TEST COMPETITION

December 6, 2005

Maximum points for problems is 50

1. Figure 1 shows a portion of an electric circuit. Find the magnitude and direction of the current i in the lower right-hand wire.

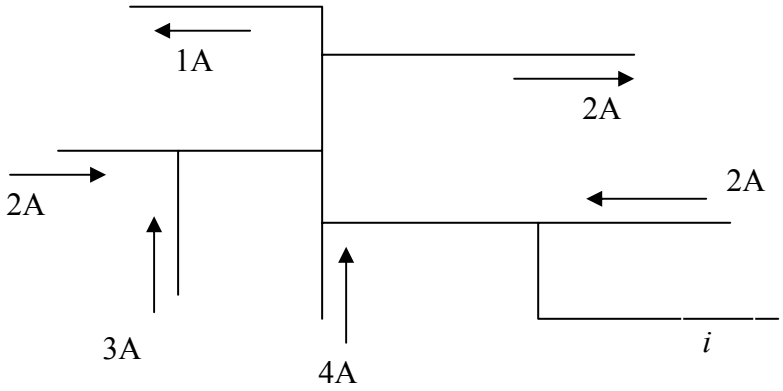
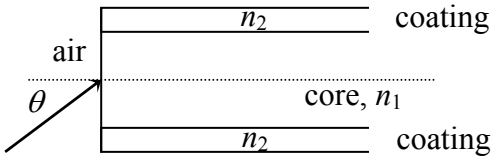


Figure 1

A. 7 A, inward
B. 7 A, outward
C. 8 A, inward
D. 8 A, outward

2. An optical fiber is composed of a glass core with a refractive index of n_1 (relative to that of air) surrounded by a coating material with a refractive index of $n_2 < n_1$ (also relative to that of air). A beam of light enters the fiber from air at an angle θ with respect to the fiber axis. The greatest possible value of θ for which a ray can travel down the fiber satisfies

A. $\theta = \cos^{-1}(n_1^2 - n_2^2)^{1/2}$
B. $\sin^2\theta = n_1^2 - n_2^2$
C. $\cos\theta = n_1^2 - n_2^2$
D. $\theta = \sin^{-1}(n_1^2 - n_2^2)$



3. A 40 kg girl and an 8.4 kg sled are on surface of a frozen lake, 15 m apart. By means of a rope, the girl exerts a horizontal force on the sled, pulling it toward her. How far has the girl traveled when she meets the sled, assuming that no frictional force acts?

A. 2.0 m
B. 4.4 m
C. 3.8 m
D. 2.6 m

4. The only force acting on a 2.0 kg body as it moves along the positive x axis has an x component F_x given by Figure 2.

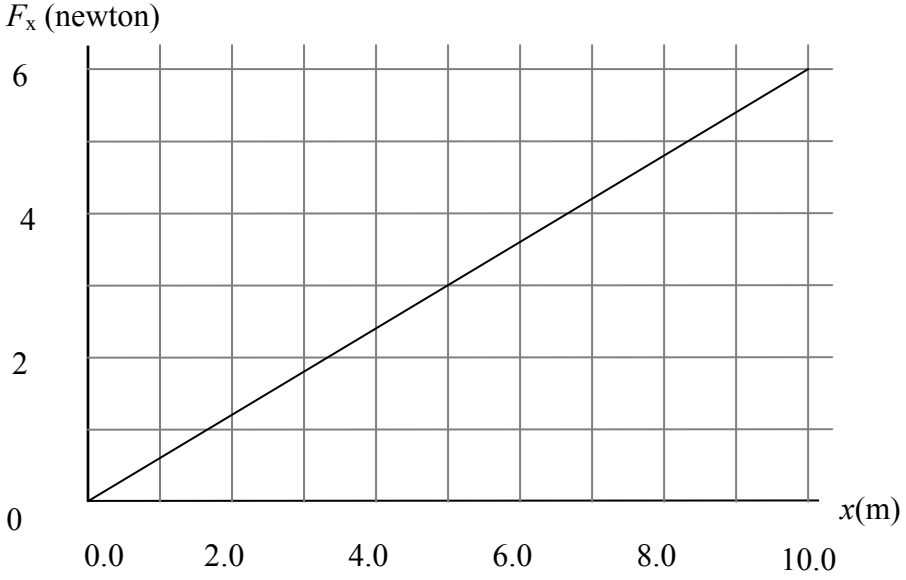


Figure 2

If the velocity of the body at x = 2.0 m is 3.0 m/s, what is the velocity of the body at x = 8.0 m?

A. 7.2 m/s
B. 6.2 m/s
C. 5.2 m/s
D. 4.2 m/s

5. A hypothetical star system with five planets revolving along different circular orbits around the star has the following distances from the star to each of the five planets equal to R_1, $2R_1$, $4R_1$, $5R_1$ and $6R_1$, successively. Find out a pair of planets that has a period of revolution's ratio approximately equals to 5.2.

A. Planet 2 and planet 1
B. Planet 4 and planet 1
C. Planet 5 and planet 2
D. Planet 5 and planet 4

6. Exposed to sunlight for an equal time interval, sand will be warmer than water. Why?

A. Because sand has a higher specific heat capacity and is less transparent to light than water.
B. Because water has a higher specific heat capacity and is more transparent to light than sand.
C. Because sand has a higher heat capacity than water.
D. Because water has a higher heat capacity than sand.

7. Figure 3 shows four arrangements of a pair of small fixed compass with moving needles in a region of zero external magnetic field. The arrows indicate the direction of needles. Which pairs are in stable equilibrium?

