

1.3.

a. $s^* = 2,929$; $\bar{s} = 2,92$

$\Delta s = 0,001$; $\delta s = \left| \frac{\Delta s}{s^*} \right| = 0,0341\%$

b. $\Delta p = |p^* - \bar{p}| = \left| \frac{1}{5!} + \frac{1}{6!} \right| = \frac{2}{220}$; $\delta p = \left| \frac{\Delta p}{p^*} \right| = \left| \frac{2/220}{41/24} \right| = 0,569\%$

c. $\pi^* = 2,4508$; $\bar{\pi} = 2,4668$; $\Delta \pi = -1,0159$; $\delta \pi = \left| \frac{\Delta \pi}{\pi^*} \right| = 0,4145$

d. $e^* = 2,128$; $\bar{e} = 2,2169$; $\Delta e = 0,5389$; $\delta e = \left| \frac{\Delta e}{e^*} \right| = 0,2534$

1.4

1.5.

a. $u = 0,814$

$\Delta u = \left| \frac{1}{x_1 + x_2^2} \right| \Delta x_1 + \left| \frac{2x_2}{x_1 + x_2^2} \right| \Delta x_2$

a. ~~$u = 0,814$~~ $u = 0,814$; $\Delta x_1 = \Delta x_2 = 0,5 \cdot 10^{-3}$

$\Delta u = \left| \frac{1}{x_1 + x_2^2} \right| \Delta x_1 + \left| \frac{2x_2}{x_1 + x_2^2} \right| \Delta x_2 = 6,538 \cdot 10^{-4}$

$\delta u = \frac{\Delta u}{u} = \frac{6,538 \cdot 10^{-4}}{0,814} = 0,000803\%$

b. $u = 6,89$; $\Delta x = \Delta y = 0,5 \cdot 10^{-3}$

$\Delta u = |ye^x + x| \Delta x + |e^x| \Delta y = 5,681 \cdot 10^{-3}$

$\delta u = \frac{\Delta u}{|u|} = \frac{5,681 \cdot 10^{-3}}{6,89} = 0,0825\%$

c. $u = -0,806$; $\Delta x = \Delta y = 0,5 \cdot 10^{-3}$

$\Delta u = |\sin y - y| \Delta x + |x \cos y - x| \Delta y$
 $= 1,122 \cdot 10^{-3}$

$\delta u = \frac{\Delta u}{|u|} = 0,139\%$

d. $u = 0,124$; $\Delta x = \Delta y = 0,5 \cdot 10^{-3}$

$\Delta u = \left| \frac{-\sin x}{1+y} \right| \Delta x + \left| \frac{e^x - \cos x}{(1+y)^2} \right| \Delta y$

$= 6,315 \cdot 10^{-4}$

$\delta u = \frac{\Delta u}{u} = 0,501\%$

1.2.

a. $\Delta x = 22,8$

$$\Delta x = \left| \frac{1}{2} \frac{G}{\lambda^2} \right| \frac{1}{2} f^2 \left| \Delta a + \left| a_t + v \cdot \Delta t \right| \Delta t + \left| t \right| \Delta v + \left| t \right| \Delta v_0 \right|$$

$$= 4,225$$

$$\delta x = \frac{\Delta x}{x} = 18,08\%$$

b. $E = 13,698$

$$\Delta E = \left| \frac{m_1 m_2}{\lambda^2} \right| \Delta G + \left| \frac{G m_2}{\lambda^2} \right| \Delta m_1 + \left| \frac{G m_1}{\lambda^2} \right| \Delta m_2 + \left| \frac{-2 G m_1 m_2}{\lambda^3} \right| \Delta R$$

$$= 0,3966$$

$$\Rightarrow \delta E = 2,896\%$$

c. $D = 2\sqrt{2}$

$$\Delta D = \left| \frac{2 \sqrt{2}}{\sqrt{(x_A - x_B)^2 + (y_A - y_B)^2}} \right| \left(\left| (x_A - x_B) \right| (\Delta x_A + \Delta x_B) + \left| (y_A - y_B) \right| (\Delta y_A + \Delta y_B) \right)$$

$$= 0,0424$$

$$\delta D = 1,5\%$$

d. $E = 32,14$

$$\Delta E = \left| \frac{1}{2} v^2 \right| \Delta m + \left| m v \right| \Delta v + \left| m h \right| \Delta g + \left| m g \right| \Delta h$$

$$= 2,1268$$

$$\delta E = 6,22\%$$