```python
#B.TECH PROJECT

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
np.seterr(divide='ignore', invalid= 'ignore')

a=(input("Enter the value of porosity (%) of shale rock:"))

b=(input("enter the permeability 'K' (md) of shale rock"))


# import pandas as pd
# df = pd.read_csv (r'C:\Users\madhu\Desktop\PRO2022\shale.csv')
# print (df)
#Porosity (%) and Permeability (mD) values of the studied shale samples
#        Sample          Porosity(%)        Permeability (mD)
#        sand-A          3.93               0.00057
#        Sand-B          0.90               0.00040
#        Sand-C          0.17               0.00021
#        Sand-D          1.93               0.00039
#        Sand-E          2.27               0.00083
#        Sand-F          1.75               0.00088
#        sand-G          2.29               0.00037
#        Sand-H          1.30               0.00810

T = float(input("Time for fracture propagation(min) :"))
G = float(input("Shear modulus (psi) :"))
Q = int(input("Flow rate of fracturing fluid (bbl/min) :"))
v = float(input("Poisson's ratio :"))
mu = float(input("viscosity of fracturing fluid (cp) :"))
cl = float(input("fluid loss coefficient (ft/min^0.5) :"))
h = float(input("fracture height (ft) :"))
Sigma_min = float(input("Horizontal minimum stress (psi) :"))
proppant_concentration_at_time_t = float(input("proppant concentration at time t(% or fraction) :"))
final_proppant_concentration = float(input("final proppant concentration(% or fraction):"))




v1 = 1-v
t = np.linspace(0,T,50)
pi = 3.14
#KGD MODEL
A = 0.48*(8*G*(Q**3)/(v1*mu))**(1/6)
B = 1.32*(8*v1*(Q**3)*mu/G)**(1/6)
KGD_L = A*(t**(2/3))
KGD_w = B*(t**(1/3))
C = 0.96*(2*(G**3)*Q*mu/((v1**3)*(KGD_L**2)))
KGD_Pw = Sigma_min + C




#PKN MODEL

# 1. FOR A LARGE FLUID LEAK-OFF
D = Q/(pi*cl*h)
E = 4*(2*v1*mu*(Q**2)/((pi**3)*G*cl*h))**(1/4)
F = 4*(2*(G**3)*mu*(Q**2)/((pi**3)*(v1**3)*cl*(h**5)))**(1/4)
PKN_L1 = D*(t**(1/2))
PKN_w1 = E*(t**(1/8))
PKN_Pw1 = F*(t**(1/8))

#2. FOR NO FLUID LEAK-OFF

J = 0.68*(G*(Q**3)/(v1*mu*(h**4)))**(1/5)
K = 2.5*(v1*mu*(Q**2)/(G*h))**(1/5)
M = 2.5*((G**4)*mu*(Q**2)/(v1**4)*(h**6))**(1/5)
PKN_L2 = J*(t**(4/5))
PKN_w2 = K*(t**(1/5))
PKN_Pw2 = M*(t**(1/5))
KGD_MODEL = {'TIME':t,'FRACTURE LENGTH':KGD_L,'WIDTH':KGD_w,'PRESSURE':KGD_Pw}
PKN_MODEL_LARGE_LEAKOFF = {'TIME':t,'FRACTURE LENGTH':PKN_L1,'FRACTURE WIDTH':PKN_w1,'PRESSURE':PKN_Pw1}
PKN_MODEL_NO_LEAKOFF = {'TIME':t,'FRACTURE LENGTH':PKN_L2,'FRACTURE WIDTH':PKN_w2,'PRESSURE':PKN_Pw2}
KGD_DF = pd.DataFrame(KGD_MODEL)
PKN1_DF = pd.DataFrame(PKN_MODEL_LARGE_LEAKOFF)
PKN2_DF = pd.DataFrame(PKN_MODEL_NO_LEAKOFF)

plt.figure(figsize=(20,5))
plt.subplot(1,4,1)
plt.plot(t,KGD_L)
plt.xlabel('time')
plt.ylabel('fracture length')
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plt.grid(True)
plt.subplot(1,4,2)

plt.plot(t,KGD_w)
plt.xlabel('time')
plt.ylabel('fracture width')
plt.grid(True)
plt.subplot(1,4,3)

plt.plot(KGD_L,KGD_Pw)
plt.xlabel('length')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.subplot(1,4,4)

plt.plot(t,KGD_Pw)
plt.xlabel('time')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.suptitle('KGD MODEL',fontsize='15')

plt.show()
plt.figure(figsize=(18,5))
plt.subplot(1,3,1)
plt.plot(t,PKN_L1)
plt.xlabel('time')
plt.ylabel('fracture length')
plt.grid(True)
plt.subplot(1,3,2)

plt.plot(t,PKN_w1)
plt.xlabel('time')
plt.ylabel('fracture width')
plt.grid(True)
plt.subplot(1,3,3)
plt.plot(t,PKN_Pw1)
plt.xlabel('time')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.suptitle('PKN MODEL WITH LARGE FLUID LEAKOFF',fontsize='16')


plt.show()
plt.figure(figsize=(18,5))
plt.subplot(1,3,1)
plt.plot(t,PKN_L2)
plt.xlabel('time')
plt.ylabel('fracture length')
plt.grid(True)
plt.subplot(1,3,2)
plt.plot(t,PKN_w2)
plt.xlabel('time')
plt.ylabel('fracture width')
plt.grid(True)
plt.subplot(1,3,3)
plt.plot(t,PKN_Pw2)
plt.xlabel('time')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.suptitle('PKN MODEL WITH NO FLUID LEAKOFF',fontsize='16')

plt.show()
plt.figure(figsize=(16,5))
plt.subplot(1,3,1)
plt.plot(t,PKN_L1,t,PKN_L2)
plt.xlabel('time')
plt.ylabel('fracture length')
plt.grid(True)
plt.legend(['large leakoff','no leakoff'])
plt.subplot(1,3,2)
plt.plot(t,PKN_w1,t,PKN_w2)
plt.xlabel('time')
