UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

SCHOOL OF ENGINEERING

EXAMINATIONS: NOVEMBER 2018

COURSE AND CODE: MATERIALS OF CONSTRUCTION ENCH2MS

DURATION: 2 HOURS

TOTAL MARKS: 80

INTERNAL EXAMINER: MR EM OBWAKA

INTERNAL MODERATOR: DR S MOODLEY

EXTERNAL MODERATOR: DR M CHETTY

INSTRUCTIONS:

1. **ALL** questions should be attempted.
2. Any programmable or non-programmable calculator may be used provided it has been cleared of any information that would subvert the purpose of the examination.
3. Calculations must be shown in sufficient detail to illustrate your understanding of the procedure.
4. This examination question paper, together with all associated diagrams **MUST BE HANDED IN TOGETHER WITH YOUR SCRIPT.**

Student Number:

QUESTION 1

Given the Cu – Zn phase diagram in Figure 1.1 below:

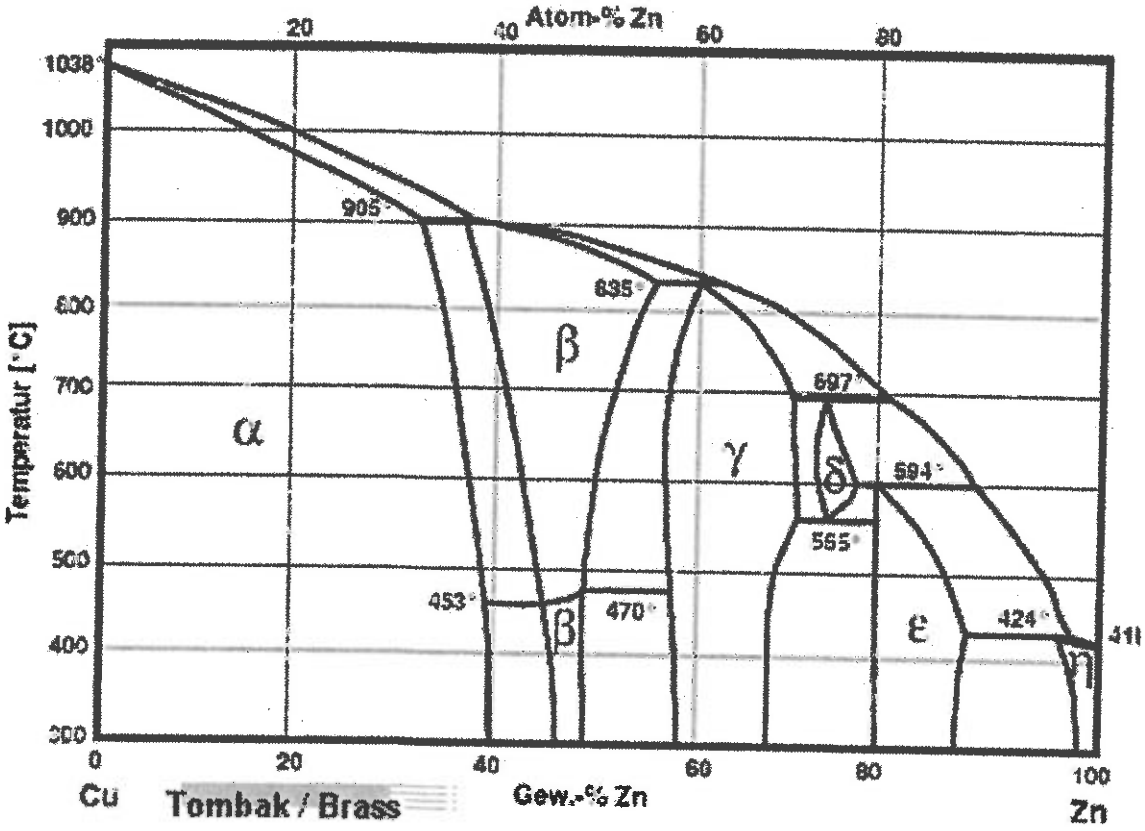

Figure 1.1: Cu – Zn phase diagram

Consider 1 kg of brass with composition 35 wt % Zn – 65 wt % Cu.

1.1) Upon cooling, at what temperature would the first solid appear?

(5)

1.2) What is the first solid phase to appear, and what is its composition?

(4)

1.3) At what temperature will the alloy completely solidify?

(2)

1.4) Over what temperature range will the microstructure be completely in the α-phase?

(3)

Continued on the next page ...

QUESTION 1 continued ...

1.5) Show, from first principles, that

$$v_\alpha = \frac{(\omega_\alpha / \rho_\alpha)}{(\omega_\alpha / \rho_\alpha) + (\omega_\beta / \rho_\beta)}$$

where

v_α = volume fraction α

ω_α = mass fraction α

(6)

1.6) Determine the relative amounts (in terms of volume fractions) of 35 wt % Zn – 65 wt % Cu at 800 °C. The density of copper at 800 °C is 8.53 g/cm^3 while that of β is 6.57 g/cm^3.

(6)

TOTAL /26/

QUESTION 2

A 10-mm diameter rod of 3003-H14 aluminum alloy is subjected to a 6-kN tensile load.
Modulus of Elasticity, E = 70 GPa; Yield Stength, YS = 145 MPa;
Tensile strength, TS = 150 MPa; Percent elongation at failure = 8 – 16;
Poisson's ratio, ν = 0.33; Shear modulus, G = 25 GPa.

2.1) Calculate the resulting rod diameter.

(8)

2.2) Calculate the diameter if this rod is subjected to a 6-kN compressive load.

(3)

2.3) Calculate the rod diameter at the tensile yield stress.

(4)

TOTAL /15/

QUESTION 3

A polymer was fractionated into the following six fractions:

Fraction	*Molecular Weight*	*Mole fraction*
1	10000	0.1
2	15000	0.2
3	20000	0.4
4	25000	0.15
5	30000	0.1
6	35000	0.05

Given:

$$DP = \frac{\overline{M}_n}{m} \quad or \quad DP = \frac{\overline{M}_w}{m}$$

The molecular weight of the monomer was 25 g/mol.

Determine:

3.1) the number average molecular weight and degree of polymerisation

(9)

3.2) the weight average molecular weight and degree of polymerisation

(9)

TOTAL /18/

QUESTION 4

4.1) What is a composite? (2)

4.2) Why are composites important? (3)

4.3) List features of the following types of composites:

a) dispersion-strengthened composites (2)

b) true-particulate composites (2)

c) fibre-reinforced composites (2)

d) laminar composites (2)

4.4) List possible applications of the following types of composites:

a) dispersion-strengthened composites (2)

b) true-particulate composites (2)

c) fibre-reinforced composites (2)

d) laminar composites (2)

TOTAL /21/