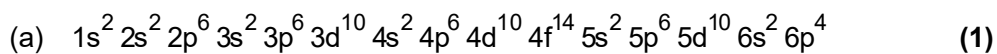


## 8. Polonium



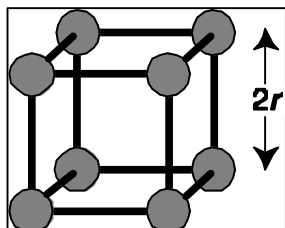
exact ordering is irrelevant  $[\text{Xe}] 4f^{14} 5d^{10} 6s^2 6p^4$  is also acceptable



(c) half life = 138 days. 1 year = 365 / 138 half lives = 2.645 half lives. Power output after one year =  $141 \times (0.5^{2.645}) = 22.5(4) \text{ W g}^{-1}$  (2)

(d) after  $x$  half lives, power drops to 0.96 of initial, so  $[0.5^x] = 0.96$  taking logs:  $x(\ln 0.5) = \ln(0.96)$ ,  $x = 0.05889$  half lives in 5 years so time for one half life =  $5 / x = 84.899$  years = 85 years (2)

(e)



1 unit cell contains  $8 \times 1/8$  atoms = 1 (1)

volume of unit cell =  $(2r)^3$  where  $r$  = radius

$9.142 \text{ g} = 1 \text{ cm}^3 = 1 \times 10^{-6} \text{ m}^3$  (1)

mass of 1 atom =  $210 \text{ g} / 6.022 \times 10^{23} = 3.487 \times 10^{-22}$

volume occupied by 1 atom

$= (2r)^3 = (1 \times 10^{-6} / 9.142) \times 3.487 \times 10^{-22} \text{ m}^3$  (1)

$= 3.814 \times 10^{-29} \text{ m}^3$

so  $r = \frac{1}{2} \sqrt[3]{3.8143 \times 10^{-29}} = 1.68(3) \times 10^{-10} \text{ m} = 168 \text{ pm}$

(168pm x 2 = 2 unless

they can say

336 diameter)

(3 for ans)

**Total 9**