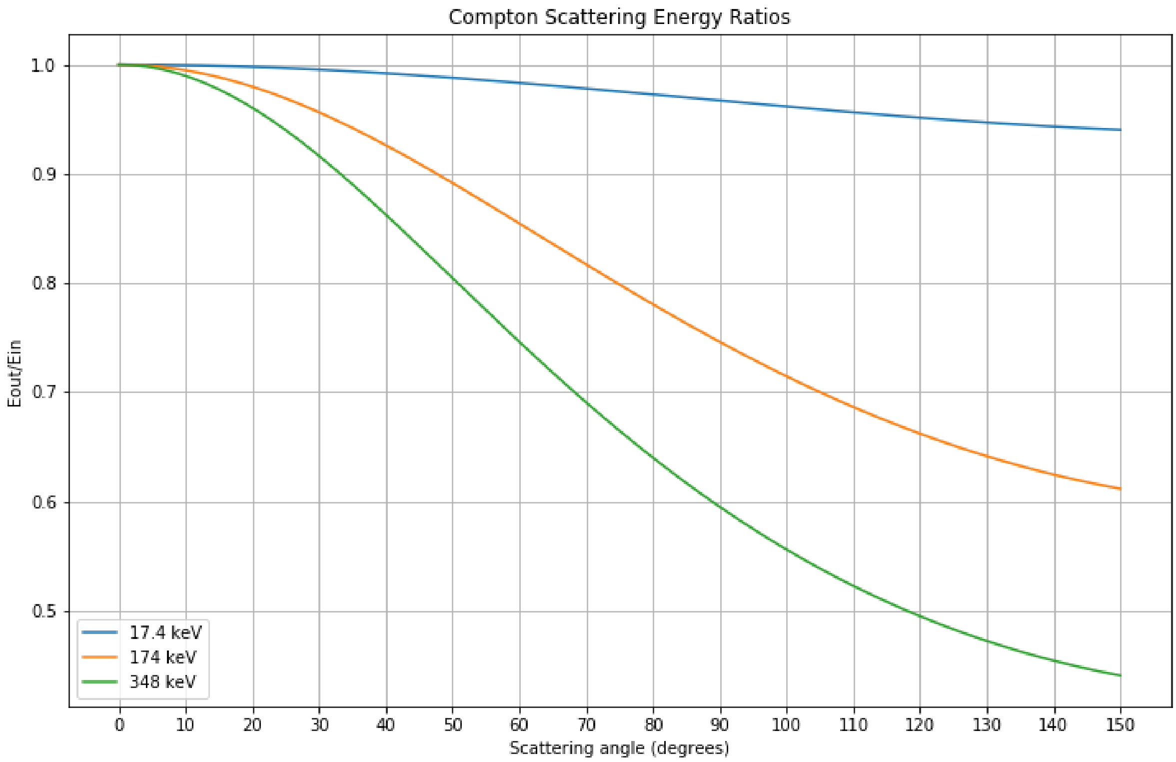
In [60]:

```python
# This function can be used to quickly calculate the theoretical predictions of Compton's
# formula, and can be used in doing such experiments as the one undertaken in Question 1
# of this TMA, namely to compare experimental results to the theoretical prediction for
# given energy values and scattering angles.

# Import the necessary packages (including those for plotting graph later).
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np

# Define program, including variables Ein and theta, and including the calculation.
# Also define Eout as the result that is given to the user and tell the program to display
# it.  The calculation must convert theta from degrees to radians to use the cos function.

def compton (Ein,theta):
    Eout = Ein/(1+(Ein/511.0)*abs(1-np.cos(theta*np.pi/180))) # The actual calculation.
    return(Eout) # Allows Eout to be taken and used for other calculations etc.


qContinue = 'y' # Sets up the question of doing multiple calculations

while(qContinue == 'y'):
    Ein = float(input('What is the incoming energy in keV? '))
    theta = float(input('What is the scattering angle in degrees? '))

    Eout=compton(Ein,theta)

    print('The scattered energy is ',Eout,' keV')

    qContinue = input('Do you want to do another (y or n)?')

print('All done!')
```

```
What is the incoming energy in keV? 17.4
What is the scattering angle in degrees? 50
The scattered energy is  17.19090026456452  keV
Do you want to do another (y or n)?n
All done!
```

In [58]:

```
plt.rcParams['figure.figsize'] = [12, 7.5]
angle = np.arange(0,151)
x = angle
y1 = ((compton(17.4,angle))/17.4)
y2 = ((compton(174,angle))/174)
y3 = ((compton(348,angle))/348)
plt.plot(x,y1,label='17.4 keV')
plt.plot(x,y2,label='174 keV')
plt.plot(x,y3,label='348 keV')
plt.legend(loc='lower left')
plt.title('Compton Scattering Energy Ratios')
plt.xlabel('Scattering angle (degrees)')
plt.ylabel('Eout/Ein')
plt.grid()
plt.xticks([0,10,20,30,40,50,60,70,80,90,100,110,120,130,140,150])
plt.show()
```



In [37]:

```
compton (348,150)
```

Out[37]:

153.25021474986693