1a)

$$BW = \Delta f = \gamma \cdot G_{ss} \cdot \Delta z$$

$$TBW = \tau_{RF} \cdot BW$$

$$\Rightarrow \frac{TBW}{\tau_{RF}} = \gamma \cdot G_{ss} \cdot \Delta z$$

$$G_{ss} = \frac{TBW}{\tau_{RF} \cdot \gamma \cdot \Delta z}$$

$$= 15{,}66 \frac{mT}{m}$$

$$\tau_{ss}^{rise} = \frac{G_{ss}}{\text{slew rate}}$$

$$\tau_{ss,tot} = 1\,ms + 2 \cdot \frac{15.66 \frac{mT}{m}}{180 \frac{T}{m \cdot s}} = 1{,}17\,ms$$

b) Depends on the phase encoding line.
for $k_y = 0$: $\tau_{phase} = 0$

For the outermost phase encoding line:

$$k_{y,max} = \frac{1}{2 \cdot \Delta y}$$

$$= \gamma \cdot G \cdot \tau_{phase}$$

$$\tau_{phase} = \frac{1}{2 \cdot \gamma \cdot G \cdot \Delta y}$$

$$= 0.39\,ms$$

$$\tau_{phase,tot} = \tau_{phase} + 2 \cdot \frac{G_{phase}}{\text{slew rate}} = 0{,}67\,ms$$

c) $rBW = \gamma \cdot G_{read} \cdot FOV$

$$\frac{rBW}{pixel} = \frac{\gamma \cdot G_{read} \cdot FOV}{256}$$

$$= \gamma \cdot G_{read} \cdot \Delta x$$

$$G_{read} = \frac{rBW / pixel}{\gamma \cdot \Delta x} = 14.7 \ \frac{mT}{m}$$

$$k_{x,max} = \frac{1}{2 \Delta x}$$

$$= \gamma \cdot G_{read} \cdot \frac{\tau_{read}}{2}$$

$$\tau_{read} = \frac{1}{\Delta x \cdot \gamma \cdot G_{read}}$$

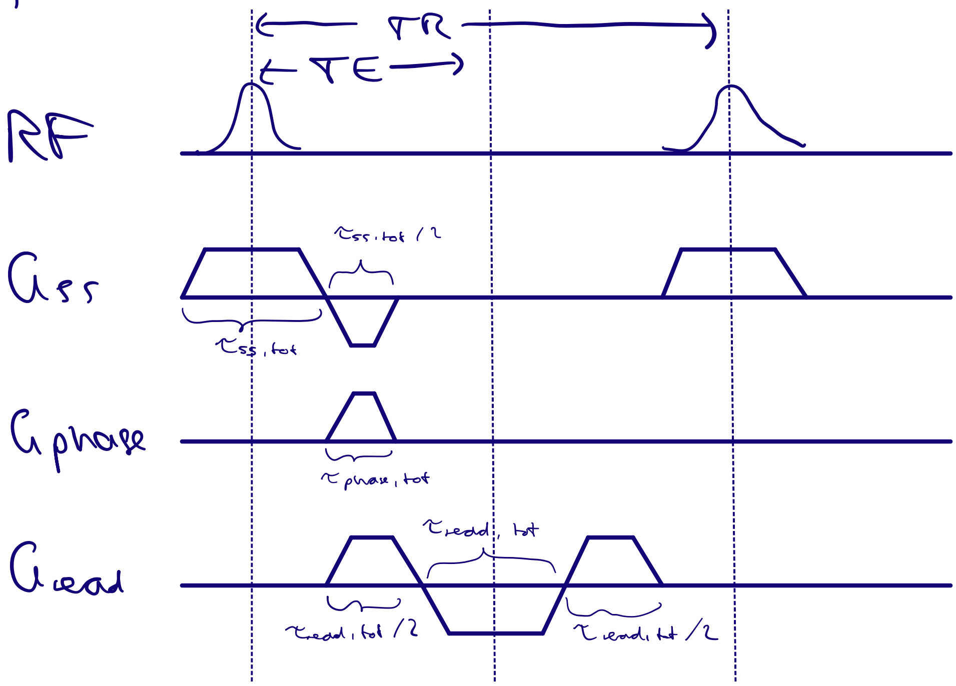
$$= \frac{\gamma \cdot \Delta x}{\Delta x \cdot \gamma \cdot rBW/pixel}$$

$$= \frac{1}{rBW/pixel}$$

$$= 1{,}33 \, ms$$

$$\tau_{read,tot} = \tau_{read} + 2 \cdot \frac{G_{read}}{slew \ rate} = 1{,}49 \, ms$$

d)



$$TE_{min} = \tau_{ss,tot}/2 + (\tau_{read,tot}/2)\cdot 2 = \tau_{ss,tot}/2 + \tau_{read,tot} = 2{,}08\,ms$$

$$TR_{min} = (\tau_{ss,tot}/2)\cdot 2 + (\tau_{read}/2)\cdot 2 + \tau_{read} = \tau_{ss,tot} + 2\cdot\tau_{read} = 2\cdot TE_{min} = 4{,}16\,ms$$

e)

- bigger slice
- Increase receiver bandwidth
- decrease TBW