BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI – DUBAI
FIRST SEMESTER 2003 – 2004
Course: TA UC222 Measurement Techniques – II

Test No: 1(Theory)   **Maximum Marks: 20**   **Weightage: 10%**

Duration: 50 Minutes   **Date: 02.11.03, Sunday**

Q1A. Refer figure Q1 that shows an inclined tube manometer. Starting from the first principles show that

$$P_2 - P_1 = \rho g l \left[Sin\theta + \frac{a}{A} \right],$$ where "a" and "A" are areas of tube and well respectively. Using the above

equation or otherwise justify the statement" inclined manometers have better sensitivity"   **[3M]**

Q1B. A well type manometer has the measurement leg inclined at 30^0 from the horizontal. Diameter of the measurement column is 5mm. Diameter of the tube well is 5cm. Manometric fluid has a specific gravity of 0.85. l = 15cm. Find the value of $P_2 - P_1$ in Pascals.   **[2M]**

Q2A. With neat diagrams wherever required explain how the torque and hence power can be measured by using Prony brake dynamometer.   **[2M]**

Q2B. With neat diagrams wherever required explain working and applications of McLeod gauge.   **[2M]**

Q2C. Refer figure Q2 of a rope brake dynamometer used to measure the power out put of an electrical motor. Net load on the load hanger is 350N; Speed of the shaft is 300rpm; Rope diameter is 2cm and that of shaft is 1m. Find the torque and hence the power.   **[1M]**

Q3A. A temperature-sensing element is stated to behave as a first-order system with a 96% rise time of 30 sec. If the element is initially at a temperature of 25°C and suddenly subjected to a temperature of 135°C, what temperature will the element indicate after a time of 15 sec.?   **[2M]**

Q3B. A large building mass behaves like a first order system when responding to a harmonic thermal input. If the harmonic input follows the pattern of daily heating and cooling (i.e.) one cycle occurs over a 24-hour period, and the time delay is 3 hours, estimate the time constant. Also, estimate how much the amplitude response decreases at this frequency.   **[3M]**

Q4. The measurement of power dissipated in the resistor R_1 is conducted by measuring the voltage across and current through the resistor in the circuit shown below. Calculate the nominal value of power dissipated in R_1 and its uncertainty for the following conditions: V = 50 V +- 3%; R_1= 500 Ω +- 5%; R_2 = 1000 Ω +- 5%

[5M]

Please see overleaf for figures

P_2

Area A

L

scale

P_1

O —

h

d

θ

O

O_1 | O_1

Area 'a'

Intial reference line

Fig Q1

//////

Rope

Shaft

W | load
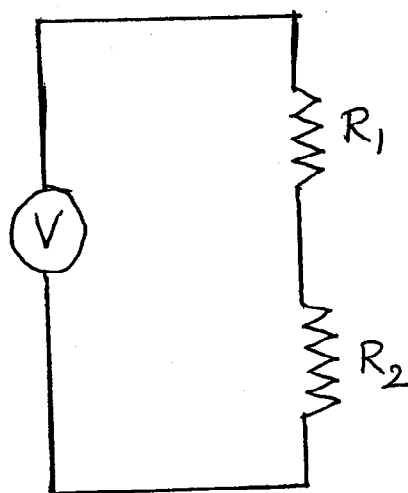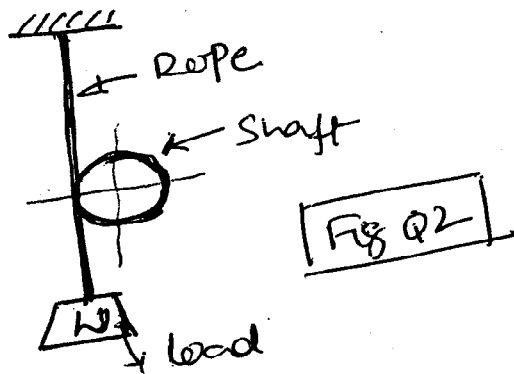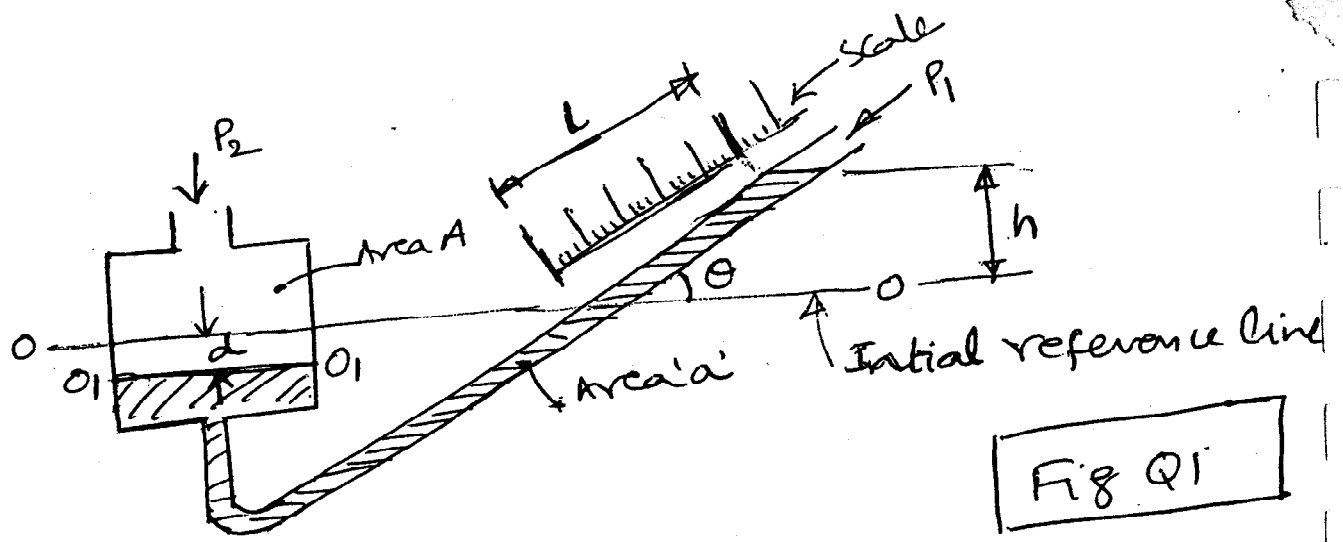
Fig Q2

