Part 4
Problems and Solutions

Test Competitions and Solutions (in English)
Theoretical Problems and Solutions (in English)
Experimental Problems and Solutions (in English)
In Other Languages

TEST COMPETITION
December 7, 2004

EXAMINATION RULES

1. All competitors must be present at the front of examination room ten minutes before the examination starts

2. No competitors are allowed to bring any tools except his /her personal medicine or any personal medical equipment.

3. Each competitor has to sit according to his or her designated desk.

4. Before the examination starts, the competitor has to check the stationary and tools (pen, eraser, ruler, sharpener, pencil, calculator, and note book) provided by the organizer.

5. Each competitor has to check the question and answer sheets. Rise your hand, if you find any missing sheets. Start after the bell.

6. The competitor must write down their name and country (in Latin characters) on each answer sheets. The question may be answered in a random order but each answer can only be written on one side of the answer sheet.

7. During examination, competitors are not allowed to leave the examination room except for emergency case and for that the examination supervisor will accompany them.

8. The competitors are not allowed to bother other competitor and disturb the examination. If assistance is needed, competitor may raise his/her hand and the supervisor will come to help.

9. There will be no question or discussion about the examination problems. The competitor must stay at their desk until the examination time is over, although he/she has finished the examination or does not want to continue working.

10. The end of the examination time will be a signal (bell rings). You are not allowed to write anything on the answer sheet after the allotted time has finished. All competitors must leave the room quietly

11. **The question and answer sheets must be left on your desk.**

TEST COMPETITION
December 7, 2004

Read carefully the following instructions:

1. The time available is two (2) hours.
2. Check that you have a complete set of the test questions and the answer sheet.
3. Use only the pen provided.
4. Write down your name, country and signature in the answer sheet.
5. Read carefully the problem and choose your correct answer by crossing the Capital letter in your answer sheet. There is only one right answer for each question.
    Example:

1	A	B	C	D

6. If you want to change your answer, you have to circle the first answer and then cross a new letter as your correct answer. You may only allow making one correction.
    Example:

1	Ⓐ	B	C	D

    A is the first answer and D is the correct answer.

7. Point rules:

    - Correct answer   :   + 2.0 Points

    - Wrong answer   :   - 1.0 Point

    - No answer   :   0.0 Point

8. **All competitors are not allowed to bring any stationary and tools provided outside. After completing your answer, all of the question and answer sheets you must put them on desk.**

Name		Signature:
Country		

TEST COMPETITION
December 7, 2004

ANSWER SHEET

No.	ANSWER			
1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D

| No.	ANSWER			
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D
21	A	B	C	D
22	A	B	C	D
23	A	B	C	D
24	A	B	C	D
25	A	B	C	D

TEST COMPETITION

1. The mobile system in the Figure is in the equilibrium condition. The object of m_A has a mass of 0.5 kg and hang at the first crossbar. The second crossbar supports the mass of m_B and m_C. Determine the tension F at the first crossbar and the masses of the objects m_B and m_C by neglecting the weights of crossbars. (g = 9.8 m/s^2).
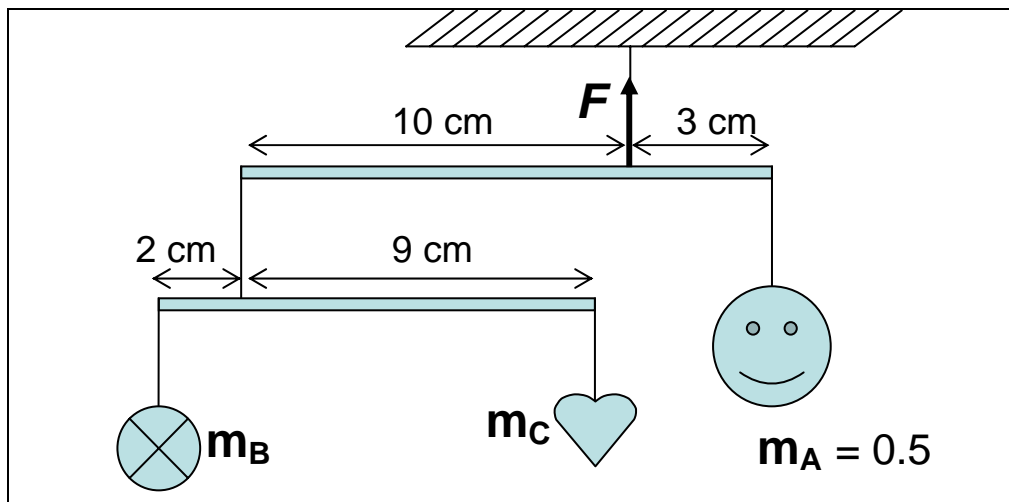
A. F = 6.37 N, m_B = 0.12 kg, m_C = 0.03 kg
B. F = 5.37 N, m_B = 0.12 kg, m_C = 0.03 kg
C. F = 6.37 N, m_B = 0.10 kg, m_C = 0.03 kg
D. F = 6.37 N, m_B = 0.12 kg, m_C = 0.01 kg

2. Two identical twin babies are born from one mother. The babies are the result of the fertilization of:

A. One ovum with two sperms
B. Two ovums with one sperm
C. One ovum with one sperm
D. Two ovums with two sperms

3. The voltage in household wiring (220 volt) is used for lighting of a 100 W-bulb. The resistance R of the tungsten at 20 $^\circ$C is 89.5 Ω. If the temperature coefficient of tungsten α = 0.0045 $^\circ$C^{-1}, estimate the temperature of the tungsten used as a wire resistance in the bulb.