A. (a) (c)
B. (a), (b), (d)
C. (b), (c)
D. (a), (c), (d)

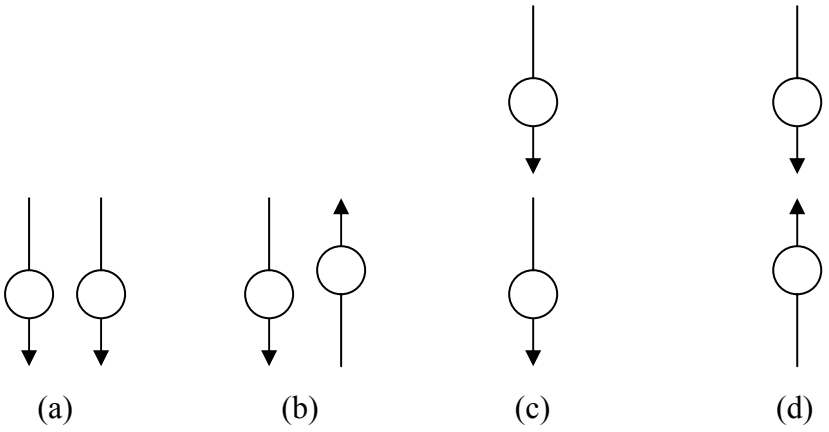
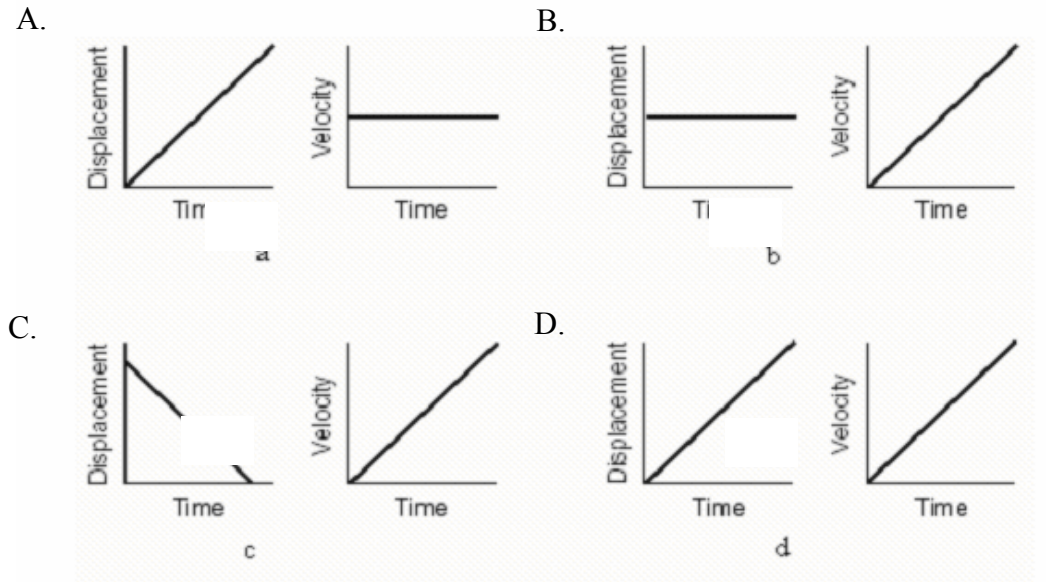


Figure 3

8. Which pair of graphs in Figure 4 characterizes the same motion?



9. A rocket is moving at a constant acceleration of 9.8 m/s^2 far away from any astronomical object. A marble is fired 'horizontally' inside the rocket at a speed of 20 m/s (see Figure 5). According to an observer inside the rocket,

   A. the marble will have no 'vertical' velocity.
   B. the marble will have a 'horizontal' velocity of 20 m/s and a 'vertical' velocity of 9.8*t* m/s in *t* second after firing.
   C. the marble will have a 'horizontal' velocity of 20 m/s and a 'vertical' velocity of –9.8*t* m/s in *t* second after firing.
   D. the marble will have a velocity of (20 + 9.8*t*) m/s in *t* second after firing.

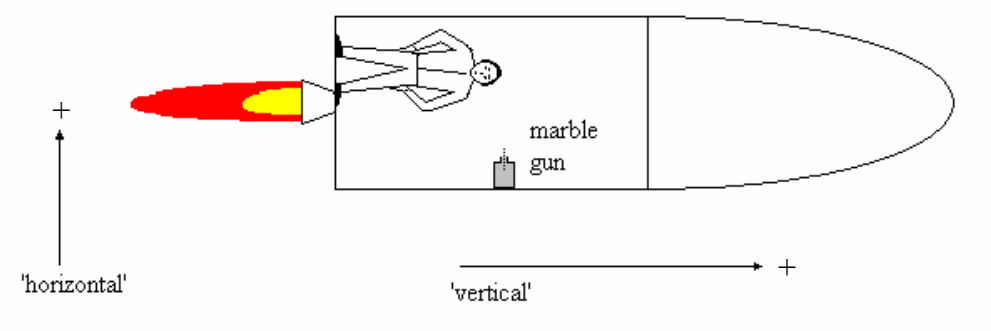


Figure 5.

10. Consider a miracle car having a 100% efficient engine burns fuel that has energy content of 40 mega joules per liter. If the air drag and overall frictional forces on the car at highway speed are 500 N, what is the upper limit in distance per liter the car could go at this speed?

    A. 100 km/l
    B. 90 km/l
    C. 80 km/l
    D. 70 km/l

11. A parallel-plate capacitor is charged and then disconnected from the charging battery. If the plates of the capacitor are then moved apart by the use of insulated handles, which one of the following results is correct?

    A. The charge on the capacitor increases.
    B. The charge on the capacitor decreases.
    C. The capacitance of the capacitor increases.
    D. The voltage across the capacitor increases.

12. Figure 6 shows a uniform metal disk of radius R which has a section removed. The removed section is a disk of radius b the center of which is located at distance a from the center O of the original disk. Find the coordinates of the center of mass (X_{cm}, Y_{cm}) of the disk in Figure 6.

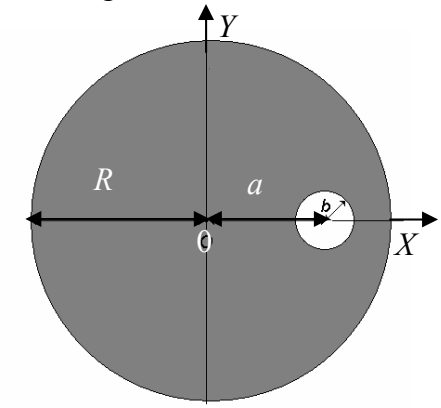


Figure 6.

A. $X_{cm} = -(R + a)b/2a$, $Y_{cm} = 0$
B. $X_{cm} = -(R + a)a/2b$, $Y_{cm} = 0$
C. $X_{cm} = -(b^2a)/(R^2 - b^2)$, $Y_{cm} = 0$
D. $X_{cm} = -(a^2b)/(R^2 - a^2)$, $Y_{cm} = 0$

13. Groundwater becomes acid when atmospheric CO_2 is dissolved in it. The groundwater trickles through the limestone with which it reacts producing

A. calcium carbonate
B. calcium bicarbonate
C. calcium oxide
D. calcium hydroxide

14. An aqueous solution containing 1.0×10^{-8} mole/liter HCl is

A. acidic.
B. basic.
C. neutral.
D. strong basic.

15. What kind of gas will be produced in the decomposition of sodium azide, NaN_3 from the chemical reaction occurring in an automotive air-bag safety system?

