \\ 10 \end{bmatrix}$

Q6. The following y vs. x data is given.

x	2	4	6	19	21	23
y	50	60	70	80	90	100

For conducting quadratic (second order polynomial) interpolation, one would choose three data points. If you are interpolating at $x = 7$, the three data points you would choose are

(A) (2,50), (4,60), (6,70)
(B) (2,50), (6,70), (19,80)
(C) (4,60), (6,70), (19,80)
(D) (2,50), (6,70), (23,100)