BOTTOM-LINE ANSWERS PHYS30101 January 2015

Q1:
(a) 7 substates with splitting 7.7 μeV.

(d) J=4 with M=+4 to -4 in integer steps.
J=3 with M=+3 to -3 in integer steps.
J=2 with M=+2 to -2 in integer steps.
J=1 with M=+1 to -1 in integer steps.

Q2:
(c) Current increases by a factor of 2.05 when using $\hbar c$=197.3 eV.nm

Q3:
(a) Outcomes of measurements of S_z are $\pm\hbar/2$ with 50% probability each.

(c) $\langle S_x\rangle = -\hbar\cos(2\omega t)/2$ and $\langle S_y\rangle = -\hbar\sin(2\omega t)/2$.

Q4:

Energy levels given by: $E(n_x,n_y,n_z) = (4n_x^2+n_y^2+n_z^2)\hbar^2\pi^2/2ma^2$.

First three energy levels:

$E(1,1,1)=3\hbar^2\pi^2/ma^2$

$E(1,2,1)=E(1,1,2)=9\hbar^2\pi^2/2ma^2$

$E(1,2,2)=6\hbar^2\pi^2/ma^2$.

Degeneracies are: 1x2, 2x2 and 1x2 respectively (where the x2 is from two different spin directions).

Magic numbers are: 2, 6, 8.

Normalisation factor is $4/a^{3/2}$.

First-order shift is $8V_0/3\pi$.