A. NO
B. O_2
C. H_2
D. N_2

16. When it reacts with water, hydrazine (N_2H_4) will produce

A. a neutral solution.
B. a basic solution.
C. an acid solution.
D. an amphoter solution.

17. A gas is confined in a closed cylinder fitted with a piston. The volume of the gas is 2.00 L at 398 Torr. When the piston is moved to increase the gas pressure to 5.15 atm at a constant temperature, which of the following is a reasonable volume for the gas at the new pressure?

A. 0.20 L
B. 0.40 L
C. 1.00 L
D. 20.00 L

18. At which part of the periodic table would you expect to find element(s) having the largest atomic size?

A. At the bottom right corner.
B. At the bottom left corner.
C. At the top right corner.
E. At the top left corner.

19. Biological species concept is stressed on the organisms ability to interbreed and produce viable and fertile offspring. Different species are separated by barriers that prohibit interbreeding, also called as reproductive isolation. Which of the following isolating mechanism is the simplest to achieve but is also the least robust?

A. Geographical isolation
B. Mechanical isolation
C. Behavioral isolation
D. Temporal isolation

20. The information of the physical world outside our body, as well as the processes inside, is collected by sensory receptors. Most of these receptors are specialized neurons or epithelial cells, existing in single or groups with other types of cells within the sensory organs. Choose the correct match among organs, sensory cells and receptor types from the table below.

Organ	Sensory cells	Type of receptor
I. skin	1. hair cells	a. thermoreceptor
II. tongue	2. cone cells	b. mechanoreceptor
III. nose	3. rod cells	c. chemoreceptor
IV. eye	4. taste bud	d. photoreceptor

A. I, 1, b
B. II, 2, c
C. III, 3, a
D. IV, 4, d

21. A woman with heterozygous A-blood type is married to a man with heterozygous B-blood type. What is the probability of having a child with O- and A-blood type?

A. O = 0%, A = 50%
B. O = 50%, A = 50%
C. O = 50%, A = 0%
D. O = 25 %, A = 25%.

22. The foods that enter our digestive system will undergo several processes, which are function- and place-specifics. Choose the correct statement from the following list.

A. While in the mouth, starch is broken down into disaccharide by the action of salivary amylase.
B. Stomach lining produces peptides.
C. The function of large intestine is to produce digestive enzymes.
D. The function of small intestine is to absorb water.

23. Global warming is recently considered as a big environmental issue. This phenomenon creates climate changes which cause several effects with different magnitudes. Minimum effect of climate change can be observed on:

I. plant germination
II. plant flowering
III. deciduous trees losing leaves in the fall

A. I only
B. II only
C. II and III
D. I and III

24. AIDS (Acquired Immune Deficiency Syndrome) is caused by HIV (Human Immunodeficiency Virus). People with AIDS are susceptible to opportunistic diseases, infections and cancers that take advantage of the collapsed immune system. HIV suppresses the immunes system by killing the victim's

A B-cells
B Macrophage
C T-cells
D Plasma cells

25. Insects can provide important evidence in a crime investigation. Size and age of particular larvae found in corpse can be used to estimate the time of death. What kind of insects that usually arrive earliest on human dead bodies?

A. Blowfly
B. Ants
C. Mite
D. Dung beetle

EXPERIMENTAL EXAMINATION

December 10, 2005

Maximum points for problem is 20

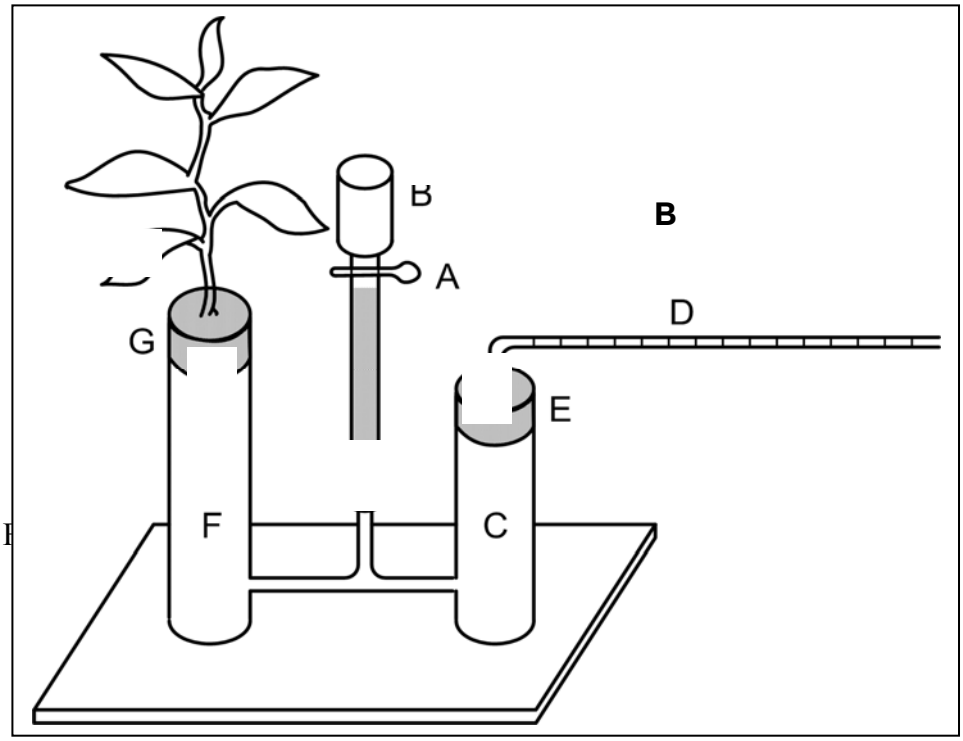
A. Introduction

The following experiment deals with transpiration phenomena which usually occurs in plants, i.e. water loss as water vapor from living tissues of the aerial parts of the plants. A laboratory apparatus known as "potometer" is usually used to quantitatively measure the transpiration rate of such plants, employing the amount of water consumed by the plant for a given period of time.

Due to the differences in the structure of plant tissues and in the its related physiological processes, the transpiration rate of one plant may differ considerably from the other. Moreover, several factors influencing transpiration rates, such as the atmospheric temperature, pressure, and humidity, as well as light intensity and wind speed have been well documented.

In this experiment, a simple laboratory made potometer, as schematically shown in Figure 1, will be used to quantify the influence of those factors on the transpiration rate of soybean (*Glycine max*) as a test plant.

