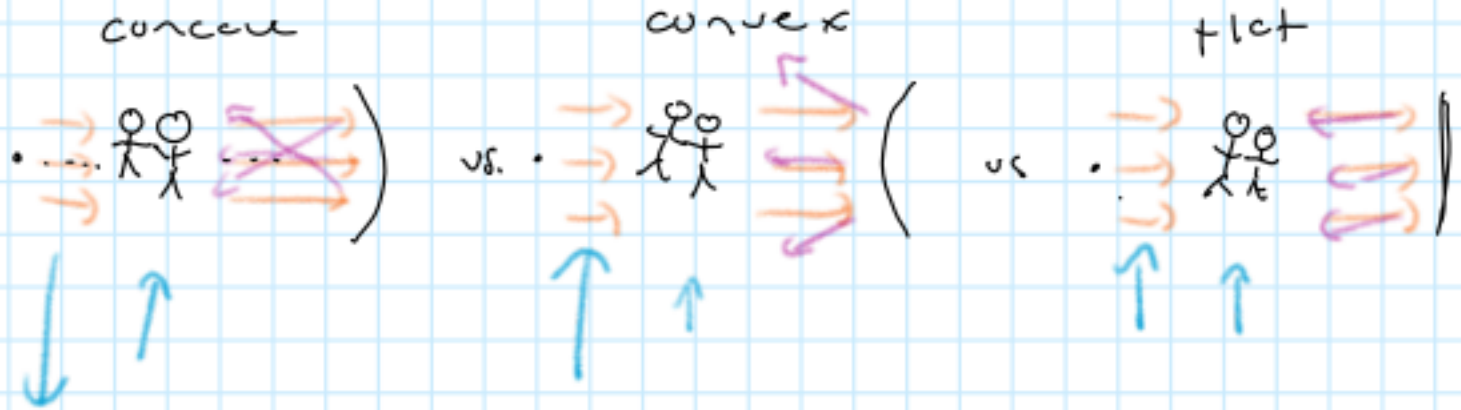
1 The mirror in van Eyck's painting is convex. ✓

3/3

This can be determined by examining the image of the two people. They are between the observer and the mirror and past its focal point. This means for a concave mirror their image would be flipped, which it clearly is not. We can also rule out a flat mirror by looking at how things scale. ✓ In a flat mirror everything would be evenly scaled, but in the painting things near the center are still similar but towards the edges of the mirror the image is bent. ✓



↳ larger, flipped
↳ less stretched in center, more so at edges

↳ larger right way up
↳ less stretched in center
↳ more so further out

↳ same size, right way up
↳ all equally scaled ✓

(2) $R_1 = 24\,cm$ $R_2 = 40\,cm$ $d = 60\,cm$ $x = 6\,cm$

$$\frac{1}{g} + \frac{1}{b} \approx \frac{2}{R}$$

$\Rightarrow$ $g_1 = \overline{S_1 A} = x = 6\,cm$ $R_1 = 24\,cm$

$$b_1 = \frac{g_1 R_1}{2g_1 - R_1} = \frac{6\,cm \cdot 24\,cm}{2 \cdot 6\,cm - 24\,cm} = -12\,cm$$

$g_2 = -(d - x) = -54\,cm$

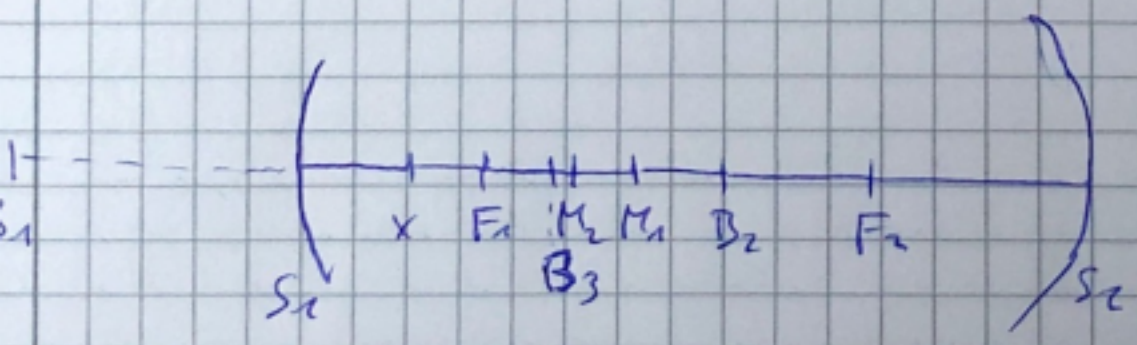
$R_2 = -40\,cm$

$$b_2 = \frac{54\,cm\,40\,cm}{-2 \cdot 54\,cm + 40\,cm} = -31{,}76\,cm$$

$x(b_2) = (60 - 31{,}76)\,cm = 28{,}24\,cm$

$$b_3 = \frac{g_3 R_1}{2g_3 - R_1} \quad \text{mit } g_3 = 28{,}24\,cm$$

$b_3 = 20{,}87\,cm \approx$ Mittelpunkt M_2 (20cm)