   A.   1120 $^\circ$C
   B.   1020 $^\circ$C
   C.   1000 $^\circ$C
   D.   980 $^\circ$C

4. Select the statement that is **not** an appropriate method for separating and purifying substances:

   A.   Petroleum is separated from crude oil by fractional distillation
   B.   The mixture of various compounds could be separated by chromatography
   C.   Sodium Chloride is separated from the seawater by extraction
   D.   Iodine contained in sand mixture is separated by sublimation

5. A student sees the top and the bottom edges of a pool simultaneously at an angle of 14° above the horizontal as shown in the Figure.
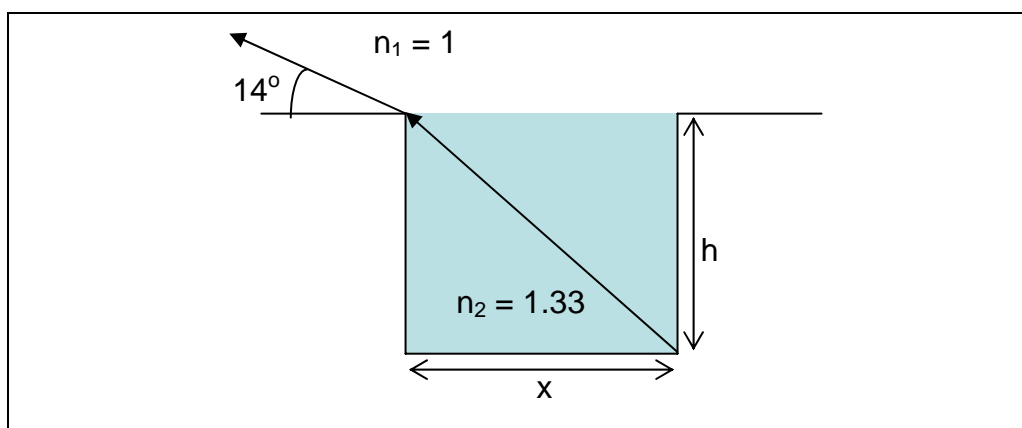
   What is the new view angle, if he wants to see the top edge and the bottom center of the pool (n = index of refraction, n_{water} = n_2 = 1.33 and n_{air} = n_1 = 1)?

   A.   28.4°
   B.   38.0°
   C.   46.8°
   D.   51.3°

6. The mechanisms of antibiotics are to inhibit the following processes, **except**:

   A.   nucleic acid synthesis
   B.   protein synthesis
   C.   capsule synthesis
   D.   cell wall synthesis

7. Several indicators are used to determine the pH of river water sample. If an indicator was added to the sample, the color of indicators added to the water sample is shown below:

Indicator added	Color of indicator in water sample
Methyl orange	yellow
Methyl red	yellow
Bromthymol blue	blue
Phenolphthalein	colorless

Table: pH range of indicators used:

Indicator	Range of pH	Changes in color
Methyl orange	3.1 – 4.4	red to yellow
Methyl red	4.2 – 6.2	red to yellow
Bromthymol blue	6.0 – 7.6	yellow to blue
Phenolphthalein	8.3 – 9.6	colorless to red

By using pH range of above indicators, the pH range of the river water is:

A. $3.1 < pH < 7.0$
B. $4.4 < pH < 7.6$
C. $6.0 < pH < 8.3$
D. $7.6 < pH < 8.3$

8. Choose the **incorrect** match between organ, sensory cell and type of receptor from the table below.

Organ	Sensory cells	Type of Receptor
I. Tongue	1. Cone cells	a. Chemoreceptor
II. Ear	2. Chemoreceptor cells	b. Photoreceptor
III. Nose	3. Hair cells	c. Mechanoreceptor
IV. Eye	4. Taste bud	

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

9. A woman who has four sisters married to a man who has three brothers and one sister. What is the usual probability of having a son if they have a child?

A. 12.5%
B. 25%
C. 50%
D. 75%

10. In a chemical reaction, when calcium changes (atomic number, Z = 20) to form calcium ions, the ions react with carbonate ions. In this reaction each calcium atom:

A. releases one electron
B. releases two electrons
C. gains two electrons
D. increases atomic number by two

11. X is a white solid substance. When X is heated, it produces a white solid substance Y and gas Z. The produced gas in the reaction is similar to the gas produced by burning carbon in excess of oxygen, and Y is an oxide. From this information, it can be concluded that:

A. X, Y and Z are compounds
B. Only X and gas Z are compounds
C. Y is an element and gas Z is a compound
D. X and Y are pure compounds
.

For test problems No. 12 and 13, read the statement below:

Hypertension is one of diseases that can cause death. The disease is indicated by a high blood pressure (above normal, higher than 140/90 mm Hg). The term blood pressure usually refers to the force pushing against an arterial wall. Hypertension can increase the risk of heart attacks, heart disease, strokes and kidney failure. Hypertension might be related to increasing of sodium ion concentration [atomic mass (A) of sodium = 23; atomic number (Z) = 11]. Diet plays important role in hypertension, additional food such as orange, banana and vegetables could reduce blood pressure. Based on the study, orange, banana and vegetables contain potassium ion, K (A = 39, Z = 19). Fifteen out of twenty people that take those diets have reduction of blood pressure (diastolic & systolic) with obvious reduced of diastolic up to 2.4 mm Hg.

12. Active metal ion that present in orange, banana and vegetable contains .... electrons and ……………protons

A. 10 and 11
B. 11 and 11
C. 18 and 19
D. 19 and 19