## PHYS 301 HOMEWORK #12

Due: 11 April 2014

1. Refer to the accompanying figure (in another link). Use Legendre polynomials to express the potential due to the indicated electric quadrupole.

2. Expand the following as Legendre series (you may verify results using Mathematica but must show all your work by hand) :



(5 pts for each series)

3. The generating function for Bessel's functions of the first kind (solutions to the Bessel differential equation, see sections 12 - 15 in Boas) is :

$$g(x, t) = e^{(x/2)(t-1/t)} = \sum_{n=-\infty}^{\infty} J_n(x) t^n$$

where  $J_n$  is the  $n^{\text{th}}$  order Bessel function of the first kind. Use the generating function to show that:

a) 
$$J_{n-1}(x) + J_{n+1}(x) = \frac{2n}{x} J_n(x)$$
  
b)  $J_{n-1}(x) + J_{n+1}(x) = 2 \frac{d J_n(x)}{dx}$ 

(10 pts each part)