Question 1:

The input parameters required are summarized in **Table 1**.

Table 1: Input Values for all models

Net pay (ft) -h	50
Reservoir Pressure (psi) -p_e	3000
Wellbore Pressure (psi) -p_{wf}	1500
Fluid viscosity (cp) - μ	8
Volume Factor - B_0	1.1
Drainage length (ft)	4000
Drainage width (ft)	3000
Wellbore length (ft) -L	5000
Wellbore Radius (ft) -r_w	0.25
Horizontal Permeability (md) -k_H	2
Vertical Permeability (md) -k_V	1

a) Joshi/Economides model can not be applied to a fully penetrated well as the model assumed an elliptical horizontal flow and elliptical horizontal flow can not exist at the end of the drainage region if the well extends to the end of drainage region.

b) Furui et al. model can be used as shown below

Distance to the reservoir boundary, $y_b = 1500$ ft **(see Fig. 1).**

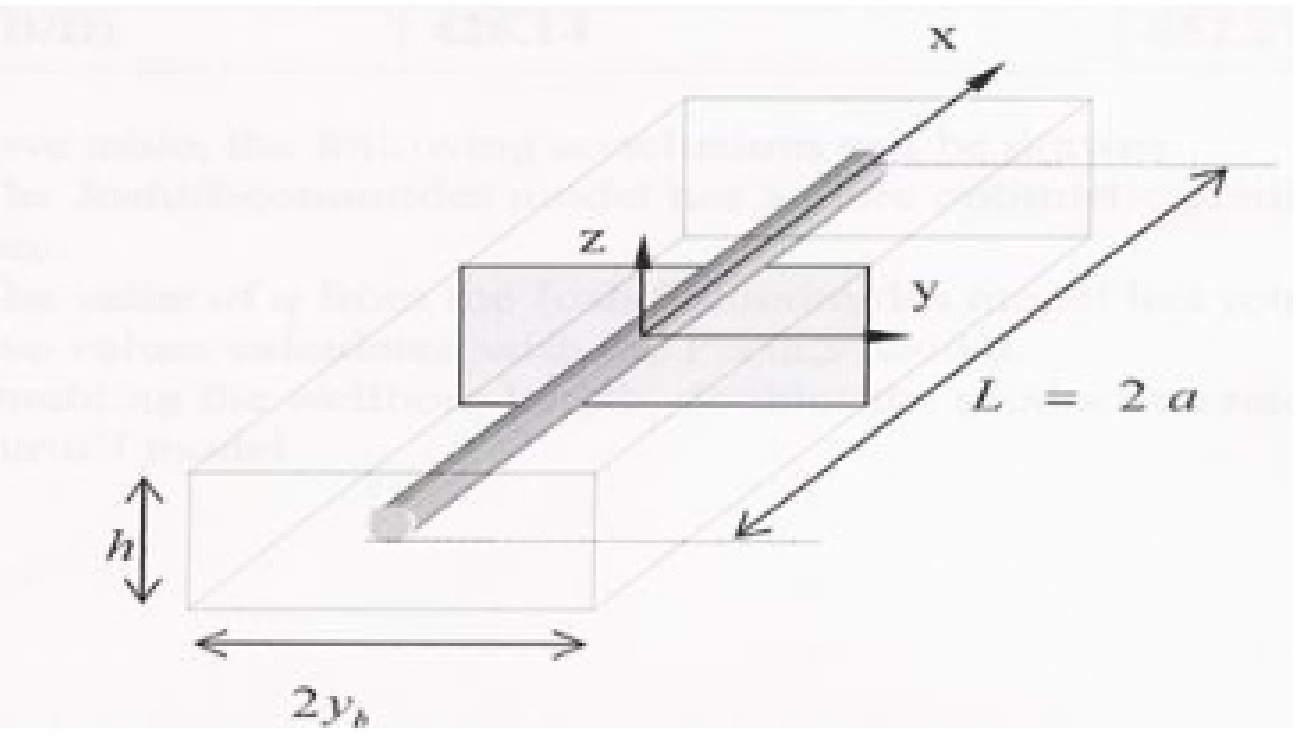

Fig. 1: Furui et al. Model geometry of horizontal well in reservoir

The mean permeability = $k = \sqrt{k_y k_z} = \sqrt{1} = 1.0$ md.

Skin, s = 0 assumed as there is no mention of any formation damage.

$$q = \frac{kL(p_e - p_{wf})}{141.2\mu B_o\left(\ln\left[\frac{hI_{ani}}{r_w(I_{ani}+1)}\right] + \frac{\pi y_b}{hI_{ani}} - 1.224 + s\right)}$$

For P_{wf} = 1500 psi,

$$q = \frac{(1)\cdot(5000)\cdot(3000-1500)}{141.2(8)(1.1)\left(\ln\left[\frac{(50)(2)}{(0.25)(2+1)}\right] + \frac{\pi(1500)}{(50)(2)} - 1.224 + 0\right)} = \textbf{118.8 STB/d}$$

Production rate for different bottomhole pressure's are calculated and shown in IPR curve below (**Fig. 2**).

