Question

The Euler number e satisfies $e = \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$. The following MATLAB code approximates e using this mathematical identity for large n.

```
format long
e_true = exp(1)
n = [1e4; 1e8; 1e12; 1e16];
e_approx = (1+1./n).^n
```

Running the above code generates the following output showing that as n increases, the numerical accuracy first increases, and then decreases.

```
e_true = 2.718281828459046
e_approx =
        2.718145926824926
        2.718281798347358
        2.718523496037238
        1.000000000000000
```

- This is due to a coding error in representing the mathematical identity.

Correct Answer

- This is due to round-off error in double precision arithmetic.
- This is due to a mathematical error.

Question

The ratio $\dfrac{\text{Absolute error}}{\text{Relative error}}$ is always equal to

- the true value.

Correct Answer

- either the true value or the negative of the true value.
- the square of the true value.

Question

To evaluate infinity minus infinity, one types `Inf - Inf` in MATLAB, which returns `NaN` (not a number). This is

- an example of round-off error.

Correct Answer

- NOT an example of round-off error.

Question

For x small, $\dfrac{\log(1+x)}{x} \approx 1$. However, typing

```
log(1 + 3e-16)/3e-16
```

in MATLAB returns 0.7401, an answer that has significant numerical error. The error goes away if we instead type

```
log(1 + 3e-16)/((1 + 3e-16) - 1)
```

which indeed returns 1.0000. This is an example of

Correct Answer

- significant round-off error.
- mathematical error.
- coding mistake.

Question

The relative error between the computed value x_{approx} and the exact value x_{true} is

Correct Answer

- $\dfrac{|x_{\text{true}} - x_{\text{approx}}|}{|x_{\text{true}}|}$
- $|x_{\text{true}} - x_{\text{approx}}|$
- $\dfrac{|x_{\text{true}} - x_{\text{approx}}|}{|x_{\text{approx}}|}$

Question

To output the last entry of a vector $\boldsymbol{x}$ in MATLAB, one types

- x(1)
- x(-1)

Correct Answer

- x(end)

Question

To output the first entry of a vector $\boldsymbol{x}$ in MATLAB, one types

Correct Answer

- x(1)
- x(0)
- x(-1)

Question

If $\boldsymbol{A}$ is a rectangular matrix with real entries, then `sin(A)` in MATLAB returns

Correct Answer

- a rectangular matrix of the same size.
- a scalar.
- an error.

Question

Consider 5×1 vectors $\boldsymbol{x}, \boldsymbol{y}, \boldsymbol{z}$. Denote their respective ith entry as x_i, y_i, z_i for all $i = 1, 2, \ldots, 5$.

Assuming $z_i \neq 0$ for all i, which of the following is the correct way to compute

$$\frac{x_1 y_1}{z_1} + \frac{x_2 y_2}{z_2} + \ldots + \frac{x_5 y_5}{z_5}$$

in MATLAB?

Correct Answer

- `sum((x.*y)./z)`
- `sum((x*y)/z)`
- `(x.*y)./z`

Question

If A, B are **both diagonal matrices of the same size**, then the MATLAB operations `A * B` and `A .* B` must produce

Correct Answer

- the same output.
- different outputs.