2. Mathematical Methods for ME

Starter Quiz ·

University Mechanical Engineering Name: _____ Score: _____

1. v(t) = 3t^2 - 12t + 9. v(2), and the times it is zero?

   _____ m/s

2. x + 2y = 10 and 3x - y = 5. x (three decimals)?

   _____ kN

3. m = 1, k = 25. The natural frequency (rad/s)?

   _____ rad/s

4. Euler errors at h = 0.2, 0.1: 4.0e-2 and 1.9e-2. The error at h = 0.05 (two significant figures)?

   _____

5. T = x^2 + 2y^2 + 3z^2. The y-component of grad T at (1,1,1)?

   _____ K/m

6. The budget is dominated by resolution and calibration. The efficient fix:

   ☐ reporting more decimals

   ☐ a longer ruler

   ☐ a better instrument

   ☐ ninety more readings

7. a(t) = 6t - 12 is zero at t = 2. There:

   ☐ the trolley stops

   ☐ distance resets

   ☐ velocity is at an extremum

   ☐ position is at an extremum

8. A condition number of 250,000 means:

   ☐ the system is singular

   ☐ input noise can reach the answer amplified 250,000 times

   ☐ the matrix has 250,000 rows

   ☐ the answer has six correct digits

9. The true peak of M(r) for zeta = 0.2 sits at:

   ☐ there is no peak

- ☐ r = 1, M = 2.5
- ☐ r = 1.059, M = 2.6
- ☐ r = 0.959, M = 2.552

10. Pushing Simpson to a million panels, the error stops falling because:
    - ☐ Simpson loses its order
    - ☐ the integrand changes
    - ☐ the panels round up
    - ☐ round-off accumulates ~1e-16 per step across 1e6 steps

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Answers ·

University Mechanical Engineering

1. **3 m/s**

   v(2) = 12 - 24 + 9 = -3; zeroes at t = 1 and 3.

2. **2.857 kN**

   x = 20/7 = 2.857, y = 25/7 = 3.571.

3. **5 rad/s**

   sqrt(25) = 5.

4. **0.0094**

   Order 1: halve h, halve the error.

5. **4 K/m**

   grad T = (2x, 4y, 6z) - the y component is 4y.

6. **a better instrument**

   The instrument is the ceiling - the Type A term is already an order smaller.

7. **velocity is at an extremum**

   dv/dt = 0 means v peaks or dips - here v = -3, its minimum.

8. **input noise can reach the answer amplified 250,000 times**

   Nearly parallel lines: the intersection runs when the data nudges.

9. **r = 0.959, M = 2.552**

   sqrt(1 - 2 zeta^2) = 0.959 - just below resonance.

10. **round-off accumulates ~1e-16 per step across 1e6 steps**

    The U-curve floor: truncation falls, round-off rises.