V

R_1

R_2

Fig Q4

BITS , Pilani – Dubai Campus
Knowledge Village
II Year Section II, I Semester 2003 – 2004

TEST – II (OPEN BOOK)

Course No.: TA UC222
Date: 21.12.03, Sunday
Duration: 50 minutes

Course Title: Measurement Techniques II
Marks: 20
Weightage: 10%

NOTE: Answer all Questions.
  Marks are indicated inside the brackets.
  Answers of all parts a question should be written at one place.

Q1A. Explain the term: Compensated wattmeter. [2]
Q1B. What is the phenomenon that is normally associated with thermocouple instruments? How is it taken care of? [2]
Q1C. Which type of voltmeter requires voltages in KV range as input? Mention any two of its advantages. [1]

Q2A. If two signals of 10 sin ωt and 10 sin (ωt + 90°) are applied to horizontal and vertical plates of a CRO, what will be the resultant waveform in the CRO screen? [1]
Q2B Describe the principle of transduction of capacitive transducer in angular displacement measurement. [2]
Q2C. An ac bridge is balanced at 1000 Hz and has the following parameters: arm AB, unknown inductor and resistance in series; arm BC, a fixed resistor of 10 KΩ; arm CD, a resistance and a capacitance in series adjusted at 2.5 KΩ and 1 μF respectively; and arm DA, a resistance adjusted at 1 KΩ. Find the unknown parameters of arm AB. [2]

Q3. A bimetal strip of 55mm long is made of strips of nickel – chrome alloy and invar bonded together at 30°C. Each material has thickness of 1.5mm. When the bimetal strip was used to measure temperature in a certain situation, the radius of curvature was found to be 2.3m. What will be the temperature corresponding to this. The properties of the materials are
For Invar: Coefficient of thermal expansion: 1.5×10^{-6} °C^{-1}
    Modulus of elasticity: 1.5×10^{11} N/m^2
For Nickel – Chrome alloy: Coefficient of thermal expansion: 12.5×10^{-6} °C^{-1}
        Modulus of elasticity: 2.3×10^{11} N/m^2 [2]

Q4A. The inlet diameter of a venturimeter is 30cm and at the throat diameter is 15cm. This venturimeter is used to measure the flow rate of the water flowing through a pipeline. A manometer having Mercury as the manometric fluid shows a reading of 25cm when it is connected between venture meter inlet & throat. C_d of the meter is 0.97. Find the flow rate of water. [2]
Q4B. Compare the advantages of various flow measuring devices used for incompressible fluid flows. [2]

Q5. Write a short notes on the following.
   (a) The experimental procedure to grade a given sample of soil.
   (b) Methods to find the convective heat transfer coefficient.
   (c) Typical applications of theodelite.
   (d) Viscosity measurement [4]

BITS, Pilani-Dubai Campus
Knowledge Village

II Year – I Semester 2003 - 2004
## MT-1

COURSE NO.: <u>TAUC211</u>;   COURSE TITLE: <u>Measurement Techniques -I</u>;
DATE: <u>15th Jan'04</u>;   TIME: <u>2 Hrs</u>;   MARKS: <u>48</u>

Program Name: _____

Examination No. _____

CHEMISTRY

1. Starch is a polymer of
   (a)glucose (b)sucrose (c)both glucose and sucrose (d) none of the above.

2. The degree of dissociation in a weak electrolyte increases
   (a)on increasing dilution (b)on increasing pressure
   (c) on decreasing dilution (d)none of these.

