Test – 01/11/2018

1. Palladium metal may form an interstitial metal with hydrogen. When H2 molecules are in contact with the Pd particle’s surface they are split into H atoms through the cleavage of the H-H bonds. H atoms may then diffuse into the Pd crystal lattice. First they form a solid solution of Pd and H atoms (α phase) until the H concentration is high enough at which point the H atoms take up the interstitial positions in the Pd crystal lattice and the hydride (β) phase is formed.

The figure provided shows the phase diagram of the system, the structure of the α and β phases, and the van’t Hoff plot relating the energy change in the Pd on hydrogenation. What is the composition of the Pd-H systems at the marked pressure-composition diagrams; how many phases are there, what is there proportion and their composition?

[10 marks]

Make sure that you put your name the figure and label your reading of the diagram accurately.

What does *T*c stand for?

[2 marks]

Total: [12 marks]

1. With the help of an illustration explain the phenomenon of reverse osmosis.

[5 marks]

Explain the driving force behind reverse osmosis by discussing the chemical potential of the solvent on both sides of the semipermeable membrane.

[10 marks]

Remember that we assume a constant temperature. Recall the definition of the chemical potential in relation to the Gibbs free energy.

Total: [15 marks]

1. An effusion cell has a circular hole of diameter 1.50 mm. If the molar mass of the solid in the cell is 300 g mol-1 and its vapour pressure is 0.735 Pa at 500 K, by how much will the mass of the solid decrease in a period of 1 h? Assume negligible pressure change.

[15 marks]

1. A layer of 20.0 g of sucrose is spread uniformly over a surface of area 5.0 cm2 and covered in water to a depth of 20 cm. What will be the molar concentration of sucrose molecules at 10 cm above the original layer at 24 h? Assume diffusion is the only transport process and take *D*=5.216\*10-9 m2 s-1. The molar mass of sucrose, M(sucrose)= 342.30 g mol-1.

[18 marks]

Grand total [60 marks]