The potometer consists of "water reservoir A", made of a capillary connected H-shaped glass tube and a valved funnel, and a capillary arm gauge - B is connected to the water reservoir with a rubber stopper. The test plant should be inserted into the water reservoir using a rubber support.



B. Objectives

B.1 General Objective

To demonstrate experimentally the transpiration process in a soybean test plant.

B.2 Specific Objectives

a. To measure quantitatively factors influencing transpiration rate of the test plant, such as light intensity and wind speed.
b. To recognize the influence of chemicals added to the media on the transpiration rate of the test plant.
c. To check participant knowledge on the physiological process involved in plant transpiration.

C. Apparatus and Materials

C.1 *Apparatus :*

1.	Potometer	1 set
2.	Stop watch	1 unit
3.	Circulating fan	1 set
4.	Tray	1 unit

C.2 *Materials :*

1.	Soybean plant	2 pots (1 plant per pot)
2.	Water	1 bottle (500 mL)
3.	Sugar solution of 2.5 % (w/w)	1 bottle (500 mL)
4.	Vaseline grease	1 tube
5.	Tissue paper	1 box
6.	Cutter	1 unit

D. Experiment

D.1 General Instruction

In the following experiments, you have to measure transpiration rates under different conditions e.g. light intensity, wind speed, and media. Experimentally, data are collected by measuring the water uptake due to the pulling force developed by transpiration. Read instructions carefully before doing the experiments. In each experiment, there will be questions related to the particular experiment. Answer all questions on the answer sheets provided.

D.2 Preparation steps

The following preparation steps should be carried out first, before doing any experiment.

1. Fix the capillary arm gauge B into the “water reservoir A” as shown in Figure 1.

2. Through the valved funnel, carefully fill up the "water reservoir A" of the potometer with water.
3. Prepare the test plant by cutting the soybean plant in the pot about 1 cm above the soil level, then fix the cut plant into the water reservoir of the potometer through the hole of rubber support provided. Be sure that all the cutting part of the plant has been immersed in the water of the reservoir!
4. You may use vaseline grease especially on the capillary arm gauge and the cut plant to avoid any leakage.

Experiment-I : Effects of Light on Transpiration Rate (5.5 points)

I-1 Set the water in the capillary arm gauge in full position (at the end of the arm). Be sure that no air bubble is present in the whole system of the potometer, otherwise serious difficulties will arise in subsequent observations. In the case air bubbles show up in your system, slightly open the rubber support and put in additional water to release the air.

I-2 Allow the system (for 15 minutes) for acclimatization. Under room light condition, record the length (in millimeters) of water column shifted (L) in the capillary arm gauge after 2, 5, and 10 minutes of transpiration process (1 point). Plot L (in millimeters) versus t (in minutes) from your data obtained in this particular experiment (1.5 points).

I-3 Similarly, after setting the water in the capillary arm gauge in full position, under "light off" condition (the test plant is shielded with a black cover available), record the length of water column shifted in the capillary arm gauge after 2, 5, and 10 minutes of transpiration process (1 points). Plot L (in millimeters) versus t (in minutes) from your data obtained in this particular experiment (1.5 points).

I-4 Based on the plots obtained in step I-2 and step I-3, choose one correct answer of the conclusion concerning the effects of light on the transpiration rates by crossing the letter of the correct answer on the answer sheet provided (0.5 point).

Experiment-II : Effects of Wind on Transpiration Rate (3 points)

II-1 This experiment is the continuation of experiment-I, finished previously. First of all, uncover the test plant. Then place and switch on circulating fan provided at a distance about 50 cm from the test plant in the potometer. Set the water in the capillary arm gauge at full position. Be sure that no air bubble is present in the whole system of the potometer.

II-2 Under the affect of "wind blowing" and room lighting, record the length (in millimeters) of water column shifted (L) in the capillary arm gauge after 2, 5, and 10 minutes of transpiration process (1 point). Plot L (in millimeters) versus t (in minutes) from your data obtained in this particular experiment (1.5 points).

II-3 Based on the plots obtained in step I-2 and those obtained in this experiment, choose one correct answer of the conclusion concerning the effects of wind on the transpiration rates by crossing the letter of the correct answer on the answer provided (0.5 point).

Experiment-III : Effects of Medium on Transpiration Rate (3 points)

III-1 Before conducting this particular experiment, you have to prepare an experimental set up using a different medium of transpiration, as follows: Pour out completely the water content in the potometer used previously. Through the valved funnel, carefully fill up the "water reservoir A" of the potometer with a 2.5 % (w/w) aqueous sugar solution available. Be sure that all the cut part of the plant has been immersed in the aqueous sugar solution of the reservoir!

III-2 Set the aqueous sugar solution in the capillary arm gauge at full position. Be sure that no air bubble is present in the whole system of the potometer, <u>otherwise</u> serious difficulties will arise in subsequent observations.

III-3 Under room light condition, record the length (in millimeters) of aqueous sugar solution column shifted (L) in the capillary arm gauge after 2, 5, and 10 minutes of transpiration process (1 point). Plot L (in millimeters) versus t (in minutes) from your data collected in this particular experiment (1.5 points).

III-4 Based on the plots obtained in step I-2 and those obtained in this experiment, choose one correct answer of the conclusion concerning the effects of medium on the transpiration rates by crossing the letter of the correct answer on the answer sheet provided (0.5 point).

E. *A. Questions*

B. You are provided with four possible answers. Read the question very carefully and then choose one correct answer by crossing one of the answers provided on the answer sheet. It should be noted that there is only one correct answer for each question.

1. The following data are observed in a transpirasion experiment.

Time (minute)	Water displacement (mm)
t_1	l_1
t_2	l_2
t_3	l_3

Assuming that the inner diameter of the capillary arm gauge is d mm, then the water volume taken up by the plant in a period between t_2 and t_3 would be (0.75 points):

A. $0.25\ \pi d^2(l_3 - l_2)$

B. $0.50\ \pi d^2(l_3 - l_2)$

C. $0.75\ \pi d^2(l_3 - l_2)$

D. $1.00\ \pi d^2(l_3 - l_2)$

2. Assuming that the water column displacement in the capillary arm gauge is linearly related to the transpiration time, then the calculated transpirasion rate of the plant, based on the data in question 1, would be (0.75 points):

A. $0.25\ \pi d^2(l_3 - l_2)/(t_3 - t_1)$

B. $0.25\ \pi d^2(l_3 - l_2)/(t_3 - t_2)$

C. $0.50\ \pi d^2(l_3 - l_1)/(t_3 - t_1)$

D. $0.50\ \pi d^2(l_3 - l_2)/(t_3 - t_2)$

3. When transpiration experiments of soybean were conducted in two different conditions, i.e. pure water and water containing 2.5 % (w/w) of sugar, the following observation could be expected (1 point).

