

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Mid Term Examination : Semester I

Academic Year : 2006

Date : August 3, 2006.

Time : 09:00-12:00

Subject : 226-443 Ergonomics

Room : A 401

ทฤษฎีในการสอบ โทษชั้นต่ำปรับตกในรายวิชานั้น
และพักการเรียน 1 ภาคการศึกษา

DIRECTIONS :

1. Only short note on an A4 piece (both sides), dictionary and calculator are allowed.
2. 7 questions are given on **6** 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. Dr. Angoon Sungkhapong

1. Sketch the spine (or vertebral column) and show me five groups of vertebrae (the position and numbers of vertebrae in each group must be shown). (10 points)
2. Explain the roles of glucose, fat and proteins on muscular work. (Hint: diagram or chart should be shown.) (10 points)
3. The term "fatigue" has been used in so many different senses, but a reasonable distinction is the common division into *muscular fatigue* and *general fatigue*.
 - a) Explain the causes and results of muscular fatigue. (5 points)
 - b) How many types of general fatigue? Explain all of them clearly. (10 points)
4. Show five factors that affect the capacity of human's perceiving and transforming the data. How to improve this capacity for the workers? (10 points)
5. A worker is holding an object with weight of 10 kg in his right hand. The posture is shown in Figure 1—his elbow angle is 90 degrees. The total weight of lower arm and hand is 2 kg and its center of mass (CM) is 0.148 m from the elbow joint. The distance between elbow joint and CM of the object is 0.325 m. The lever arm of muscle force is 0.042 m from the elbow joint ($d = 0.042$ m as shown in Figure 1). Find the muscle force near the elbow joint to maintain this posture. (15 points)

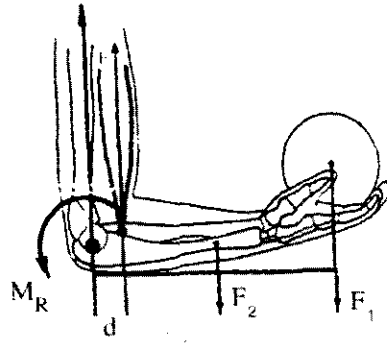


Figure 1 : position of upper and lower arm for Question #5.

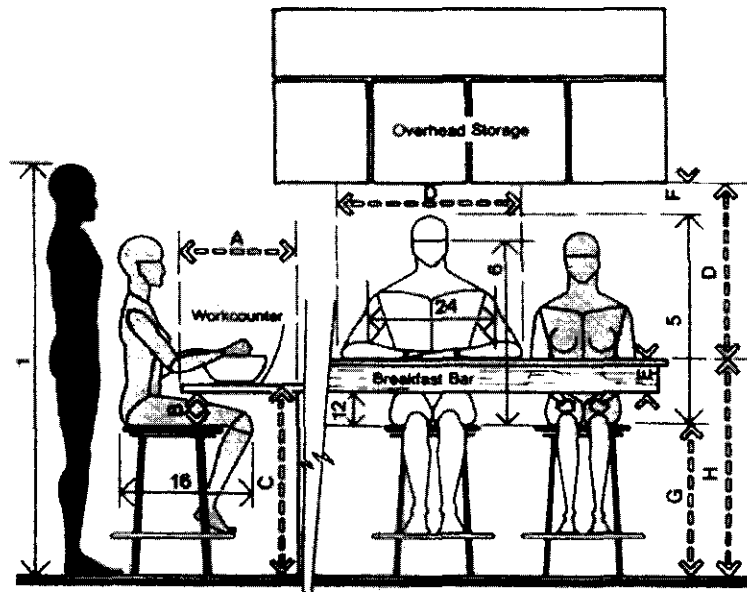
6. Cartons weighing 30 lbs are to be picked up from the floor and placed on a roller conveyor 24" above floor level. Hand holds are located 18" above the floor and 12" forward of the midpoint of the worker's ankles. The number of lifting is around 200 lifts in one and a half hours and the task duration is assigned at 3 hours. Find the AL, MPL and show your comment on this task. [Hint: Tables on page 6 might be needed.] (20 points)
7. According to the data in Table 1, please suggest the appropriate distances of C, D and G which are shown in Figure 2. (20 points)

ANTHROPOMETRY OF FEMALE WORKERS (CM)
(AGE 17-55 YEAR, N = 250)