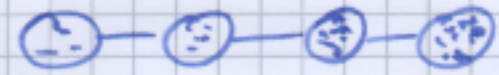


Es entstehen drei Bilder

B_1 ist ein virtuelles Bild

B_2, B_3 sind reell

Aufg. 4.



4/4

a) Zu:

$$S_0 = -k_B \sum_{k=1}^{4} N_k \ln\left(\frac{N_k}{N}\right) = -R \cdot \sum n_k \cdot \ln\left(\frac{n_k}{n}\right)$$

Es gilt: $\frac{n_k}{n} = 1 \quad \forall k \in \{1,\dots,4\}$

$$\Rightarrow \underline{\underline{S_0 = 0 \frac{J}{K}}} \quad \checkmark$$

Offen: → Gleichverteilung

$$S_1 = -R \cdot \left(\frac{1}{4} \cdot \ln\left(\frac{1/4}{1}\right) + \frac{1}{2} \ln\left(\frac{1/2}{2}\right) + \frac{3}{4} \ln\left(\frac{3/4}{3}\right) + 1 \cdot \ln\left(\frac{1}{4}\right) \right) \cdot 4$$

$$\Rightarrow S_1 \approx \underline{\underline{115{,}25 \frac{J}{K}}} \quad \checkmark$$

$$\Rightarrow \Delta S = S_1 - S_0 = 115{,}25 \frac{J}{K} \quad \checkmark$$

b) Zu: | Gleichverteilung: $\frac{n_k}{n} = \frac{2{,}5}{10} \quad \forall k \in \{1,\dots,4\}$

$$\Rightarrow S_0 = -R \cdot \sum n_k \cdot \ln\left(\frac{n_k}{n}\right) \text{ mit } n = 10$$

→ $N_k = n_k \cdot N_A$, $R = k_B \cdot N_A$

$$= -R \cdot \left(1 \cdot \ln\left(\frac{1}{10}\right) + 2 \cdot \ln\left(\frac{2}{10}\right) + \dots\right)$$

(da gleiches Gas; gilt $\Delta S_b \neq \Delta S_a$)

$$\Rightarrow S_0 = 12{,}8 \cdot R \approx \underline{\underline{106{,}41 \frac{J}{K}}} \quad \checkmark$$

Offen: | $\frac{n_k}{n} = \frac{2{,}5}{10} \Rightarrow S_1 = -R \cdot \sum n_k \cdot \ln\left(\frac{n_k}{n}\right) = -R \cdot \sum n_k \cdot \ln\left(\frac{2{,}5}{10}\right)$

$$\Rightarrow \Delta S = 8{,}84 \frac{J}{K} /// \quad \checkmark \qquad S_1 = -10 \cdot R \cdot \ln\left(\frac{2{,}5}{10}\right) = 115{,}25 \frac{J}{K} //$$

5) a) für jedes Gas ist V_2 viermal so groß wie V_1.

$$\Rightarrow \Delta S = k_B \cdot \ln(4) \cdot (N_A + 2N_A + 3N_A + 4N_A)$$

$$= R \cdot 10 \ln(4)$$

$$= \underline{115{,}3 \frac{J}{K}} \quad \checkmark \qquad 2$$

b) Gefäß 1: $\Delta S = k_B \cdot N_A \cdot \ln\left(\frac{\frac{1}{10} V_{ges}}{\frac{1}{4} V_{ges}}\right)$

Gefäß 2: $\Delta S = k_B \cdot 2N_A \cdot \ln\left(\frac{\frac{1}{5}}{\frac{1}{4}}\right)$

Gefäß 3: $\Delta S = k_B \cdot 3N_A \cdot \ln\left(\frac{3/10}{1/4}\right)$

Gefäß 4: $\Delta S = k_B \cdot 4N_A \cdot \ln\left(\frac{2/5}{1/4}\right)$

gesamt: $\Delta S = R \cdot \left(\ln\frac{2}{5} + 2\ln\frac{4}{5} + 3\ln\frac{6}{5} + 4\ln\frac{8}{5}\right)$

$$\underline{\Delta S = 8{,}9 \frac{J}{K}} \quad \checkmark \qquad 2$$