plt.ylabel('fracture width')
plt.grid(True)
plt.legend(['large leakoff','no leakoff'])
plt.subplot(1,3,3)
plt.plot(t,PKN_Pw1,t,PKN_Pw2)
plt.xlabel('time')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.legend(['large leakoff','no leakoff'])
plt.suptitle('PKN MODEL BOTH CASES COMPARED',fontsize='16')

plt.show()
plt.figure(figsize=(16,5))
plt.subplot(1,3,1)
```

```python
plt.plot(t,KGD_L,'b.',t,PKN_L1,'g-',t,PKN_L2,'r*')
plt.xlabel('time')
plt.ylabel('fracture length')
plt.grid(True)
plt.legend(['KGD','PKN-large leakoff','PKN-no leakoff'])
plt.subplot(1,3,2)
plt.plot(t,KGD_w,'b.',t,PKN_w1,'g-',t,PKN_w2,'r*')
plt.xlabel('time')
plt.ylabel('fracture width')
plt.grid(True)
plt.legend(['KGD','PKN-large leakoff','PKN-no leakoff'])
plt.subplot(1,3,3)
plt.plot(t,KGD_Pw,'b.',t,PKN_Pw1,'g-',t,PKN_Pw2,'r*')
plt.xlabel('time')
plt.ylabel('wellbore pressure')
plt.grid(True)
plt.legend(['KGD','PKN-large leakoff','PKN-no leakoff'])

#formation breakdown pressure calculation

ro = float(input("average density of overlying rocks(ppg):"))
depth = float(input("depth(ft):"))
pore_pressure_gradient = float(input("pore pressure gradient(psi/ft):"))
tensile_stress = float(input("tensile stress(psi):"))
tectonic_stress = float(input("tectonic stress(psi):"))

#biot's constant
alpha = 0.7
vertical_stress = 0.052*ro*depth
pore_pressure = pore_pressure_gradient*depth
effective_vertical_stress = vertical_stress - alpha*pore_pressure

effective_horizontal_minimum_stress = v*effective_vertical_stress/v1
horizontal_minimum_stress = effective_horizontal_minimum_stress + alpha*pore_pressure
horizontal_maximum_stress = horizontal_minimum_stress + tectonic_stress
Formation_breakdown_pressure = 3*horizontal_minimum_stress - horizontal_maximum_stress + tensile_stress - pore_pressure

#pad volume
fracture_half_length = (A*(T**(2/3)))/2
average_width = 0.075*(pi/4)*(mu*Q*v1*(fracture_half_length**2)/(G*h))**(1/4)
volume_injected = Q*T
volume_of_fracture = 2*fracture_half_length*h*average_width
eta = volume_of_fracture/volume_injected
abselon = (1-eta)/(1+eta)
Pad_volume = volume_injected*abselon
#proppant schedule calculation
#pad volume injection time
pad_time = Pad_volume/Q
#injection time is total fracturing fluid injection time
proppant_schedule = pad_time + (T - pad_time)*((proppant_concentration_at_time_t/final_proppant_concentration)**(1/eta))

#proppat weight calculation
proppant_volume = final_proppant_concentration*(volume_injected - Pad_volume)/(1 + abselon)
proppant_type = int(input("proppant: 1. sand \n 2. ceramic \n 3. resin coated sand \n 4. soil with mica or iron\n "))

if proppant_type == 1:
 proppant_weight = 2.65*proppant_volume # S.G OF SAND 2.65
elif proppant_type == 2:
 proppant_weight = 3.2*proppant_volume # S.G OF CERAMIC 3.2
elif proppant_type == 3:
 proppant_weight = 2.6*proppant_volume #S.G OF RESIN COATED SAND 2.6
elif proppant_type == 4:
 proppant_weight = 2.75*proppant_volume # S.G OF SOIL WITH MICA OR IRON 2.75
else:
    proppant_weight = 1*proppant_volume # slurry


KGD_fracture_length = A*(T**(2/3))
KGD_fracture_width = B*(T**(1/3))
pressure_2 = 0.96*(2*(G**3)*Q*mu/((v1**3)*(KGD_fracture_length**2)))
KGD_pressure = Sigma_min + pressure_2
PKN_fracture_length_1 = D*(T**(1/2))
PKN_fracture_width_1 = E*(T**(1/8))
PKN_pressure_1 = F*(T**(1/8))
PKN_fracture_length_2 = J*(T**(4/5))
PKN_fracture_width_2 = K*(T**(1/5))
PKN_pressure_2 = M*(T**(1/5))

print("KGD model")
print("\nKGD fracture length = ",KGD_fracture_length,"ft")
print("KGD fracture opening width = ",KGD_fracture_width,"inch")
print("KGD wellbore pressure = ",KGD_pressure,"psi")
print("\nPKN model - large fluid leakoff")
print("\nPKN fracture length = ",PKN_fracture_length_1,"ft")
print("PKN fracture opening width = ",PKN_fracture_width_1,"inch")
print("PKN wellbore pressure = ",PKN_pressure_1,"psi")
```
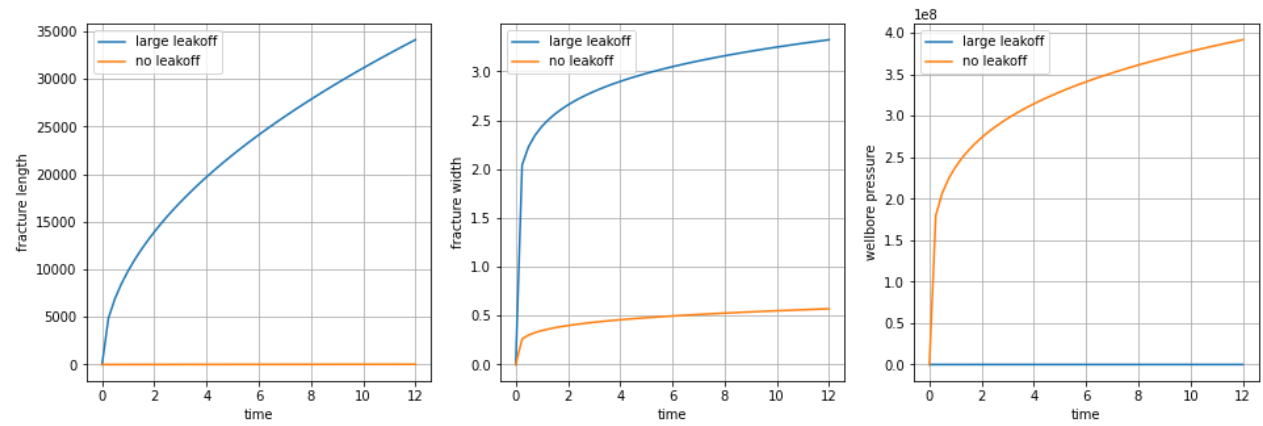
```python
print("\nPKN model - no fluid leakoff")
print("\nPKN fracture length = ",PKN_fracture_length_2,"ft")
print("PKN fracture opening width = ",PKN_fracture_width_2,"inch")
print("PKN wellbore pressure = ",PKN_pressure_2,"psi")
print("\nFormation breakdown pressure = ",Formation_breakdown_pressure,"psi")
print("Pad volume = ",Pad_volume,"bbl")

print("Proppant schedule = ",proppant_schedule,"min")
```