A. No difference in the transpiration rate was observed with the two conditions applied.

B. The transpiration rates obtained in experiments using pure water medium were significantly lower than that using the water medium containing sugar.

C. The transpiration rates obtained in experiments using pure water medium were significantly higher than that using the water medium containing sugar.

D. No definite pattern in transpiration rate was observed with the two conditions applied.

4. Dealing with aqueous sugar solution, the following statement is *correct* (0.5 point).
   A. The density and viscosity of sugar solution are lower than those of water.
   B. The density and viscosity of sugar solution are higher than those of water.
   C. The density of sugar solution is higher than that of water, but the viscosity of an aqueous sugar solution is lower than that of water.
   D. The density of an aqueous sugar solution is lower than that of water, but the viscosity of sugar solution is higher than that of water.

5. In order to prepare a 2.5 % (w/w) aqueous sugar solution from 5.0 grams of sugar, the following amount of water should be added (0.5 point):
   A. 48.75 grams
   B. 97.50 grams
   C. 195.00 grams
   D. 390.00 grams

6. Among the formulas listed below, the chemical formula representing sugar obtained from sugar cane is (0.5 point):
   A. C_6H_5OH
   B. $C_6H_{12}O_6$
   C. $C_{12}H_{24}O_{12}$
   D. $C_{12}H_{22}O_{11}$

7. Both melting point and boiling point of substances may often be predicted based on their chemical formulas, molecular structures, and sometimes on their physical appearances. Concerning the melting point and the boiling point of sugar, the following statement is *correct* (0.5 point).

   A. Both the melting and boiling points of sugar are lower than those of water.
   B. Both the melting and boiling points of sugar are higher than those of water.
   C. Only the melting point of sugar is higher than that of water.
   D. Only the boiling point of sugar is higher than that of water.

8. Based on the involvement of heat observed experimentally, it could be concluded that the transpiration of soybean plant is (0.5 point):
   A. an endothermic process.
   B. an exothermic process.
   C. an adiabatic process.
   D. an isothermic process.

9. During your experiment of plant transpiration, water evaporation process occurring on the leaves of the soybean test plant, may be represented by the following chemical equation (0.5 point):
   A. $H_2O\ (s) \rightarrow H_2O\ (g)$
   B. $H_2O\ (g) \rightarrow H_2O\ (l)$
   C. $H_2O\ (l) \rightarrow H_2O\ (s)$
   D. $H_2O\ (l) \rightarrow H_2O\ (g)$

10. In the presence of light, both photosynthesis and transpiration are taking place in the chlorophilic parts of living plants, including in soybean leaves. One of the following chemical equations describes the photosynthesis (0.5 point):
   A. $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (l)$
   B. $H_2O\ (l) + CO_2\ (g) \rightarrow$ carbohydrates $[C_n(H_2O)_m] + O_2\ (g)$
   C. $H_2O\ (l) + CO_2\ (g) \rightarrow H_2CO_3\ (l)$
   D. carbohydrates $[C_n(H_2O)_m] + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (l)$

11. In principle, the transpiration investigated is due to (0.5 point):
   A. water pressure in the roots.
   B. water tension in the stem.
   C. absorption of water by the roots.
   D. evaporation of water from the leaves.

12. Transpiration mostly occurs from the leaves through their multitude of tiny holes called stomata. The stomata are responsible for (0.5 point):
   A. translocation of nutrients.
   B. releasing growth hormones.
   C. regulating water loss.
   D. transporting minerals.

13. Various environmental factors, directly influencing the opening and closing of the stomata, affect transpiration rates. The opening and closing of the stomata are controlled by (0.5 point):
    A. sieve tube member.
    B. guard cells.
    C. mesophyll.
    D. root hairs.

14. The presence of light is an important factor regulating plant transpiration in order to prevent plants from losing water. The involvement of photosynthesis in the transpiration process may cause stomata to (0.5 point):
    A. close, therefore the transpiration rate increases.
    B. close, therefore the transpiration rate decreases.
    C. open, therefore the transpiration rate increases.
    D. open, therefore the transpiration rate decreases.

15. Each of the following statements is related to factors affecting the rate of transpiration, *except* (0.5 point):
    A. Water evaporation is faster at higher temperatures.
    B. Transpiration increases as wind speed increases.
    C. Transpiration decreases when water supply is insufficient.
    D. Transpiration increases as humidity increases.

THEORETICAL EXAMINATION

December 8, 2005

Problem I and II. (Maximum point for problems is 20)

If we arbitrarily set the electric potential of a particular electrode at zero, we can use it to determine the relative potentials of the other electrodes. The hydrogen electrode shown in Figure 1 serves as the reference for this purpose. Hydrogen gas is bubbled into a hydrochloric acid solution at 25 ^{o}C. The platinum electrode has two functions. First, it provides a surface on which the dissociation of hydrogen molecules can take place:

$$H_2 \rightarrow 2H^+ + 2e^-.$$

Second, it serves as an electrical conductor to the external circuit.

