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Q. 1 Do as directed

(i) The number of significant digit(s) in 0.00006032 is/are ----------
(ii) Biased data are considered to be inaccurate/imprecise.
(iii) Newton Raphson method is an **open/close** root finding method.
(iv) The length and breadth of a rectangular sheet of metal are 4.234 and 1.005 cm respectively. The area of the sheet to correct significant figures ---------.
(v) True error is always --------- than estimated error.
(vi) In Gauss Jordon method for solving linear simultaneous equations, the elimination steps results in ---------- matrix.
(vii) 3/8 Simpson's rule is ---------- order accurate.
(viii) Heun's method for solving ODE is ---------- order accurate.
(ix) IF THAN ELSE is the syntax of Fortron/C computer language.
(x) While declaring any variable as double precision in FORTRON code, by default it is considered as real variable (TRUE/FALSE).

Q. 2 (a) Recorded time by the Stopped clock are the most precise data. Justify this statement. **(3)**

(b) A physical quantity P is related to four observations a, b, c, and d as follows.

$$P = a^3 b^2 / \sqrt{c}\, d$$

The percentage errors of measurement in *a*, *b*, *c*, and *d* are 1%, 3%,4% and 2%, respectively. What is the percentage error in the quantity *P*. **(6)**

(c) If X = 0.51 and is corrected to 2 decimal places. Find the relative error. **(3)**

Q.3 (a) In environmental engineering, the following equation can be used to compute the oxygen level in a river downstream from a sewage discharge:

$$c = 10 - 20\left(e^{-0.2x} - e^{-0.75x}\right)$$

where *x* is the distance downstream in kilometres. Determine the distance downstream where the oxygen level first falls to a reading of 5. Determine your answer to a 1% error. Initial gauss can be chosen as 1. **(8)**

(b) Explain the concept of bisection method graphically and write the necessary conditions to find out the real root by bisection method**.** **(4)**

Q.4 (a) Explain the concept of Pivoting. **(3)**

(b) Given the system

$$x_1 + x_2 - x_3 = -3$$
$$6x_1 + 2x_2 + 2x_3 = 2$$
$$-3x_1 + 4x_2 + x_3 = 1$$

Solve by Gauss Jordon Method. Show all the steps of computation. **(9)**

Q. 5 (a) The heat flux q is the quantity of heat flowing trough a unit area of a material per unit time. It can be computed with Fourier's law $q = -k\frac{dt}{dx}$ where q has unit W/m^2 and k is a coefficient of thermal conductivity that parameterizes the heat conducting properties of the material and has units of W/^{0}C.m, T = Temperature (^{0}C); and x = distance (m) along the path of heat flow. The following temperature are measured from the surface (x = 0) into a stone wall

x (m)	0	0.1	0.2
T (^{0}C)	20	17	15

If the flux at $x = 0$ is 60 W/m^2, compute k. **(8)**

(b) Derive the multiple application Trapezodial formula, to be used for numerical integration. **(4)**

Q. 6 (a) The table below gives the temperature T (^{0}C) and length l (mm) of a heated rod. If $l = a_0 + a_1T$, find the values of a_0 and a_1 using linear least squares

T	40	50	60	70	80
l	600.5	600.6	600.8	600.9	601.0

(8)

(b) Write the algorithm of Bisection method. **(4)**

Q. 7 (a) Explain the concept of Heun's Method and write the necessary expression of Predictor and Corrector. **(4)**

(b) Solve the following ODE using Euler's method from t = 0 to 3 taking step size of 0.5. Find the local error in each step.

$$\frac{dy}{dt} = -y + t \qquad \text{given } y(0) = 1$$ **(8)**

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