Points deducted   **Points earned**   **Scaled Score +25**
     -43.3   56.7 / 100   81.7

Average = 81.7		#students	%students	
A	>90	16	33	
B	80-90	8	17	50
C	70-80	12	25	
D	60-70	5	10	
F	50-60	4	8	
F	<50	3	6	

EXAM and KEYS are on the class web page
Let's review that now

Leaky Aquifers

$b_2 \ K_2 \ S_{s2}$

$b' \ K' \ S_s'$

Q

$b_1 \ K_1 \ S_{s1}$

unpumped aquifer

aquitard

previously K' was zero
(i.e. no leakage)
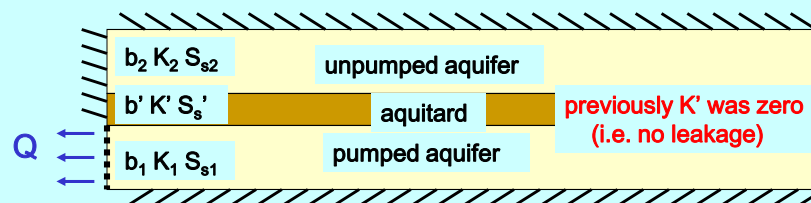
pumped aquifer

subscript 1 = pumped zone
subscript 2 = unpumped aquifer
prime   = aquitard
     Q = pumping rate
     b = thickness
     K = hydraulic conductivity
     S_s = specific storage

assume:
no head change in unpumped aquifer
horizontal flow in aquifers
vertical flow in aquitards
aquifer extends far enough to
   intercept enough leakage to satisfy Q
Theis assumptions
(other than impermeable aquitard) apply

What conditions justify assuming no head change in the unpumped aquifer?

A sufficiently permeable unpumped aquifer so flow to the "disk" above
the drawdown cone is low enough to require nearly zero gradient.

Q

What will happen that did
not occur in the completely
confined aquifer?

water level in shallow aquifer

Vertical leakage, first from
storage in the aquitard, then
from the shallow aquifer.

What do we expect regarding
the magnitude of leakage?

Greatest leakage where head difference is
largest, decreasing away from the well.

What will be the maximum
extent of drawdown?

Drawdown will be limited to the radius at which the
entire Q leaks from the upper aquifer to the lower.

What controls the rate of
drawdown cone development?
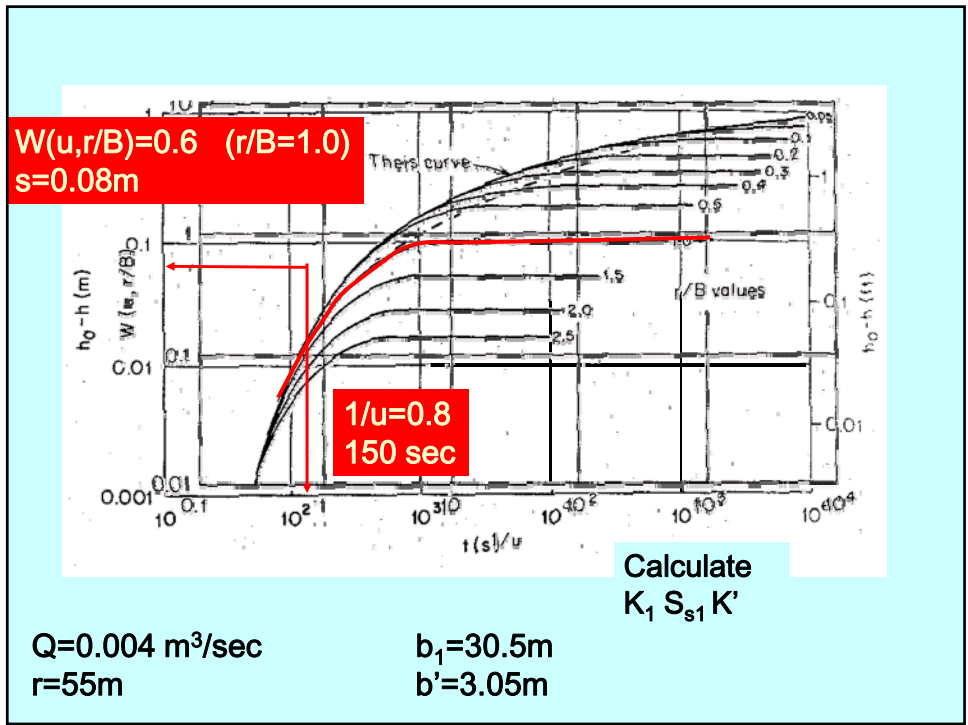
S & T of aquifer
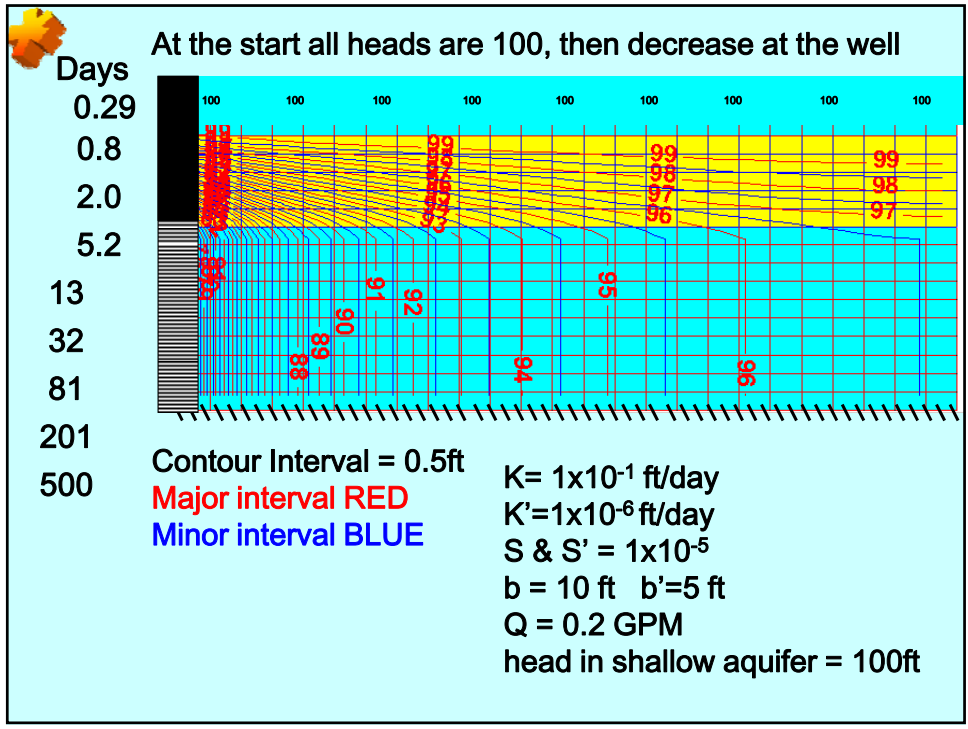AND
S and Kv of the aquitard

