Note: These questions will be discussed in the tutorial sessions on October 10th 2014.

Question 1:

(a) Describe the substitutional and interstitial diffusion mechanisms in solid metals

(b) Compare interstitial and vacancy atomic mechanisms for diffusion.

(c) Cite two reasons why interstitial diffusion is normally more rapid than vacancy diffusion.

Question 2:

A sheet of steel 1.5 mm thick has nitrogen atmospheres on both sides at 1200°C and is permitted to achieve a steady-state diffusion condition. Knowing that the concentration of nitrogen in the steel at the high-pressure surface is 4 kg/m^3, how far into the sheet from this high-pressure side will the concentration be 2.5 kg/m^3? The diffusion coefficient for nitrogen in steel at this temperature is 6×10^{-11} m^2/s, the diffusion flux is 1.2×10^{-7} kg/m^2-s and the concentration profile is linear.

Question 3:

N_2 (gas) is to be diffused into pure iron at 700°C. What will be the concentration 1 mm from the surface after 10 h if the surface concentration is maintained at 0.15 wt% N. The diffusion coefficient for nitrogen in iron at 700°C is 2.5×10^{-11} m^2/s.

Question 4:

The diffusion coefficients for iron in nickel are given at two temperatures:

T (K)	D (m^2/s)
1273	9.4×10^{-16}
1473	2.4×10^{-14}

(a) Determine the values of D_0 and the activation energy Q_d.

(b) What is the magnitude of D at 1100°C (1373 K)?

Question 5:

A cylindrical copper rod (E = 110 GPa) is to be subjected to a load of 6660 N. If the length of the rod is 400 mm, what must be the diameter to allow an elongation of 0.50 mm? Yield strength of copper is 240 MPa.

Question 6:

A cylindrical specimen of some alloy (E=140 GPa) 8 mm in diameter is stressed elastically in tension. A force of 15,100 N produces a reduction in specimen diameter of 5×10^{-3} mm. Calculate Poisson's ratio for this material.

Question 7:

T*he following true stresses produce the corresponding true plastic strains for a brass alloy:*

True Stress (psi)	**True Strain**
50,000	0.10
60,000	0.20

What true stress is necessary to produce a true plastic strain of 0.25?