



MASENO UNIVERSITY
UNIVERSITY EXAMINATIONS 2016/2017

**THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE
DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF
EDUCATION SCIENCE WITH INFORMATION TECHNOLOGY**

MAIN CAMPUS

SPH 305: STRUCTURE AND PROPERTIES OF MATTER

I

Date: 1st December, 2016

Time: 8.30 - 11.30 am

INSTRUCTIONS:

- Answer ALL questions in SECTION A and any TWO questions in SECTION B.



SECTION A. This section is **COMPULSORY**.

It carries a total of **30 marks**.

1. a) Give two advantages and two disadvantages of a cantilever beam. **(4 marks)**

b) (i) What is the difference between ideal gas and real gas? **(3 marks)**

(ii) Determine the volume occupied by 2.34gm of carbon dioxide gas at STP. (1 mole of $\text{CO}_2 = 44 \text{ gm}$, Gas constant (R) = $8.314 \text{ JK}^{-1}\text{mol}^{-1}$). **(4 marks)**

c) (i) Define a *triple point* of a real gas. **(2marks)**

(ii) What happens at *critical point* of a substance? **(2 marks)**

(iii) For a gas, what is a *supercritical state*? **(1 mark)**

d) (i) Define a *Newtonian fluid*. **(2 marks)**

(ii) Give two examples each of a Newtonian fluid and a non-Newtonian fluid. **(4 marks)**

e) Cite four properties each of crystalline solids and non crystalline solids. **(4 marks)**

f) A block of gelatine is 60mm by 60mmx 20cm when unstressed.

A force of 245N is applied tangentially to the upper surface causing a 5mm displacement relative to the lower surface. The block is placed such that 60mmx60mm comes on the lower and upper surface.

Find : (i) shearing stress

(ii) shearing strain

(iii) shearing modulus. **(6 marks)**

SECTION B: Answer ONLY TWO questions from this section.

Each question carries 20 marks.

2. a) (i) What factors determine the amount by which a wire stretches? **(3 marks)**

(ii) A patient's leg was put into a traction, stretching the femur from a length of 0.46 m to 0.461m. The femur has a diameter of 3.05cm.

With the knowledge that a bone has a Young's modulus of approximately $1.6 \times 10^{10} \text{N/m}^2$ in tension, what force was used to stretch the femur? **(4 marks)**

b) (i) Why is the study of bulk modulus important? **(2 marks)**

(ii) What happens to the bulk modulus of water as it comes under more pressure? Explain. **(2 marks)**

c) (i) Define Poisson's ratio. **(1 marks)**

(ii) What is the physical significance of Poisson's ratio with respect to materials? **(4 marks)**

(iii) Explain the meaning of negative Poisson's ratio. **(1 marks)**

(iv) Explain Poisson's effect in a fluid pipe. **(3 marks)**

3. a) (i) Define *surface tension*. **(2 marks)**

(ii) Cite three effects of surface tension that can be seen with ordinary water. **(3 marks)**

(iii) (I) Air is introduced through a nozzle into a tank of water to form a stream of bubbles. If the bubbles are intended to have a diameter of 2mm, calculate how much the pressure of the air at the tip of the nozzle must exceed that of the surrounding water. Assume that the value of the surface tension between air and water as $72.7 \times 10^{-3} \text{N/m}$. **(5 marks)**

(II) Water has a surface tension of 0.4N/m . In a 3mm diameter vertical tube if water rises 6mm above the water outside the tube, calculate the contact angle. **(5 marks)**

b) (i) What is capillary action? **(2 marks)**

(ii) Why does water not climb the sides of glass of drinking water as much as it does that of a straw/tube of glass? **(3 marks)**

4. a)

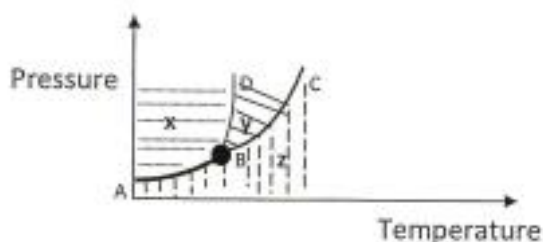


Fig.1

Figure 1 is a phase diagram which summarises the effect of temperature and pressure on a substance in a closed container. Every point in the diagram represents a possible combination of temperature and pressure for the system. The diagram is divided into three areas x, y and z

- What is the state of the substance in the three areas? (3 marks)
- Name point B and describe what happens here (3 marks)
- Explain what curves AB, BC and BD represent. (6 marks)

b) A particular reaction in gas phase has activation energy of 8.0kJ. For 1.0 mole of gas, calculate the number of molecules which exceed this activation energy at 300K (8 marks)
(Note: Gas constant = $8.314\text{JK}^{-1}\text{mol}^{-1}$, Avogadro's number = 6.02×10^{23})

5. a) (i) Define a *crystal lattice*. (1 mark)

(ii) A crystal lattice can always be constructed by the repetition of a fundamental set of translational vectors in real space \mathbf{a} , \mathbf{b} and \mathbf{c} . Any point in the lattice can be written as $\mathbf{r} = n_1\mathbf{a} + n_2\mathbf{b} + n_3\mathbf{c}$.

What is the name of such a lattice? (1 mark)

(iii) Name and draw the common types of lattice in (ii) above. (6 marks)

b) Name and describe briefly the types of bonds by which the properties of a solid can be predicted. (12 marks)

END