3. The conductance of one cm cube of a solution represents
   (a)equivalent conductance (b)specific conductance (c) cubic conductance
   (d)resistivity.

4. Glucose is distinguished from fructose by using conc HCl and _____

5. All organic acids give brisk effervescence when treated with sodium
   bicarbonate solution. This is due to the formation of
   (a)O_2 (b)CO_2 (c)H_2 (d) none of the above.

6. The acylation of an amine is a _____ type acid – base reaction .

7. The alkaline hydrolysis of an ester is represented by

$$RCOOR' + OH^- \longrightarrow RCOO^- + R'OH$$

   this reaction is
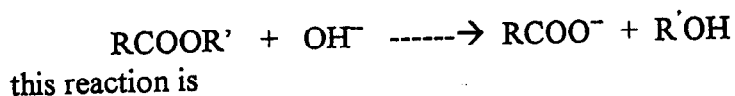
(a) bimolecular but of second order (b)bimolecular but of first order

(b) bimolecular but not of second order (d)second order but not bimolecular.

8.Balance the following ionic equation

$$MnO_4^- + C_2O_4^{2-} + H^+ ---\rightarrow Mn^{2+} + CO_2 + H_2O$$
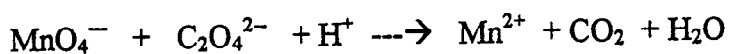
9.The specific rate constant of a first order reaction depends on the
   (a) concentration of the reactant (b) concentration of the product
   (c) time (d) temperature.

10.When $K_2Cr_2O_7$ is converted into K_2CrO_4, the change in oxidation number
    of Cr is
    (a) 3 (b) 6 (c) 0 (d) 4

11.The pH at the stoichiometric point of acetic acid versus sodium hydroxide
    titration is on the basic side of neutrality (pH > 7) due to the presence of
    _____ ions.

12. The pH of a buffer solution containing a weak acid (pka) and its salt is
    (a) pH = pka + log [salt] / [acid]   (b) pH = pka + log [acid] / [salt]
    (c) pH = ½ pka + log [acid] / [salt] (d)pH = log pka + log [acid] / [salt]

BIOLOGY

Fill up the blanks and mark your answer from the multiple-choice questions.

1. In a compound microscope, the angle and size of the focused light can be controlled and optimized by?

   A) Iris Diaphragm   B) Condenser

   C) Objective   D) Filter

2. If the magnification obtained by a compound microscope having 10X ocular is 400 times then the Microscope holds _____ power Objective.

3. Most predominant stage observed in a squash preparation of Onion Root Tip is?

   A)Anaphase   B)Telophase

   C)Metaphase   D)Prophase

4. The purple color obtained by the Biuret reaction is read at_____nm wave length falling in _____ range of the light spectrum.

5. Increased counts of a particular type of leukocytes during a particular disease state is know as.

   A) Leukemia   B) Anemia

   C) Hyperemia   C) Leukocytosis

6. Interphase describes the stages of cell growth in between Mitotic cell division events.

   TRUE / FALSE ?

7. Hemoglobin molecule comprises of two heme and 4 polypeptide chains.

   TRUE / FALSE ?

8. While estimating Hb by Sahli's method, blood is hemolysed with..?

   A) 1.0 N HCL   B) 0.1 N HCL
   C) 0.01 N HCL   D) 10.0 N HCL

9. During total RBC count, Blood sample is diluted _____ times.

3

10. Which of the following Hemoglobin has greater affinity towards Oxygen?
   A) Hb A   B) Hb S
   C) Hb F   D) Hb H

11. The numerical value indicating the fraction of cells
    that are in the process of Mitosis is known as?

12. Resolving power of a microscope can be increased by decreasing the _____ and
increasing _____.

PHYSICS

NOTE: (Answer all Questions, Show workings wherever required, Data provided are complete. Some questions might have more than one correct answer. Mark all the right choices)

1. A pitched 140g baseball, in horizontal flight with a speed V_i of 39.0 m/s, is struck by a bat. After leaving the bat, the ball travels in the opposite direction with speed V_f, also 39.0 m/s. What impulse J acts on the ball while it is in contact with the bat during the collision? **[2 Marks]**

2. If a moving car X collides head on with a moving car Y in the opposite direction, the conservation of momentum states **[1 Mark]**
   i) the final momentum of X = the final momentum of Y
   ii) the total momentum of X and Y is reversed by the collision
   iii) the total momentum of X and Y stays constant
   iv) the initial and final momentum of X is the same
   v) the initial and final momentum of Y is the same.

