



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIPLOMA IN TECHNOLOGY

INSTRUMENTATION & CONTROL ENGINEERING (DICE 4)

ECI 2203

MEASUREMENT TECHNOLOGY II

SPECIAL/SUPPLEMENTARY EXAMINATIONS

SERIES: MARCH, 2014

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
 - Answer Booklet
 - Scientific Calculator
2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All questions carry equal marks (20 marks).
5. Maximum marks for each part of a question are shown.

This paper consists of FOUR printed pages.

QUESTION 1

- (a) (i) State the importance of standards in measurements.
- (ii) Define calibration and name at least **THREE** factors that influence selection of a measuring instrument. **(8 marks)**
- (b) (i) What is the difference between heat and temperature.
- (ii) Exemplify thermal equilibrium phenomenon.
- (iii) State examples and explain the three basic ways of transferring heat. **(6 marks)**
- (c) (i) Distinguish between absolute temperature scales and relative temperature scales.
- (ii) Give a clear analogy between the **TWO** types of each kind and their interrelationship.
- (iii) A material has a temperature of 335k. Find the temperature in °R. **(6 marks)**

QUESTION 2

- (a) (i) Explain the operational principles of gas thermometers.
- (ii) A gas in a closed volume has a pressure of 100psi at a temperature of 20°C. What will the pressure be at 80°C.
- (iii) State the usefulness of gas thermometers and outline at least **ONE** advantage and disadvantage of the transducer. **(8 marks)**
- (b) Outline the effect that forms the basic operation of the liquid-in-glass thermometer and explain why this type of temperature sensor is not commonly used in process-control work. **(5 marks)**
- (c) (i) State how it is possible to relate temperature to actual thermal energy.
- (ii) A sample of oxygen gas has a temperature of 90°F. Its molecular mass is 5.3×10^{-26} kg. Find the average thermal speed of the molecule. **(7 marks)**

QUESTION 3

- (a) (i) Explain the operation process of a vapour-pressure thermometer.

- (ii) Shown below is a vapour pressure curve for methychloride.

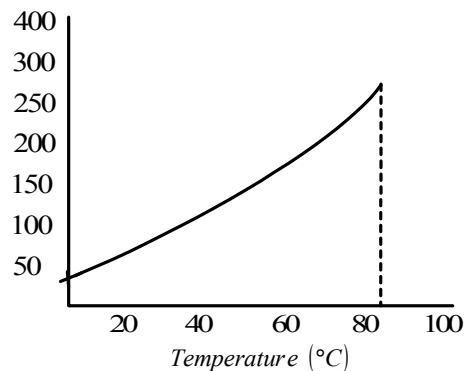


Fig. 1

Two methyl chloride vapour-pressure temperature sensors are used to measure the temperature difference between two reaction vessels. The nominal temperature is 85°C. Find the pressure difference per degree Celsius at 85°C from graph Figure 1 above.

(7 marks)

- (b) (i) Original radiation pyrometers have evolved through which other two names?
- (ii) State for Radiation thermometers, two advantages as they represent the practical application of the Planck law and Planck radiator. Formula (1900).
- (13 marks)**

QUESTION 4

- (a) With aid of a schematic diagram describe the principle of operation of a pitot tube as a form of flow measuring device industrially. **(6 marks)**
- (b) For (a) what can you deduce from the equation $\frac{1}{2}MV^2 = mgh$. **(4 marks)**
- (c) With aid of a sectioned diagram describe a positive displacement meter and explain its principle of operation. **(10 marks)**

QUESTION 5

- (a) Using a diagram, describe an electromagnetic flow meter and its system (mode) of operation and application. **(8 marks)**
- (b) With aid of a diagram describe and analyse pressure formulae of an inverted U-tube differential manometer. **(8 marks)**
- (c) Figure 2 below shows an inverted differential manometer connected to two pipes A and B which convey water. **(8 marks)**

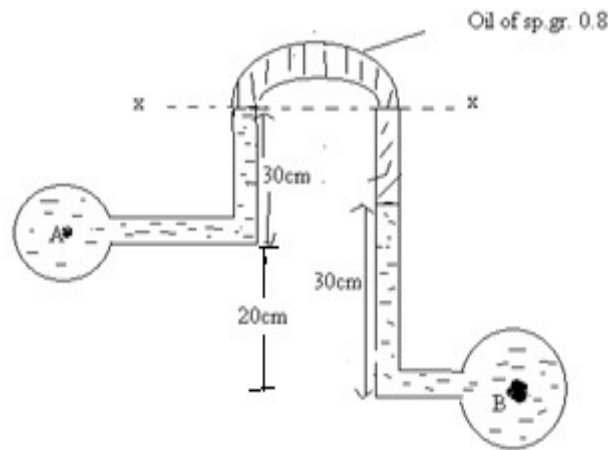


Fig. 2

The fluid in manometer is oil of sp. gr. 0.8. For the manometer readings shown in the figure, find the pressure difference between A and B.

(4 marks)