KGD MODEL

PKN MODEL WITH LARGE FLUID LEAKOFF

PKN MODEL WITH NO FLUID LEAKOFF

PKN MODEL BOTH CASES COMPARED


```
average density of overlying rocks(ppg):22.05
depth(ft):10000
pore pressure gradient(psi/ft):0.38
tensile stress(psi):1000
tectonic stress(psi):2000
proppant: 1. sand
 2. ceramic
 3. resin coated sand
 4. soil with mica or iron
 3
KGD model

KGD fracture length =  312.4850272588997 ft
KGD fracture opening width =  3.6497108677629235 inch
KGD wellbore pressure =  1897978734384879.5 psi

PKN model - large fluid leakoff

PKN fracture length =  34120.115718081506 ft
PKN fracture opening width =  3.324591827128012 inch
PKN wellbore pressure =  36163.24759958495 psi

PKN model - no fluid leakoff

PKN fracture length =  26.80380723585102 ft
PKN fracture opening width =   0.5708144318966644 inch
PKN wellbore pressure =  391763559.36731786 psi

Formation breakdown pressure =  4923.0 psi
Pad volume =  136.69178928402937 bbl
Proppant schedule =  3.8063104517499378 min
Proppant weight required =  17229.24046990798 lbs

C:\Users\madhu\AppData\Local\Programs\Python\Python310\lib\site-packages\IPython\core\pylabtools.py:151: UserWarnin
g: Glyph 2 ( ) missing from current font.
  fig.canvas.print_figure(bytes_io, **kw)
```

COMPARISON BETWEEN KGD,PKN-LARGE LEAKOFF & PKN□NO LEAKOFF