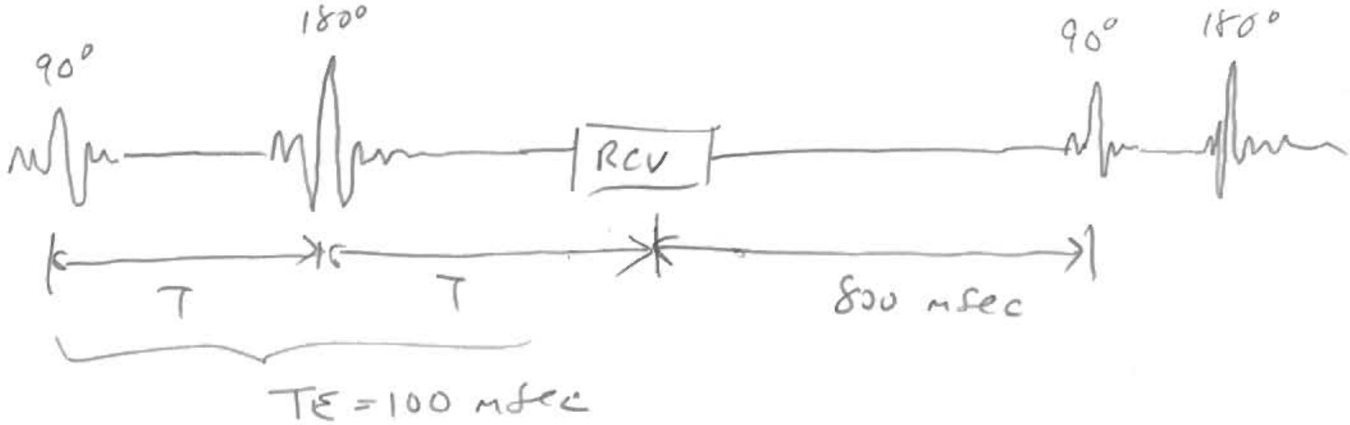
1.) TE = 100 msec



256 phase encodes × 0.9 sec/encode = 3.84 mins
(230.4 sec)

2.) $I(x,y) \sim \rho(x,y)\left(1 - e^{-TR/T_1}\right) e^{-TE/T_2}$

for data given in problem, pulse sequence (a) (TR = 750 msec, TE = 20 msec) gives higher intensity for white matter compared to gray matter.

3. Webb 4.3

a) $(0, M_0, 0)$

b) $(0, M_0 \sin 80°, M_0 \cos 80°)$

c) 90_x gives $(0, M_0, 0)$ (part a)

90_y gives no change, since the magnetic moment vector is pointing in y direction.

Result $(0, M_0, 0)$

d) 80_x gives $(0, M_0 \sin 80°, M_0 \cos 80°)$

80_y only affects the z component,

$(0, 0, M_0 \cos 80°)$ becomes

$(M_0 \cos 80° \sin 80°, 0, M_0 \cos 80° \cos 80°)$

Combining this with y component yields,

$(M_0 \cos 80° \sin 80°, M_0 \sin 80°, M_0 \cos 80° \cos 80°)$

4) Webb 4.8

$T_{2,fat} = 100$ msec, $T_{2,water} = 500$ msec

Eqn 4.32 says spin echo return

$$s(\tau) = M_0 e^{-2\tau/T_2}$$

Maximize

$$f(\tau) = M_0 e^{-2\tau/100} - M_0 e^{-2\tau/500}$$

$$\frac{df(\tau)}{d\tau} = -\cancel{M_0} \frac{2\cancel{\tau}}{\cancel{100}} e^{-\frac{2\tau}{100}} + \cancel{M_0} \frac{\cancel{2\tau}}{\underset{5}{\cancel{500}}} e^{-\frac{2\tau}{500}} = 0$$

$$5 e^{-2\tau/100} = e^{-2\tau/500}$$

Take ln of both sides

$$\ln(5) - \frac{2\tau}{100} = -\frac{2\tau}{500}$$

$$500 \ln(5) - 10\tau = -2\tau$$

$$\tau = \frac{500 \ln(5)}{8} = 100.6 \text{ mSec.}$$