5) $\sum_{k=5}^{2n} (3k-2)$, Find the closed form solution

$$3\sum_{k=5}^{2n} k - \sum_{k=5}^{2n} 2$$

$$3\left[\sum_{k=1}^{2n} k - \sum_{k=1}^{4} k\right] - (2n-5+1)2$$

$$3\left[\frac{\cancel{2}n(2n+1)}{\cancel{2}} - \frac{\overset{2}{\cancel{4}}\cdot 5}{\cancel{2}}\right] - 2(2n-4)$$

$$3[n(2n+1) - 10] - 4n + 8$$

$$3(2n^2 + n - 10) - 4n + 8$$

$$6n^2 + 3n - 30 - 4n + 8$$

$$\boxed{6n^2 - n - 22}$$

6) $$\sum_{i=0}^{n}\left(2\underbrace{\sum_{j=n+1}^{3n}(i+j)}_{\text{Solve this 1st}}\right)$$

$$2\left(\sum_{j=n+1}^{3n} i + \sum_{j=n+1}^{3n} j\right)$$

Treat as a constant here

$$2\left(\left(3n-(n+1)+1\right) + \left(\sum_{j=\cancel{n}1}^{3n} j - \sum_{j=1}^{n} j\right)\right)$$

$$\cancel{2}\left(2n + \left(\frac{3n(3n+1)}{2} - \frac{n(n+1)}{2}\right)\right)$$

$$4\cancel{2}n + \frac{9n^2+3n-n^2-n}{\cancel{2}}$$

$$\sum_{i=0}^{n} \underbrace{8n^2+6n}_{\text{Treat as a constant}}$$

$$(8n^2+6n)(n-0+1) = (8n^2+6n)(n+1)$$

$$= 8n^3+8n^2+6n^2+6n$$

$$8n^3+14n^2+6n$$

7) $$\sum_{j=1}^{2n} \underbrace{\sum_{m=12}^{3j+5} 2}$$

This will run for: $2(3j+5-12+1)$

$$\sum_{j=1}^{2n} 2(3j-6)$$

$$2\left[\sum_{j=1}^{2n} 3j - \sum_{j=1}^{2n} 6\right]$$

$$2\left[3\left(\frac{2n(2n+1)}{\cancel{2}}\right) - (2n-1+1)6\right]$$

$$= 2\left[3(2n^2+n) - 12n\right]$$

$$= 2(6n^2 + \cancel{3n} - \cancel{12}n) \overset{9n}{} = \boxed{12n^2 - 18n}$$

8) $$\sum_{i=1}^{n+5} \underbrace{\sum_{j=1}^{m} ij}_{i \text{ is a constant in that expression}}$$

$$\sum_{i=1}^{n+5} i \sum_{j=1}^{m} j$$

$$\sum_{i=1}^{n+5} i \quad \frac{m(m+1)}{2}$$

$$\boxed{\frac{m(m+1)}{2} \cdot \frac{(n+5)(n+6)}{2}} = \boxed{\frac{m(m+1)(n+5)(n+6)}{4}}$$

$$= \frac{m^2+m}{2} \cdot \frac{n^2+11n+30}{2}$$

Don't need to multiply out

$$\cancel{= \frac{m^2n^2 + 11m^2n + 30m^2 + n^2m + 11mn + 30m}{4}}$$