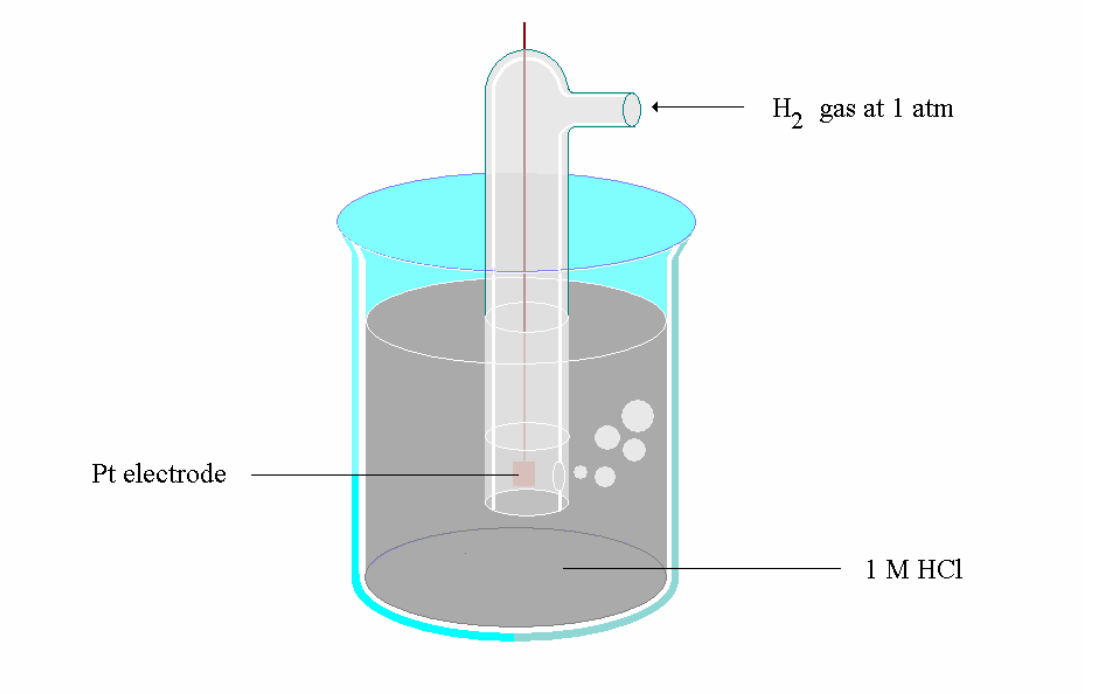


Figure 1.

Under standard-state conditions (when the pressure of H_2 is 1 atm and the concentration of HCl solution is 1 mole/liter), the potential for a reduction reaction of H^+ at 25 ^{o}C is assumed to be *exactly zero*:

$$2H^+ \text{ (1 mole/liter)} + 2e^- \rightarrow H_2 \text{ (1 atm)}. \qquad \mathcal{E}^0 = 0 \text{ V}$$

Thus, the standard reduction potential of the hydrogen electrode is defined as zero. The hydrogen electrode is called the *standard hydrogen electrode* (SHE).

Problem I. Physics (Maximum point for problems is 10)

1. A hydrogen bubble of 8.00 mm^3 volume is near the platinum electrode at a depth of 15.00 cm where the temperature is 25 ^oC. The bubble rises to the surface of the HCl solution, which is at a temperature of 27 ^oC. Assume that the temperature of the bubble is the same as that of the surrounding solution and the mass density of the solution is uniformly equal to that of water (1.00×10^3 kg/m^3). If the earth gravitation is 9.80 m/s^2 and H_2 is regarded as an ideal diatomic gas, find the volume of the bubble just before it reaches the surface of the solution (1 atm = 1.013×10^5 Pa)! **(3 points)**

2. Find the change of the net force acting on the hydrogen bubble as it rises from a point outside the lower end of the platinum electrode at the same height of the end of the electrode to the surface of the solution! **(2 points)**

3. Let r be the distance between the two hydrogen atoms of the H_2 molecule. The two hydrogen atoms of the H_2 molecule are bound together by an effective potential energy $V(r)$ that is drawn in Figure 2.

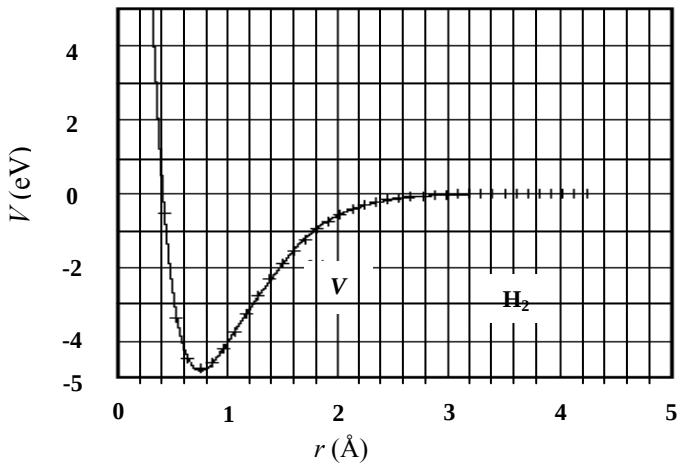


Figure 2. Effective potential energy curve of H_2 molecule

(a) *Find the equilibrium distance between the two hydrogen atoms of an H_2 Molecule!* **(1 point)**

(b) *Is the force between the two atoms repulsive* ($\leftrightarrow$) *or attractive* ($\rightarrow\leftarrow$) *if their distance is slightly smaller than the equilibrium distance?*
(1 point)

(c) *Is the force between the two atoms repulsive* ($\leftrightarrow$) *or attractive* ($\rightarrow\leftarrow$) *if their distance is slightly greater than the equilibrium distance?*
(1 point)

4. Assume that an H_2 molecule is initially at the equilibrium distance. Using the diagram in figure 2, if the molecule absorbs additional energy, the two hydrogen atoms are able either to come closer to each other or increase their distance.

   (a) *How much energy has to be absorbed by the molecule to make the two hydrogen atoms!*
   (1 point)
   (b) *If the energy absorbed by the molecule is of 2.8* eV, *determine the shortest and the longest distance between the two atoms?* **(1 point)**

Problem II. Chemistry (Maximum point for problems is 10)
(1, 2 and 3 Use the same process as in problem I)

1. What kind of the chemical bond or forces which operates between
   (a) hydrogen atoms in a hydrogen molecule
   …….. (1 point)
   (b) hydrogen molecules in liquid hydrogen state
   …….. (1 point)

2. The hydrogen gas should be bubbled continuously through the electrolyte in a hydrogen electrode in order to satisfy one of the following requirements **(2 points)** which is

A. to keep the solution saturated with hydrogen gas B. to clear the platinum electrode C. to gate the highest electrode potential D. to minimize loss of current E. to speed up the process F. to minimize the cost

3. In redox (reduction-oxidation) reaction, electron is transfer from reducing agent to oxidizing agent. Standard electrode potential is usually used to measure the strength of the oxidizing agent.

