PHY2009: Answers to problems: Lectures 1 to 6

Lectures 1 and 2

1) 1, 3, 4 and 5 are primitive unit cells; 2 is non primitive, 6 is not a unit cell.
2) 2nd array is not a lattice —c.f. layer of graphite. It is a triangular lattice plus a two-atom basis.
3) Take **a** to be the vector along the long side and **b** along the short side. The fractional coordinates are then (00), (01), (10), (11) (or similar). The area of the PUC is ab. The Wigner Seitz cell is a rectangle sides a and b with a lattice point at its centre. Packing fraction is „b/4a.
4) Lattice vectors are any non-colinear vectors starting at the corner of the rectangle and ending at a centre lattice point. This gives fractional coordinates typically of (00), (11), (1 -1), (20) (depending on choice of vectors). If sides of rectangle are x and y, then area of primitive unit cell must be xy/2. Packing fraction depends on ratio of sides: if short side $y < x/\sqrt{3}$ then packing fraction is „y/2x, otherwise, it is $\frac{\pi}{8}\frac{\left(x^2+y^2\right)}{xy}$.