



PROGRAM : B ENG TECH
ENGINEERING METALLURGY / EXTRACTIVE METALLURGY

SUBJECT : FUNDAMENTALS OF METALLURGY:
PHYSICAL
METALLURGY

CODE : METMTB1

DATE : SUMMER EXAMINATION 2017
11 NOVEMBER 2017

DURATION : (SESSION 2) 12:30 - 14:30

WEIGHT : 40: 60

TOTAL MARKS : 100

FULL MARKS : 100

EXAMINER : MR GA COMBRINK/Ms GP APHANE

MODERATOR : Ms TSHEPHE

NUMBER OF PAGES : 6 PAGES IN TOTAL

INSTRUCTIONS : ALL THE ANSWERS MUST BE COMPLETED
IN THE EXAM SCRIPS AND HANDED IN

REQUIREMENTS : 1 POCKET CALCULATOR
NO CORRECTION FLUID SHALL BE USED
ALL WORK SHALL BE HANDED IN.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS

QUESTION 1

1.

1.1. Using the periodic table provided in the data sheet, calculate the number of atoms in 350g of each of the following:

1.1.1. Gold (2)

1.1.2. Tin (2)

1.1.3. Mercury (2)

1.1.4. Tungsten (2)

1.1.5. Tantalum (2)

1.1.6. Ruthenium (2)

1.1.7. Palladium (2)

[14]

1.2. If you have 9 moles of each of the following metals how much will each piece of metal that you have weigh? (i.e. find the mass of 9 moles of the metal)

1.2.1. Vanadium (2)

1.2.2. Platinum (2)

1.2.3. Silver (2)

1.2.4. Niobium (2)

1.2.5. Lead (2)

[10]

QUESTION 2

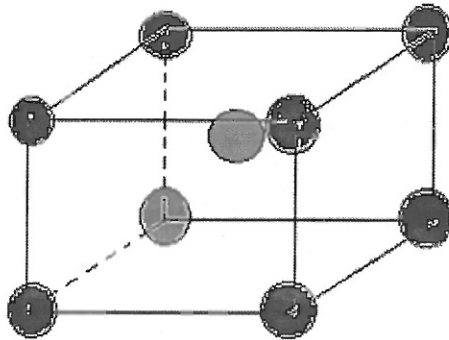


Figure 1: Schematic diagram of the expanded palladium BCC crystal unit cell

Density

- 2.1 Calculate the Density of palladium if the crystal structure is BCC and the crystal lattice parameter is $3,73\text{\AA}$ (assume that there are no crystal lattice defects). Refer to the datasheet at the end of the exam for specific information required to do this exercise. (15)

QUESTION 3

- 3.1 Refer to question 2 and use the parameters given there and calculate the number of defects in 10 cm^3 of palladium if there is a single missing Pd atom out of the right front crystal position of every 400th unit cell (i.e. out of every 400 unit cells you look at one of them has a single palladium atom missing from its corner). (15)

QUESTION 4

- 4.1 Give the coordinates of the lattice points and the miller indices of the arrows in the sketch. Assume that all single lengths are exactly equal in length as indicated on the sketch. (15)

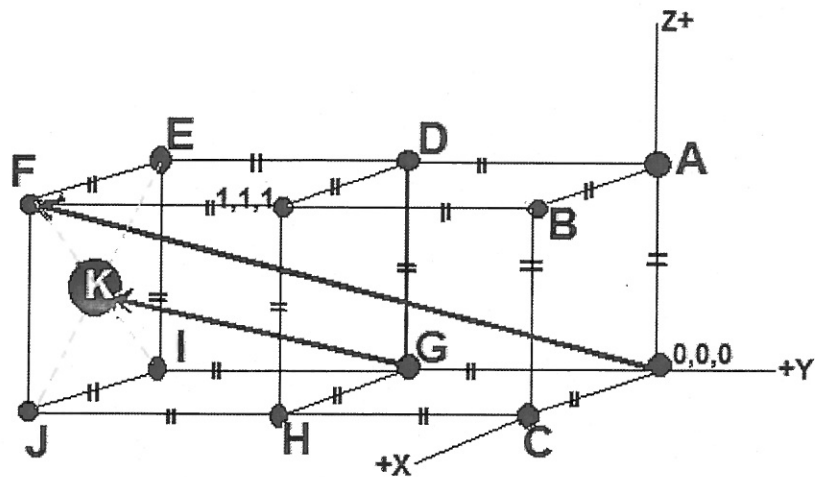


Figure 2: Schematic diagram of the unit cells

QUESTION 5

Explain what is meant by the following terms in the material science:

- 5.1 Crystal structure (3)
- 5.2 Amorphous materials (3)
- 5.3 Grain Boundary (3)
- 5.4 Vacancy (3)
- 5.5 Screw dislocation (3)

[15]

Question 6

Use the Pauli Exclusion Principle to show the shorthand notation to denote the electronic structure of a Nickel atom i.e. Ni, Nickel atom has an atomic number of 28.

[8]

Total Marks [92]

Periodic Table of the Elements

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Avogadro's number is 6.022×10^{23} atoms/mole