ANTHROPOMETRY	MEAN	STD	MIN	MAX	5TH	10TH	90TH	95TH
WEIGHT (Kg)	53.06	8.18	35.00	79.00	39.61	42.58	63.55	66.52
STATURE	151.20	4.82	140.00	170.40	143.29	145.02	157.38	159.70
ACROMION HEIGHT	124.68	4.88	114.37	155.43	116.65	118.42	130.93	132.70
BIDELTOID BREADTH	37.14	2.55	26.33	45.33	32.94	33.87	40.41	41.33
BICEPS CIRCUMFERENCE, FLEXED	26.37	3.51	20.00	37.33	20.59	21.87	30.87	32.15
BUTTOCK-POPLITEAL LENGTH	42.86	3.39	31.57	71.37	37.28	38.51	47.21	48.44
BUTTOCK-KNEE LENGTH	51.58	2.78	44.57	67.60	47.01	48.02	55.14	56.15
CALF CIRCUMFERENCE	33.56	3.01	20.70	45.20	28.62	29.71	37.42	38.51
CERVICAL HEIGHT	128.21	5.90	117.73	153.46	118.51	120.65	135.77	137.92
1. CHEST CIRCUMFERENCE AT SCYE	84.84	10.00	60.86	114.10	68.18	71.82	97.46	101.09
1. ELBOW TO CENTER OF GRIP	31.19	2.16	25.23	45.07	27.64	28.43	33.96	34.74
2. ELBOW-TO-ELBOW BREADTH	39.47	4.12	30.30	53.00	32.69	34.19	44.75	46.25
3. ELBOW-FINGERTIP LENGTH	41.34	2.14	30.20	47.90	37.81	38.59	44.09	44.87
4. FACE BREADTH (BIZYGOMATIC)	11.20	0.68	9.16	17.83	10.08	10.33	12.07	12.31
5. FACE LENGTH (SELLION-MENTON)	17.42	1.17	14.30	24.06	15.49	15.92	18.93	19.35
5. FOOT BREADTH	8.73	0.77	6.83	11.16	7.46	7.74	9.72	10.00
7. FOOT LENGTH	22.23	2.05	15.53	32.26	18.95	19.70	24.94	25.68
8. FOREARM CIRCUMFERENCE, FLEXED	24.21	2.43	18.70	39.36	20.22	21.10	27.32	28.20
9. FUNCTIONAL REACH	67.93	5.38	55.50	81.53	59.07	61.03	74.82	76.78
0. FUNCTIONAL REACH, EXTENDED	75.69	5.01	60.50	87.36	67.46	69.28	82.11	83.93
1. HAND BREADTH	7.35	0.51	5.86	9.10	6.51	6.70	8.00	8.18
2. HAND LENGTH	16.96	3.29	14.57	67.56	11.55	12.74	21.18	22.37
3. HEAD CIRCUMFERENCE	52.91	2.26	35.33	65.40	49.19	50.01	55.80	56.62
4. HEAD LENGTH	17.03	0.68	15.40	18.83	16.04	16.16	17.90	18.02
5. HIP CIRCUMFERENCE	92.40	9.19	68.50	120.20	77.28	80.62	104.17	107.51
6. INTERSCYE, BACK	68.75	8.11	45.43	98.27	55.40	58.35	79.15	82.09
7. KNEELING HEIGHT	113.00	4.88	97.53	127.10	104.97	106.74	119.26	121.03
8. NECK CIRCUMFERENCE (BASED)	31.00	2.77	24.60	42.60	26.44	27.55	34.55	35.56
9. OVERHEAD REACH BREADTH	31.73	2.26	22.73	43.36	28.01	28.83	34.63	35.45
0. OVERHEAD REACH HEIGHT	183.12	6.12	166.27	200.66	173.04	175.27	190.97	193.19
1. POPLITEAL HEIGHT	37.99	2.00	31.53	44.50	34.70	35.43	40.55	41.27
2. SHOULDER CIRCUMFERENCE	96.18	8.08	76.17	118.33	82.89	85.82	106.54	109.48
3. SHOULDER-ELBOW LENGTH	31.89	1.55	26.56	36.43	29.34	29.90	33.88	34.45
4. SHOULDER LENGTH	11.88	1.50	8.33	22.36	9.42	9.96	13.79	14.33
5. SITTING HEIGHT	78.77	3.16	71.60	97.17	73.57	74.72	82.81	83.96
6. SITTING THIGH BREADTH	31.59	2.57	24.16	41.70	27.36	28.30	34.89	35.83
7. UPPER THIGH CIRCUMFERENCE	50.71	6.38	35.00	78.30	40.22	42.53	58.88	61.20
8. VERTICAL TRUNK CIRCUMFERENCE	146.45	10.60	113.43	178.83	129.01	132.86	160.03	163.88
9. WAIST CIRCUMFERENCE (NATURAL)	73.22	10.37	46.50	97.77	56.15	59.92	86.52	90.28
0. WAIST BACK LENGTH	38.19	4.45	26.80	89.73	30.88	32.49	43.89	45.51
1. WAIST FRONT LENGTH	32.90	2.77	20.70	40.73	28.35	29.35	36.44	37.45
2. WAIST HEIGHT	92.70	4.89	65.13	110.20	84.65	86.43	98.96	100.74

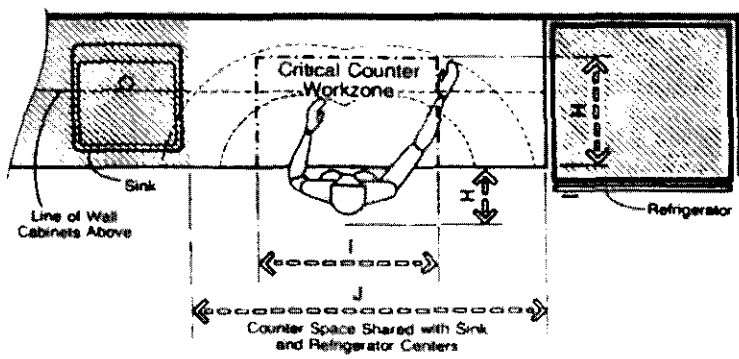
Table 1: Anthropometric data for Question # 7.

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WORKCOUNTER

BREAKFAST BAR



MIX AND PREPARATION CENTER

Figure 2: For Question # 7.

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Frequency Multiplier Table (FMD)

Frequency Lifts/min (F) †	Work Duration					
	≤ 1 Hour		>1 but ