BITS, Pilani-Dubai Campus
Knowledge Village

II Year - II Semester 2004 - 2005
MT-1

COURSE NO.: TAUC211; COURSE TITLE: Measurement Techniques-I;
TIME: 2 hrs; MARKS: 80 Date: 26th May'05.

ID NO._____

PHYSICS

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

Please enclose the final answer of the numerical questions in a box ☐

Possibly for use

{$c = 2.998 \times 10^8$ m·s^{-1} ; $\mu_0 = 4\pi \times 10^{-7}$ N A^{-2}; $\varepsilon_0 = 8.85 \times 10^{-12}$ F·m^{-1};

$h = 6.63 \times 10^{-34}$ J·s; $e = 1.602 \times 10^{-19}$ C; $m_e = 9.1 \times 10^{-31}$ kg; $m_p = 1.67 \times 10^{-27}$ kg}

(e/m ratio)

1. Of the three vectors in the equation $\vec{F}_B = q\vec{v} \times \vec{B}$, which pair(s) are always at right angles? **[2]**

(a) $\vec{F}_B$ and $\vec{v}$; (b) $\vec{v}$ and $\vec{B}$; (c) $\vec{B}$ and $\vec{F}_B$;
(d) None; (e) All three must be at right angles.

2. An electron with a speed $v_o << c$ moves in a circle of radius r_o in a uniform magnetic field. The time required for one revolution of the electron is T_o. The speed of the electron is now doubled to $2v_o$. The radius of the circle will change to

(a) $4r_o$; (b) $2r_o$; (c) r_o; (d) $r_o/2$ **[2]**

(Planck's constant by photoelectric effect)

3. What is the effect of increasing the wavelength of the light that falls on the emitter in a photoelectric-effect apparatus? **[1]**

(a) The work function decreases.
(b) The cutoff frequency decreases.
(c) The stopping potential decreases.

(d) The time delay for emission of photoelectrons increases.
(e) None of the above.

4. Monochromatic light with a frequency well above the cutoff frequency is incident on the emitter in a photoelectric effect apparatus. The intensity of the light is then doubled while the frequency is kept constant. [1]

(a) The work function decreases.
(b) The photoelectric current increases.
(c) The stopping potential increases
(d) None of the above

(Diffraction over a single and double slit)

5. In a double-slit experiment, the distance D of the screen from the slit is 52 cm, the wavelength is 480 nm, the slit separation d is 0.12 mm and the width of the central maxima is 10mm. (a) What is the spacing between adjacent fringes within the central maxima? (b) What is the slit width a? [3]

Ans:

(Induction of solenoids)

6. An inductor can be made out of a metal "Slinky", which is basically a flexible solenoid. If the "Slinky" is stretched out to twice the original length, then the inductance will [2]

$L = \mu_0 \mu \frac{}{}$?

(a) change to $L_o/2$; (b) change to $2L_o$; (c) change to $\sqrt{L_o}$;
(d) remain the same

7. An inductor has an inductance L_o. A second inductor is identical except that it has double the radius and double the number of windings. What is the ratio of the inductance of the second inductor to the original inductor? [2]

(a) 4; (b) 2; (c) 1; (d) ½ ; (e) None.

(Electron Diffraction)

8. When a high energy electron-beam enters and leaves a crystal it undergoes [1]
(a) Reflection; (b) dispersion; (c) refraction;
(d) diffraction; (e) splitting.

9. An x-ray of wavelength 0.122 nm is required for studying a lithium fluoride crystal. (a) What should be the potential applied to an electron beam for this study? (b) If the first order diffraction is a circle of radius 1.25 cm, 130 mm from the specimen, what is the lattice parameter? **[4]**

Ans:

(Fine structure of one-electron spectrum)

10. A grating has 9600 lines and has a diffraction constant of 2083 nm. It is illuminated by light from a sodium vapor discharge. (a) What is the expected position (θ) of the yellow line (λ = 589 nm) in the third order? (b) If there two yellow lines (λ = 589.00 nm and λ = 589.59 nm) what is the angular separation between them in the second order pattern? **[4]**

Ans:

(Vibration of strings)

11. A string of length 12 m that is fixed at both ends supports a standing wave with a total of 5 nodes. What are the harmonic number and wavelength of this standing wave? **[2]**

Ans:

12. A string of length 10 m and mass 200 g is fixed at both ends, and the tension in the string is 32 N. What is the frequency of the standing wave for which the distance between a node and the closest antinode is 1 m? **[3]**

Ans:

(RLC)

13. In the plot of Voltage and frequency of a parallel tuned circuit, the peak value is
(a) the maximum Q value
(b) the natural frequency of the circuit
(c) The point where the Impedence is pure resistance
(d) None of the above **[1]**

14. A circuit has L = 12 mH, C = 1.6 μF, and R = 1.5 Ω. (a) What is the frequency at which this circuit would resonate to an external frequency? (b) What is the Impedence, Z, at resonance? **[3]**

Ans:

(Ferromagnetic Hysteresis)

15. What are units for the magnetization $\vec{M}$? **[1]**
(a) T; (b) T/m^3; (c) C/m.s; (d) C.m/s

16. Which type of substance retains magnetism? **[1]**
(a) Paramagnetic; (b) Diamagnetic; (c) Ferromagnetic;
(d) Paramagnetic and ferromagnetic substances tend to be about the same;
(a) All three types are about the same.

(Hall Effect)

17. A strip of copper 150 μm thick is placed in a magnetic field B = 0.65 T perpendicular to the plane of the strip, and a current I = 23 A is set up in the strip. What Hall potential difference ΔV_H would appear across the width of the strip if there were one charge carrier per atom? **[2]**

Ans:

(Solar Cell)

18. Intensity of light at some distance from the source is 2.717×10^{34} A/m^2. What should be the short circuit current through a thermopile placed at this point? **[2]**

Ans:

(Elastic collisions)

19. Two objects move toward each other, collide, and separate. If there was no net external force acting on the objects, but some kinetic energy was lost, then **[1]**

(a) the collision was elastic and total linear momentum was conserved.
(b) The collision was elastic and total linear momentum was not conserved.
(c) The collision was not elastic and total linear momentum was conserved.
(d) The collision was not elastic and total linear momentum was not conserved.
(e) None of the above.

20. Object #1 moves toward Object # 2, whose mass is twice that of Object # 1 and which is initially at rest. After their impact, the objects lock together and move with what fraction of Object # 1's initial kinetic energy? **[2]**

(a) 1/18
(b) 1/9
(c) 1/6
(d) 1/3
(e) None of the above

CHEMISTRY

1. Which are the two functional groups present in typical carbohydrates? (1)

2. Starch reacts with iodine to give a deep colour. The blue colour is due to the formation of a complex between iodine and (1)
   (a)amylopectin fraction of starch
   (b) amylose fraction of starch
   (c)both amylopectin and amylose fraction of starch
   (d)none of the above.

3. How will you distinguish between succinic acid and oxalic acid? (1)

4. Why are carboxylic acids more acidic than their corresponding alcohols when both have –OH groups ? (1)

5. The factor which does not influence the rate of reaction is (1)
(a) nature of reactants
(b) concentration of reactants
(c) temperature
(d) molecularity of the reaction

6. The rate constant of a unimolecular first order reaction is 0.0231 sec^{-1}. The concentration of the reactant will reduce to half of its original concentration in _____ sec. (1)

7. The kinetics of acid hydrolysis of ethyl acetate is followed by the volumetric estimation of (1)
(a) acetic acid formed
(b) HCl consumed
(c) ethyl acetate consumed
(d) ethyl alcohol formed

8. How will you calculate the molar conductance at infinite dilution for a strong electrolyte and for a weak electrolyte. (1)

9. The resistance offered by 2 M acetic acid solution having specific conductance 1.6×10^{-3} mho cm^{-1} is (cell constant = 0.005 cm^{-1}) (1)
(a) 6.25ohms (b) 0.160 ohms (c) 0.64ohms (d) 3.125 ohms

10. In general the molar conductance of an electrolyte _____ with increase in concentration. (1)

11. Mention the types of potentiometric titrations. (1)

12. Plot the pH curve for the titration of a weak base (the analyte) with a strong acid (the titrant). Show approximate pH values and mark the stoichiometric point. (1)

13. The ion which contribute to pH at the stoichiometric point for the titration between hypochlorous acid & potassium hydroxide is _____ (1)

14. While titrating potassium permanganate solution with ferrous salt solution sometimes brown turbidity is seen. Why ? (1)

15. The basic character of aniline is due to _____.(1)

16. Schematically represent the experimental set up used for the preparation of acetanilide and mark the parts along with the chemicals required for the experiment. (1)

17. Balance the following redox equation in acidic medium (2)

$$MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$$

18. In the preparation of acetanilide, using aniline & acetic anhydride, the amino group will be acting as a / an (1)
(a)nucleophile in an alkylation reaction (b)electrophile in an alkylation reaction
(c)nucleophile in an acylation reaction (d) electrophile in an acylation reaction

19. In any titrimetric analysis potassium permanganate solution is first standardized. Justify this giving suitable reason. (1)

BIOLOGY

1. Match the following:(mark your answer within brackets) (2 Marks)

i. Antibiotic	a) Yeast ( )
ii. Spores	b) Penicillium ( )
iii. Rods	c) Fungi ( )
iv. Bud	d) Bacillus ( )

2. Name the synthetic protein which you have used to obtain the standard curve in Biuret method, also mention the wavelength at which readings were taken. (2 Marks)

3. Why only root tip of Onion, Alium cepa is used to study the mitotic division, but not any other part of the plant? (2 Marks)

4. What are the functions of lymphocytes? (2 Marks)

5. While estimating Hb by Sahli's method, blood is hemolysed with _____ normality of HCl (1 Mark)

6. Normal range of Hemoglobin in men is _____ and in women is_____ respectively. (2 Marks)

8. The angle and size of the focused cone of light in a microscope is controlled by _____ (1 Mark)

9. Antibodies are produced by_____type of cells in infant _____in adult. (2 Marks)

BITS, PILANI – DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI
SECOND SEMESTER 2004 – 2005
TA UC 222 MEASUREMENT TECHNIQUES – II
TEST 2 (OPEN BOOK)

MAXIMUM MARKS: 20 WEIGHTAGE: 20%
DATE: 16.05.05 DURATION: 50 MINUTES

1. A. What errors can be introduced when using wattmeters for the measurement of power? How these can be overcome? **[4M]**

1. B. A bridge is excited with a 1 KHz supply and has the following arms: A fixed resistor of 1.5KΩ in arm BC; a variable resistor adjusted to 3 KΩ and a variable capacitor adjusted to 47μF in arm CD; a variable resistor adjusted to 2 KΩ in arm DA under balanced conditions. Find out the unknown resistance and inductance connected in the other arm. **[3M]**

1. C. Compare the features of a moving iron instrument with that of an electrostatic meter. Your answer should be in tabular form. **[3M]**

2. In an Industrial application certain fluid is flowing on top and bottom surfaces of a metallic surface of diameter 2m. Metal's thermal conductivity is 50 W/m K while that of the fluid is 0.837W/m°C. Several temperature measurements indicate that the temperature gradient at all points in the vertical direction is 500°C/m, when the surface temperature is 30°C and free stream temperature is 100°C. With this available information, find the value of convective heat transfer coefficient? Also find the rate at which convection is taking place. **[3M]**

3. In viscosity measuring instruments that use Newton's law of viscosity, it is always desirable to have a linear velocity profile. Justify this statement by explaining the construction features and working principle of an instrument that uses Newton's law of viscosity. **[3M]**

4. In an experiment it is required to measure the time temperature history of a metallic object over a very small time interval. Which type temperature measuring instrument will you chose and why. **[2.5M]**

5. With necessary diagrams explain the working of an Instrument used for calibration of Pressure gauges. **[1.5M]**

10. Duplication of genetic material takes place in the _____ phase of Cell Cycle. (1 Mark)

11. Write the difference between magnification and resolving power. (2 Marks)

12. Explain the principle of Beer Lambert's law. (3 Marks)

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BITS, PILANI – DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI

SECOND SEMESTER 2004 – 2005

TA UC 222 MEASUREMENT TECHNIQUES – II

TEST 1(CLOSED BOOK)

MAXIMUM MARKS: 20 **WEIGHTAGE: 20%**

DATE: 27.03.05 **DURATION: 50 MINUTES**

1. A 0-200 V voltmeter has a guaranteed accuracy of 2% of full scale reading. The voltage measured by this instrument is 50 V. Calculate the error. If you are the manufacturer, what suggestions will you offer so as to minimise the error? **[3M]**

2. The measurement of impedance of a load is conducted by measuring the voltage across and current through the load. The voltmeter with an uncertainty of +/- 4% reads 125 V and the ammeter reads 10 A with an uncertainty of +/- 5%. Calculate the nominal value of impedance and its uncertainty. **[4M]**

3. Describe the principle of transduction of capacitive transducer in **[3M]**
i) angular displacement measurement
ii) liquid level measurement

4(a). Refer Fig. Q4(a) which shows an inclined venturi meter. Derive an expression for V_2 as a function of P_1, P_2, Z_1, Z_2, A_1 , A_2 and ρ, where P_1, P_2 are pressure in Pascals at 1 and 2; Z_1, Z_2 are elevations at 1 and 2; A_1 , A_2 are areas at 1 and 2 and ρ is the density flowing fluid. **[3M]**

4(b) Water is flowing through the above venturi meter. If D = 100 mm, d=60 mm, θ = 45°, axial distance from 1 and 2 is 120 mm, h=140 mm, specific gravity of manometric fluid is 13.6, density of water is 999 kg/m^3.
i) Find P_1-P_2 in Pascals
ii) Find V_1 and V_2 in m/s
iii) Find theoretical flow rate in m^3/s
[2M+2M+1M]

5. Refer Fig. Q5 which shows simple U tube manometer. Starting from the first principles get an expression for gauge pressure at A as a function of d_1, d_2, density of fluid in tank A and density of mercury. **[2M]**

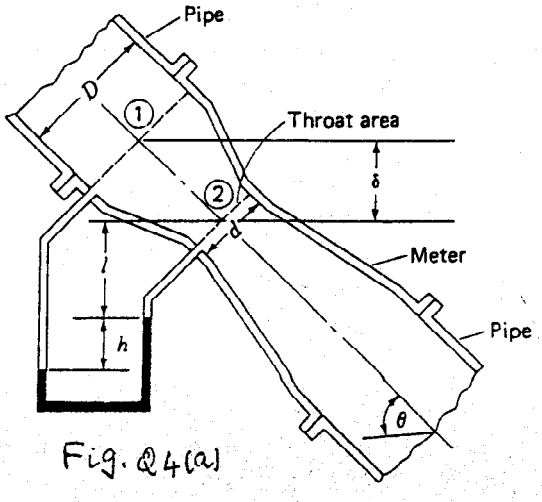

Fig. Q4(a)

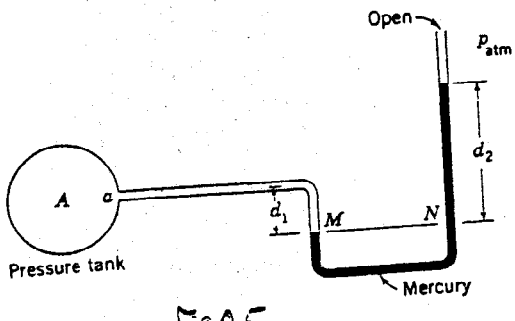

Fig Q5