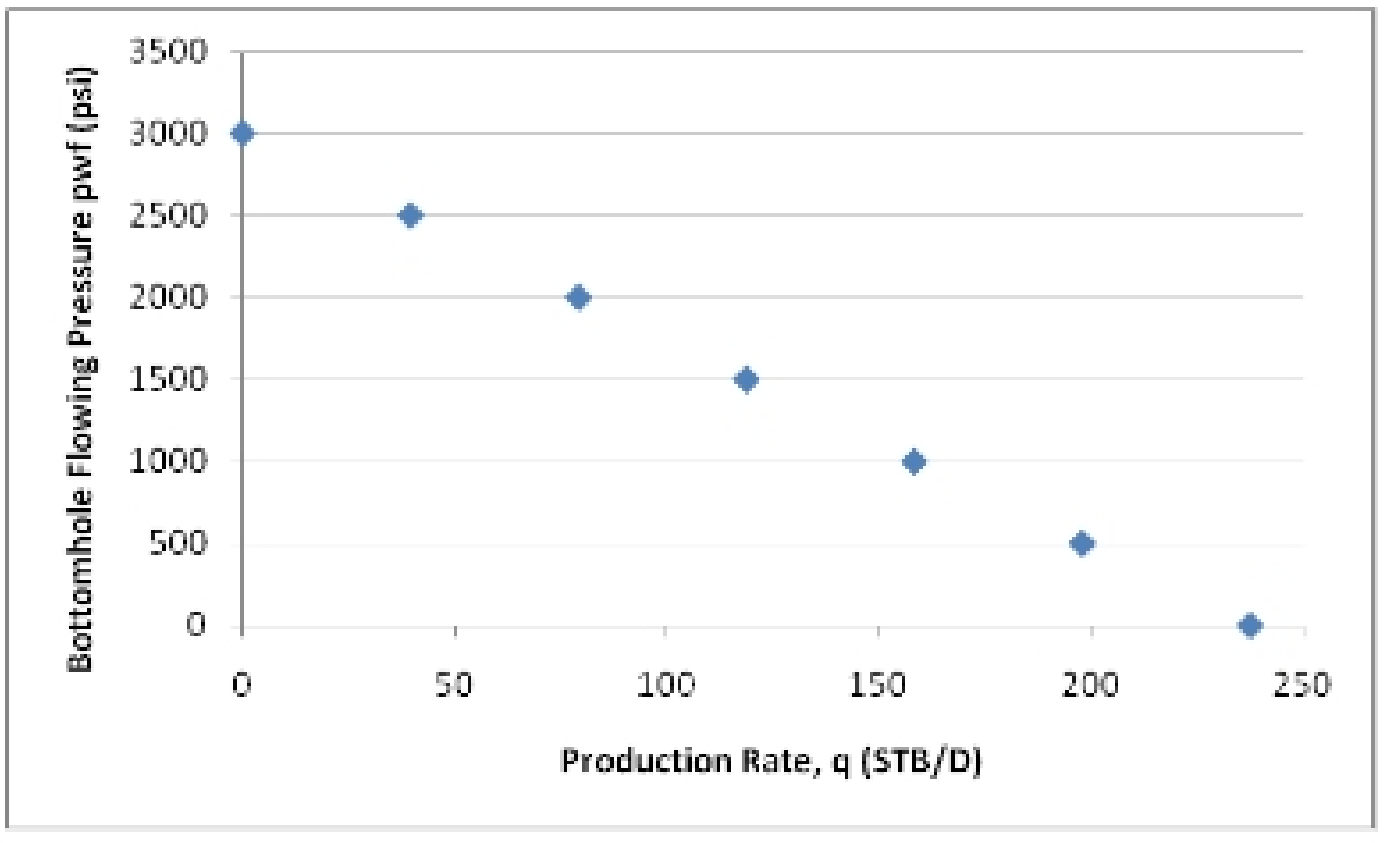

Fig. 2: IPR curve for Furui et al. model

c) Babu and Odeh model can be applied as shown below

Table 2: Input Values for Babu and Odeh Model (see Fig. 3)

Drainage length (ft) -b	5000
Drainage width (ft) -a	3000
Position in width direction (ft)-x_0	1500
Position in Length direction (ft) – y_1	0
Position in Length direction (ft) – y_2	5000
Position in height direction (ft) -z_0	25

