1. $v(t) = 3t^2 - 12t + 9$. What is $v(2)$?

   _____ m/s

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

   _____ kN

3. $m = 1$ kg and $k = 25$ N/m. The natural frequency in rad/s?

   _____ rad/s

4. Euler errors at $h = 0.2$ and 0.1 are 4.0×10^{-2} and 1.9×10^{-2}. The error at $h = 0.05$ (two significant figures)?

   _____

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

   _____ K/m

6. Resolution and calibration are the largest terms. The best way to reduce the uncertainty:

   ☐ a longer ruler

   ☐ reporting more decimals

   ☐ a better instrument

   ☐ ninety more readings

7. $a(t) = 6t - 12$ is zero at $t = 2$ s. What happens there?

   ☐ the velocity has its lowest or highest value

   ☐ the trolley stops

   ☐ the position has its lowest or highest value

   ☐ the distance starts again from zero

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. Where is the true peak of $M(r)$ for $\zeta = 0.2$?

   ☐ r = 1, M = 2.5

   ☐ r = 1.059, M = 2.6

   ☐ there is no peak

10. Simpson on $\int_0^1 e^x\,dx$ stops improving at about 4,000 strips. Why?

    ☐ the strips are rounded up

    ☐ the error has reached the round-off limit of the computer, about 1e-16

    ☐ Simpson loses its order

    ☐ the integrand changes

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1. **-3 m/s**

   $v(2) = 12 - 24 + 9 = -3$ m/s: the minus sign means the trolley moves backwards. v is zero at $t = 1$ and 3 s.

2. **2.857 kN**

   $x = 20/7 = 2.857$ kN and $y = 25/7 = 3.571$ kN.

3. **5 rad/s**

   $\omega_n = \sqrt{25/1} = 5$ rad/s.

4. **0.0094**

   Order 1: halve h and the error halves, so about 9.4×10^{-3}.

5. **4 K/m**

   $\nabla T = (2x, 4y, 6z)$, so the y-component is $4y = 4$ K/m.

6. **a better instrument**

   The instrument sets the limit. The Type A term is already three times smaller than each instrument term.

7. **the velocity has its lowest or highest value**

   $dv/dt = 0$ where v has a peak or a dip. Here $v = -3$ m/s, its lowest value.

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

   The lines are nearly parallel, so a tiny change in the data moves the crossing point a long way.

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

   $r = \sqrt{1 - 2\zeta^2} = 0.959$, just below 1, where $M = 2.552$.

10. **the error has reached the round-off limit of the computer, about 1e-16**

    Truncation error keeps falling, but the answer already equals $e - 1$ to every stored digit. Round-off sets the floor of the U-curve.

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