Table 1. Reduction standard potential

Half-cell reaction	Standard electrode potential, volt
$Ag^+ + e^- \rightleftharpoons Ag(s)$	+ 0.799
$2H^+ + 2e^- \rightleftharpoons H_2\,(g)$	+ 0.000
$Cd^{2+} + 2e^- \rightleftharpoons Cd(s)$	− 0.403
$Zn^{2+} + 2e^- \rightleftharpoons Zn(s)$	− 0.763

Based on the data listed in Table 1,

(a) write down in descending order the relative strength of the four ionic species as oxidizing agents! **(1 point)**

(b) write down the chemical reaction when a cadmium rod (Cd) is immersed into an aqueous solution of silver nitrate ($AgNO_3$) **(2 points)**

4. Air batteries use $O_2(g)$ from air as their oxidizing agent. Whilst, the reducing agent is typically metal, such as zinc or aluminum. In aluminum-air battery, the oxidation and reduction occur at the aluminum anode and the carbon cathode, respectively, and the electrolyte circulated through the battery is $NaOH_{(aq)}$. Aluminum is oxidized to Al^{3+}, but because of the high concentration of OH^-, the anionic complex $[Al(OH)_4]^-$ is formed. Write down the overall reactions! (**3 points**)

Problem III. Biology (Maximum points for problems is 10)

1. Every organism consists of cells.

1.1. Select correct group of organisms listed in the Table 2 below and match it with Figure 2a and 2b **(0.5 point).**

Table 2.

Figure 2a Figure 2b	A. Bacteria B. Archaebacteria C. Animal D. Plant E. Fungi

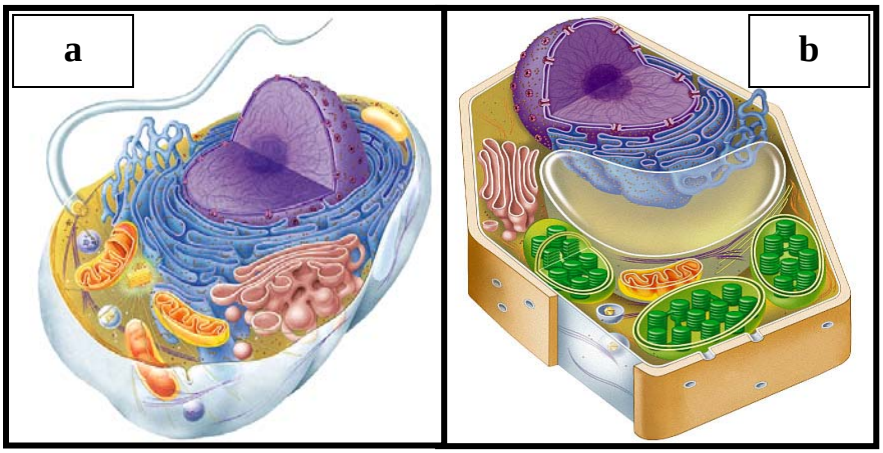


Figure 2.

1.2. The existence of some of the features listed below can be used to distinguish plant cells from animal cells. Please write appropriate four letters (A – I) into the answer sheet ! (**1.0 point)**

A. cell wall	F. centrioles
B. vacuole	G. endoplasmic reticulum
C. chloroplast	H. Golgi apparatus
D. ribosome	I. mitochondria
E. nucleus.	

2. Parathormone (Parathyroid hormone) which is produced in parathyroid gland has the main regulating function in…….and……**(0.5 point)**

A.	Increasing the level of calcium in the blood
B.	Decreasing blood glucose level in the blood
C.	Controlling carbohydrate metabolism
D.	Controlling the synthesis of protein
E.	Stimulating breakdown of glycogen to glucose

3. In most of Mammalian species, including human, male and female reproductive organs develop in accordance with age. Parts of the female reproductive organs are important in the development of ovary, and in the male reproductive organs, some play important role in spermatogenesis. Refer to Figure 3 for the pictures of female and male reproductive organs.

3.1 Match the parts of reproductive organs that are marked with letters: A, B, C and D, in the left column with appropriate organs in the right column, as shown in Table 3. **(1.0 point)**

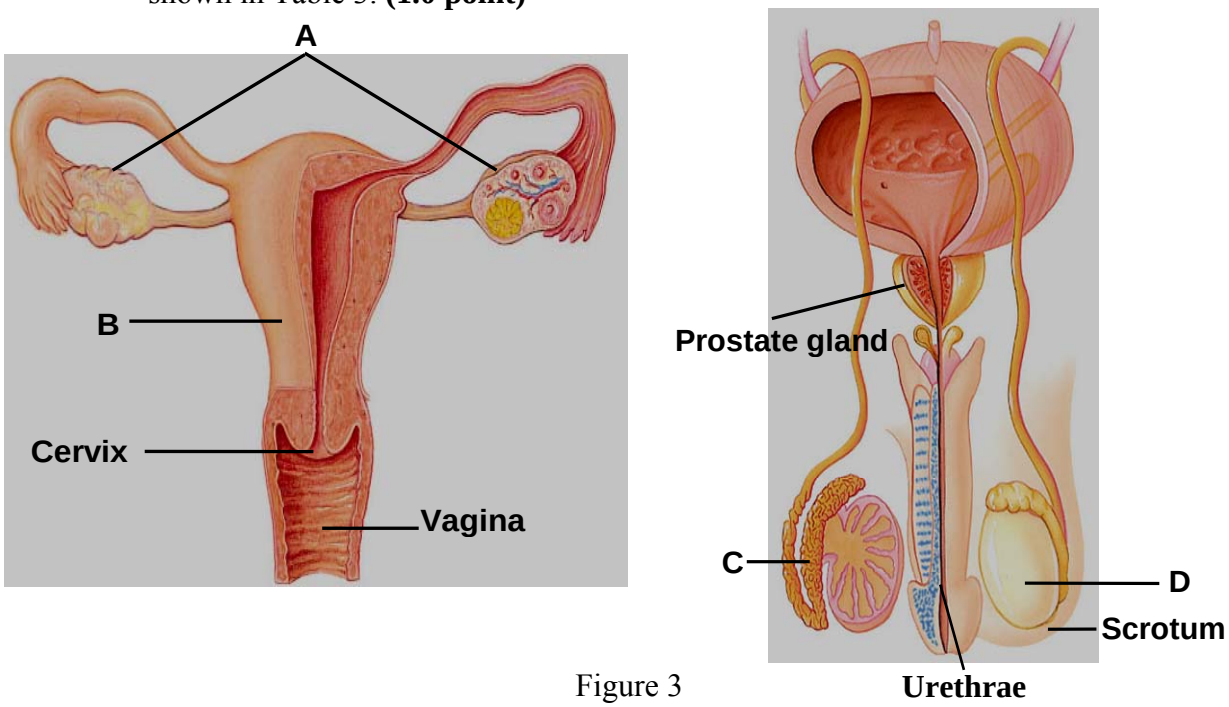


Figure 3

Table 3.

