In [5]:

```
import numpy as np
import matplotlib.pyplot as plt
import plotly.graph_objs as go
```

Problem 2.1

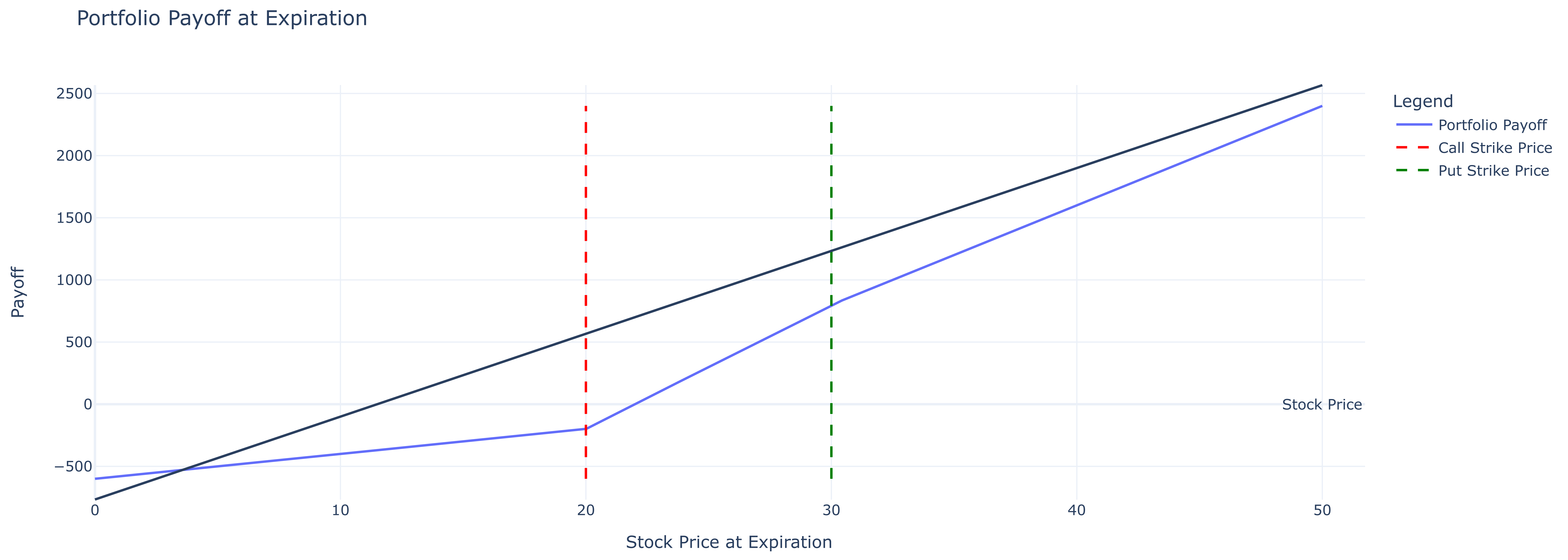
In this problem, the payoff is defined as:

$$P_T = [40(S_0 - S_T)] + [80(S_T - 20)^+] - [30(30 - S_T)^+]$$

I deemed it easier to code this solution to get the exact payoff.

In [6]:

```
import numpy as np
import plotly.graph_objs as go

# Define the range of stock prices
stock_prices = np.linspace(0, 50, 1000)

# Define the positions
short_shares = -40  # short 40 shares
long_calls = 80  # long 80 call options
short_puts = -20  # short 20 put options

# Define strike prices
strike_call = 20
strike_put = 30

# Calculate the payoffs
payoff_short_shares = short_shares * (stock_prices - stock_prices)
payoff_long_calls = long_calls * np.maximum(stock_prices - strike_call, 0)
payoff_short_puts = short_puts * np.maximum(strike_put - stock_prices, 0)

# Combine the payoffs
total_payoff = payoff_short_shares + payoff_long_calls + payoff_short_puts

# Create the Plotly figure
fig = go.Figure()

# Add traces for portfolio payoff, call strike, and put strike
fig.add_trace(go.Scatter(x=stock_prices, y=total_payoff, mode='lines', name='Portfolio Payoff'))
fig.add_trace(go.Scatter(x=[strike_call, strike_call], y=[min(total_payoff), max(total_payoff)], mode='lines', name='Call Strike Price', line=dict(color='red', dash='dash
fig.add_trace(go.Scatter(x=[strike_put, strike_put], y=[min(total_payoff), max(total_payoff)], mode='lines', name='Put Strike Price', line=dict(color='green', dash='dash'

# Update the layout
fig.update_layout(
    title='Portfolio Payoff at Expiration',
    xaxis_title='Stock Price at Expiration',
    yaxis_title='Payoff',
    legend_title='Legend',
    shapes=[dict(
        type='line',
        yref='paper', y0=0, y1=1,
        xref='x', x0=stock_prices[0], x1=stock_prices[-1]
    )],
    annotations=[dict(
        x=stock_prices[-1],
        y=0,
        xref='x',
        yref='y',
        text='Stock Price',
        showarrow=False
    )],
    template='plotly_white'
)

# Show the figure
fig.show()
```


Portfolio Payoff at Expiration
Payoff
Stock Price at Expiration
Stock Price
Legend
Portfolio Payoff
Call Strike Price
Put Strike Price