1.Determine the factor of the current compensation after 1 month of developing reservoir for data: flowrate of fluid 23 m^3/day, the pressure in the injection line 21 MPa, the average formation pressure for the contour area of the reservoir 20 MPa, the length of the line injection 1000 m; layer thickness - 17 m, permeability - $2\cdot10^{-13}$ m^2, elastic capacity factor - $2,5\cdot10^{-10}$ Pa^{-1}; the volume formation factor for oil - 1.15; volume formation factor for injected water and selected water - 1.01 and 1.03 respectively; the factor for the loss of water is taken as 1.1; water cut - 21%.

Data:

t=30 days	$ß^*=2,5\cdot10^{-10}$ Pa^{-1}
$Q_{oil}=23$ m^3/day	$b_{oil}=1,15$
$P_{inj\ line}=21$ MPa	$b_w=1,01$
$P_f=20$ MPa	$b_w'=1,03$
B=1000 m	n=20%
h=17 m	$\psi=1,1$
$k=2\cdot10^{-13}$ m^2	

m_{cur}=?

$$Q_{ing} = Q_{oil}\cdot 30 = 23\cdot 30 = 690 \text{ m}^3\text{/day}$$

$$m_{cur} = \frac{Q_{ing}b_w}{\left(Q_{oil}b_{oil} + Q_w b_w{}' + Q_{los}\right)k}$$

where Q_{inj} - volumetric flowrate injected water under standard conditions; b_w – volume formation factor for the injected water ($b_w \cong 1,01$); Q_{oil} - volumetric flowrate for the oil under standard conditions; b_{oil} – volume formation factor for the oil; Q_w - volumetric flowrate selected water under standard conditions; b_w' - volume formation factor for the selected water, which is different from the volume formation factor for fresh water; Q_{los} – loss of water that escapes the contour; k - factor for the loss of water in the periodic work injection wells, under breaks in water lines and other technological reasons. This ratio is assumed to be k = 1,1-1,15.

A factor of current compensation shows how forcing compensated selection at any given time. According to the current values of the coefficient compensation can make the following conclusions.

If $m_{cur} < 1$ injection behind the selection and expect the average formation pressure should drop.

If $m_{cur} > 1$ injection exceeds the selection and the formation pressure should rise.

When $m_{cur} = 1$ should have been the stabilization of the current formation pressure at the current level, no matter what it was in early development

$$n = \frac{Q_w}{Q_{oil}+Q_w} = \frac{Q_w}{Q_{oil}} + 1 = \frac{Q_w}{Q_l}$$

$$Q_w = n\cdot Q_l = n\cdot\left(Q_w + Q_{oil}\right)$$

$$Q_w = \frac{n\cdot Q_{oil}}{1-n} = \frac{0.2\cdot 23}{86400\cdot(1-0.2)} = 6.66\cdot10^{-5} \text{ m}^3\text{/s=5.75 m}^3\text{/day}$$

$$Q_{los} = \frac{kBh}{\mu_w}\frac{P_{line}-P_f}{\sqrt{3}\sqrt{\chi t}} = \frac{2\cdot10^{-13}\cdot1000\cdot17}{10^{-3}}\cdot\frac{(21-20)\cdot10^6}{\sqrt{3\cdot0.8\cdot30\cdot86400}} = 13.6\cdot10^{-4} \text{ m}^3\text{/s=117.5 m}^3\text{/day}$$

$$\chi = \frac{k}{\mu\cdot\beta^*} = \frac{2\cdot10^{-13}}{10^{-3}\cdot2.5\cdot10^{-10}} = 0.8 \text{ m}^2\text{/s}$$

$$m_{cur} = \frac{86400\cdot690\cdot1.01}{86400(23\cdot1.15+5.75\cdot1.03+117.5)\cdot1.1} = 4.227$$

2.Calculate the pressure at a distance 200 m from the well, if the well is operated under the water drive with flowrate 160 m^3/day. The distance from the well to drainage boundary - 1010 m, the formation pressure - 30 MPa, the productivity coefficient 40 t/day·MPa, the radius of well - 0,1 m, the density of oil - 880 kg/m^3.

Data:

R=200 m

R_{db}=1010 m

Q=160 m^3/day

P_f=30 MPa

K_o=40 t/day·MPa

r_w=0,1 m

ρ_{oil}=880 kg/m^3

P_r-?

$$P_r = P_f - \frac{P_f - P_{bh}}{\ln \frac{R_{db}}{r_w}} \cdot \ln \frac{R}{r_w}$$

$$Q = K_o \cdot \Delta P$$

$$\Delta P = P_f - P_{bh} = \frac{Q}{K_o}$$

$$K_o = \frac{40 \cdot 1000}{10^6 \cdot 880} \text{m}^3\text{/day}\cdot\text{Pa}$$

$$\Delta P = \frac{160 \cdot 10^6 \cdot 880}{40 \cdot 1000} = 3{,}52 \cdot 10^6 \, Pa$$

$$P_r = 30 \cdot 10^6 - \frac{3.52 \cdot 10^6}{\ln \frac{1010}{0.1}} \cdot \ln \frac{200}{0.1} = 27.098 \cdot 10^6 \text{ Pa}$$

Pressure at a distance 200 m 27.098 MPa.