A. ....**...**	1. Testis
	2. Ovary
B. ……	3. Ejaculatory duct
	4. Epididymis
C. …..	5. Oviduct
	6. Uterus
D. ……	7. Labia mayora
	8. Bartholin gland

3.2. In Female, several hormones are involved in completion of one cycle of menstruation. Select the kinds of hormones from the list bellow (A – G) that are involved in the cycle: (1)……., (2)……., and (3)……., (4)…… **(1.0 point)**

A. FSH (Follicle Stimulating Hormone),
B. LH (Luteinizing Hormone),
C. Estrogen,
D. Testosterone,
E. Progesterone
F. Hypothalamus
G. Androgen

3.3. In male reproductive system there are several hormones that have specific function. Match the following function of hormones in the left column with appropriate hormone available in right one! **(1.5 point)**

Table 4.

1. Stimulates early the stages of sperm formation	A. FSH
	B. Testosterone
2. Stimulates secretion of testosterone by Leydig cells	C. LH
3. Stimulates development and maintenance of male secondary sexual characteristic and accessory	D. Progesterone
	E. Estrogen

4. Blood circulation in mammals depends on the anatomy of the heart and its pumps cycles. The structural difference of artery, veins and capillaries correlates with their functions. Figure 4 shows human heart with its blood vessels. **(2.5 points)**

   Numbers and arrows in Figure 4 show the flows of blood through the heart. Fill in the blanks from number (4.1) to (4.5) in the following passage with appropriate letters (A–J) available in Table 5.

   ……..(4.1) pumps the blood to the lungs through **…… (4.2).** Within the lungs, blood cells discharge carbon dioxide and take in oxygen. Oxygen-rich blood from the lungs goes back to the heart through **…… (4.3)**, then it is pumped from the **…… (4.4)** to all over the body through the **……(4.5)**.

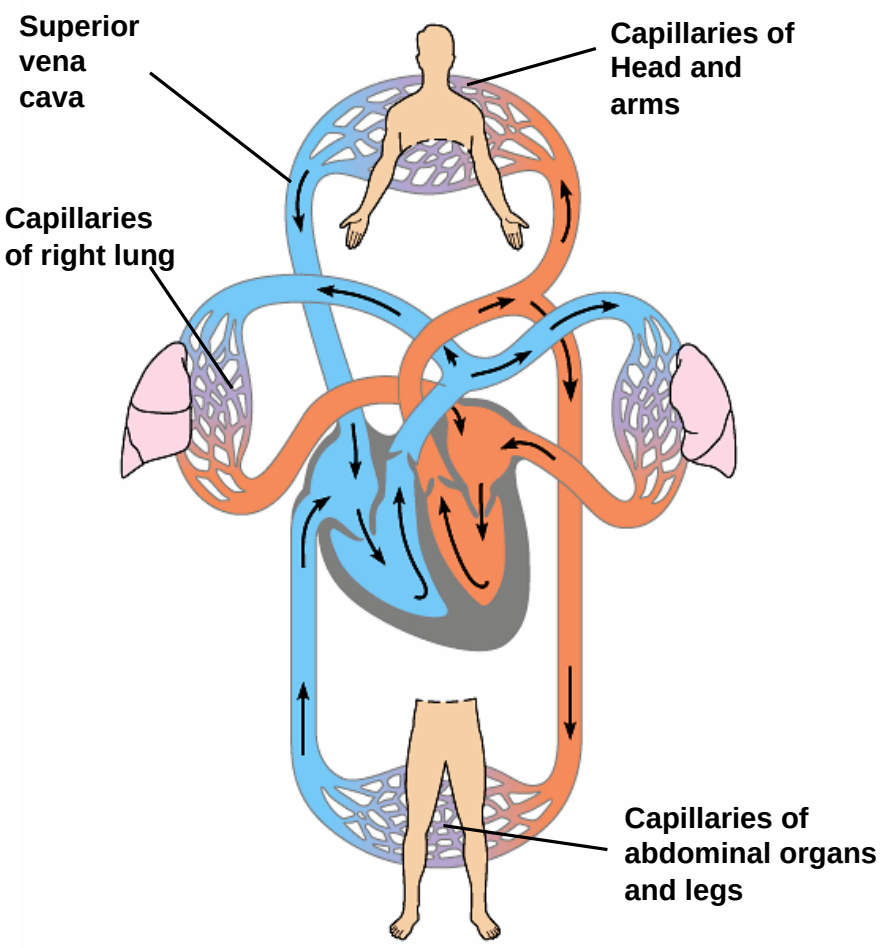


Figure 4

Table 5.

A. Pulmonary artery
B. Pulmonary vein
C. Left atrium
D. Right atrium
E. Left ventricle
F. Right ventricle
G. Aorta
H. Vein
I. Semilunar valve
J. Atrioventricular valve

5. Avian Influenza or 'bird flu' is a contagious disease of animal caused by viruses that normally infect only bird and less commonly pigs. Avian Influenza viruses are highly species-specific, but have, on rare occasion, crossed the species barrier to infect humans.

   Avian Influenza viruses have 16 H (H1 – H16) subtypes x 9 N (N1 – N9) subtypes. Among them are known to cause highly pathogenic form of the diseases. However, not all the subtypes of the viruses are highly pathogenic and not all will cause severe disease in poultry.

   5.1 Based on current understanding, viruses are introduced to poultry flock in their low pathogenic form. Allowing them to circulate in poultry population within few months, usually the viruses undergo mutation into a highly pathogenic form. The virus subtype that we (human) are most concerned about, are: ……. **(0.5 point),** and …….. **(0.5 point)**

   5.2 Is the virus transmitted easily from birds to humans ? **(0.5 point)**

A. Yes, avian influenza virus is easily transmitted to human, especially in chicken farms area
B. Yes, avian influenza virus can be transmitted from chickens/bird to human, because human and chickens/bird posses the same virus receptor
C. No, because human does not have the particular virus receptor
D. No, because only relatively small number of people is infected compared to the significant number of infected chickens and birds

6. DNA technology enables molecular biologist to directly study the genes without having to distinguish the genotype from phenotype like in classical genetics. DNA fingerprinting can be used for forensic analysis, such as in criminal investigation.

   Choose one correct answer which is primarily used in the basic definition of DNA finger printing in forensic sciences …… **(0.5 point)**

A. DNA from different individuals rarely has exactly the same array of DNA pattern, PCR technique is used.
B. DNA from different individuals has the same print out
C. DNA can be analyzed by distinguishing between the predecessor and its ancestor, concluding their blood type
D. Different sites in the DNA have different restriction enzyme sites
E. The combination of A to D should be used simultaneously