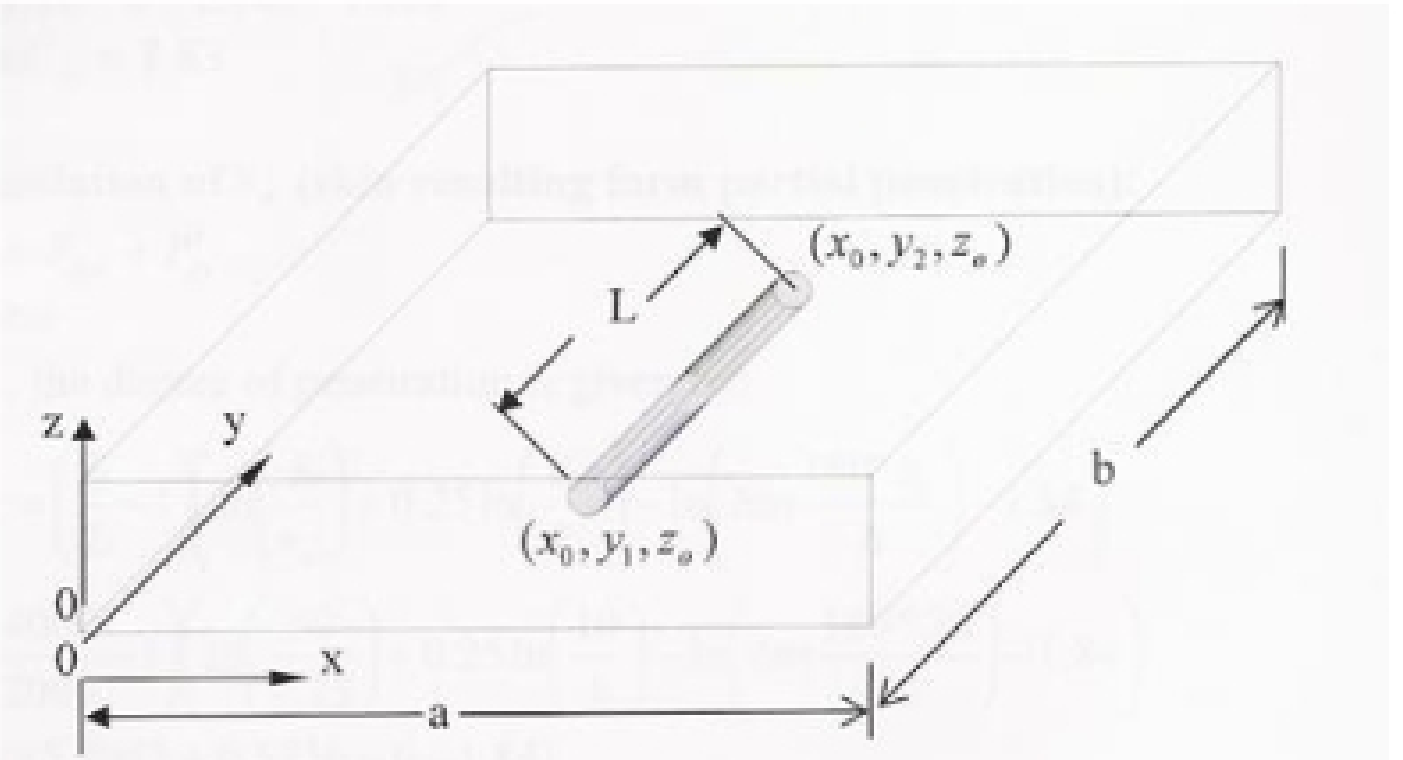

Fig. 3: Babu and Odeh Model of horizontal well in reservoir

First, we calculate the shape factor, C_H:

$$\ln C_H = 6.28\frac{a}{I_{ani}h}\left[\frac{1}{3}-\frac{x_0}{a}+\left(\frac{x_0}{a}\right)^2\right]-\ln\left(\sin\frac{\pi z_0}{h}\right)$$

$$-0.5\ln\left[\left(\frac{a}{I_{ani}h}\right)\right]-1.088$$

$$\boxed{\ln C_H = 6.28\frac{3000}{(2)(50)}\left[\frac{1}{3}-\frac{1500}{3000}+\left(\frac{1500}{3000}\right)^2\right]-\ln\left(\sin\frac{\pi(25)}{50}\right)-0.5\ln\left(\frac{3000}{(2)(50)}\right)-1.088} = 12.914$$

Now, since the well is fully penetrating the reservoir,

partial penetration skin factor, $s_R = 0$

The drainage area of horizontal well, A = a * h = 150000 ft^2

Production rate for P_{wf} = 1500 psi is calculated:

$$q = \frac{\sqrt{k_y k_z}\, b(\bar{p}-p_{wf})}{141.2B_o\mu\left[\ln\left(\frac{A^{0.5}}{r_w}\right)+\ln C_H-0.75+s_R+s\right]} = \mathbf{309.38\ STB/d}$$

Production rate for different bottomhole pressure's are calculated and shown in IPR curve below (**Fig. 4**).