Q

water level in shallow aquifer

Will drawdown vs time at the red observation well look more like? .....

log s drawdown

B

A infinite aquifer

C

C is the right answer   D none of the above

log time

At the start all heads are 100, then decrease at the well

Days
0.29
0.8
2.0
5.2
13
32
81
201
500

100 100 100 100 100 100 100 100 100

99
98
97
96

99
98
97

99
98
97

95

91 92

90

89

88

94

96

Contour Interval = 0.5ft
Major interval RED
Minor interval BLUE

$K = 1 \times 10^{-1}$ ft/day
$K' = 1 \times 10^{-6}$ ft/day
$S \, \& \, S' = 1 \times 10^{-5}$
$b = 10$ ft $b' = 5$ ft
$Q = 0.2$ GPM
head in shallow aquifer = 100ft

$W(u, r/B) = 0.6$ $(r/B = 1.0)$
$s = 0.08$m

Theis curve

0.05
0.1
0.2
0.3
0.4
0.5

r/B values

1.5
2.0
2.5

$h_0 - h$ (m)
$W(u, r/B)$

$1/u = 0.8$
150 sec

$t(s)/u$

Calculate
$K_1 \, S_{s1} \, K'$

$Q = 0.004$ m³/sec
$r = 55$m

$b_1 = 30.5$m
$b' = 3.05$m

Q=0.004 m³/sec b_1=30.5m
r=55m   b'=3.05m

W(u,r/b)=0.6   (r/B=1.0)   1/u=0.8   u=1.25
s=0.08m   150 sec

$$s = h_o - h = \frac{Q}{4\pi T} W(u, r/B)$$

$$u = \frac{r^2 S}{4Tt} \qquad \frac{r}{B} = r\sqrt{\frac{K'}{K_1 b_1 b'}}$$

$T = \dfrac{0.004 \text{ m}^3/\text{sec } 0.6}{4 * 3.1416 * 0.08\text{m}} = 2.4\times10^{-3} \text{ m}^2/\text{sec}$

K_1 = T/b = 7.8×10^{-5} m/sec

K' = $(1/55\text{m})^2$ *7.8×10^{-5} m/sec*30.5m*3.05m
   = 2.4×10^{-6} m/sec

S = (1.25*4*2.4×10^{-3} m²/sec*150sec)/(55m)²
  = 6×10^{-4}

S_s = S/b = 2×10^{-5} m^{-1}