3. In order to separate elementary particles it is important to know **[1 Mark]**
   i) Only charge.
   ii) Only mass.
   iii) Only specific charge.

4. Draw the circuit diagram of RLC parallel tuned, indicate the value of resistance and capacitance used in the two cases. Also show voltmeter and ammeter with their proper polarity. **[3 marks]**

5. At the point of resonance in a series tuned RLC circuit, the voltage value is,

    i)   Minimum   **[1 Mark]**

    ii)   Maximum

    iii)   Dependent on the frequency of the circuit

    iv)   Equal to resistance of the circuit.

6. Calculate the De broglie wavelength of an electron moving at $3 \times 10^{6}\, m/s$.
($h = 6.6 \times 10^{-34}\, Js$, $m = 9.1 \times 10^{-31}\, Kg$)   **[2 Marks]**

7. The current developed in a thermopile when it is exposed to light from a lamp is
due to   **[1 Mark]**

    i)   only heat from the source

    ii)   heat and light from the source

    iii)   only light from the source

    iv)   none of the above.

8. In a Plank's constant the voltage that we measure is _____. If it is a higher value it shows   **[2 Marks]**

         i)   frequency of incident light is high
         ii)   frequency of incident light is low
         iii)   kinetic energy is high
         iv)   photocurrent is more

9. Two wires A and B are made of two materials (density of A is greater than the density of B) are vibrating with the same frequency. The wavelength of the standing waves on A will be   **[1 Marks]**

         i)   smaller than those on B
         ii)   greater than those on B
         iii)   same as those on B.
         iv)   cannot be specified

10. The CRO reads at the 2 µs/div, C= 10pf. Calculate L.   **[2 Marks]**

11. Two strings of different densities are attached. If the tension in the string is same what remains constant   **[1 Marks]**

         i)   wavelength
         ii)   frequency
         iii)   velocity
         iv)   none/all

12. An ultraviolet light bulb, emitting at 400nm, and an infrared light bulb, emitting at 700nm, each are rated at 130W. Which bulb radiates photons at the greater rate.   **[1 Marks]**

13. Which of the following collisions are more elastic?   **[1 Marks]**

   i)   A collision between two rubber balls.
   ii)   A collision between two table tennis balls.
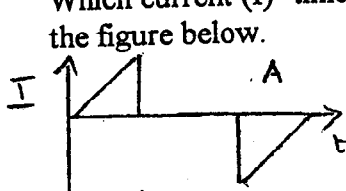
14. If p is the momentum of an object of mass m, then the expression p^2/m has the same units as **[1 Marks]**

    i)   acceleration
    ii)   energy
    iii)   force
    iv)   impulse
    v)   power

15. A short magnet M is moved steadily through a long solenoid from X to Y and out in the figure, **[2 Marks]**
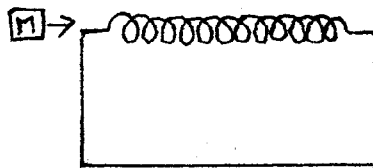
Which current (I)- time (t) graph from A to E would be obtained in the figure below.
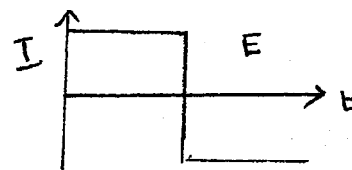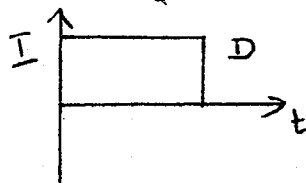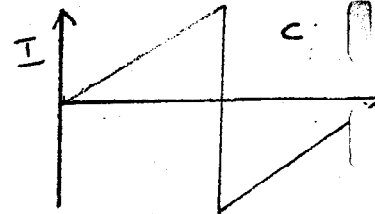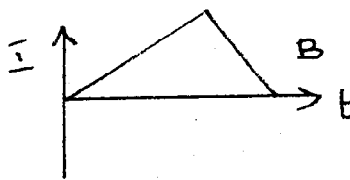
16. An atom is excited to an energy level E_1 from its ground state energy level E_0. The wavelength of the radiation emitted as **[1 Marks]**

    i) $(E_0-E_1) / hc$
    ii) $(E_1-E_0) / h$
    iii) $hc / (E_1-E_0)$
    iv) $(E_1 / hc) - (E_0 / hc)$
    v) $h / (E_1-E_0)$

17. A metal plate is illuminated with light of certain frequency. Which of the following determine whether or not electrons are ejected. **[1 Marks]**

    i)   the intensity of light
    ii)   the length of time of exposure to the light
    iii)   the thermal conductivity of the plate
    iv)   the area of the plate
    v)   the material of the plate