Prince of Songkla University

The Faculty of Engineering

Midterm Examination Semester I   **Academic Year: 2008**

Date: July 26, 08   **Time: 13:30 -15:30**

Subject: 226-443 Ergonomics   **Room: A 400**

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชานั้น และพักการเรียน **1** ภาคการศึกษา

DIRECTIONS
1. Only short note on an A4 piece (both sides), dictionary and calculator are allowed.
2. 8 questions are given on 4 pages and must be done.
3. Total score is 100.
4. Your answers could be in English or Thai.
5. Please check all questions before start working.

Good Luck
Asst.Prof. Angoon Sungkhapong, PhD.

1. Anthropometric data often are best presented in percentiles. They provide a convenient mean of describing the range of body dimensions to be accommodated, making it easy to locate the percentile equivalent of a measure body dimension. Also, the use of percentiles avoids the misuse of the average in design.

    Question: According to above paragraph, explain (1) the definition of percentiles; (2) how to calculate the percentiles? And (3) how to apply the usage of percentiles for ergonomic design? (15 points)

2. All skeletal muscles are controlled by nerves. When a nervous stimulus arrives at the muscles, calcium ions are released from the cytoplasm of the muscle cells. These ions remove an inhibition on the action molecules and allow them to form chemical bonds with myosin, using ATP to supply the energy. The release of energy from ATP involves the reaction

    $$ATP \longrightarrow ADP + PHOSPHATE + ENERGY.$$

    Question: From the information given above, explain in more details by using the metabolic diagram and show the role of glucose for this energy. (10 points)

3. Consider the interactions between having to work extremely long periods, and missing sleep, as they affect performance. (10 points)

4. The system of reference coordinates and planes facilitates description of movements of the body segments and allows for an exact definition of any point in space.

    Question: How many reference planes used in a standardized posture? Explain their location. (Illustration is needed.) (10 points)

5. What is your recommendation for a good design of stair ?
(5 points)

6. According to the anthropometric data shown in Table 1, determine the 90th percentile of elbow height (men and women). (10 points)

7. A patient is exercising his shoulder extensor muscles with wall pulleys (Fig 1) Weights of 20 lb., 10 lb., and 5 lb. are loaded on the weight pan, which itself weights 4 lb. the patient is exerting an opposing force of 45 lb.
   Question: What is the resultant of the entire system of forces which is acting? (20 points)

8. Weights totaling 30 lb. are placed on the foot (Fig 2) the leg and foot weight 9 lb. the center of gravity of the leg and foot together lies 8 in. distal to the knee joint axis, and the exercise weights are 22 in. distal to the joint axis.
   Question: Find the magnitude and action line of the total load pulling downward against the knee extensor muscles. (20 points)
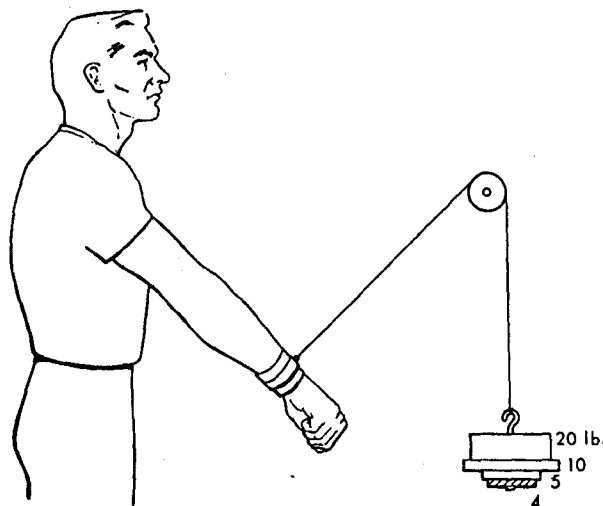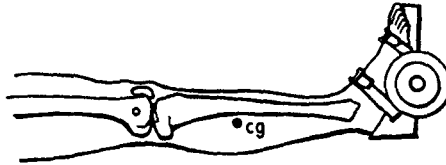

Figure 1: For question # 7.

Figure 2: For question # 8.

Table 1: Show a set of anthropometry data (in mm.)

Dimension	Men				Women			
	5th percentile	50th percentile	95th percentile	SD	5th percentile	50th percentile	95th percentile	SD
1 Stature	1647	1755	1867	67	1528	1628	1737	64
2 Eye height	1528	1633	1743	66	1415	1515	1621	63
3 Shoulder height (acromion)	1342	1442	1546	62	1241	1332	1432	58
4 Elbow height	995	1072	1153	48	926	997	1074	45
5 Hip height (trochanter)	853	927	1009	48	789	860	938	45
6 Knuckle height	na	na	na	na	na	na	na	na
7 Fingertip height	591	653	716	40	531	610	670	36
8 Sitting height	855	914	972	36	795	851	910	35
9 Sitting eye height	735	792	848	34	685	738	794	33
10 Sitting shoulder height (acromion)	549	598	646	30	509	555	604	29
11 Sitting elbow height	184	232	274	27	176	221	264	27
12 Thigh height (thickness)	149	168	190	13	140	158	180	12
13 Buttock-knee length	569	615	667	30	542	588	640	30
14 Buttock-popliteal length	458	500	546	27	440	481	528	27
15 Knee height	514	558	606	28	474	514	560	26

na = not available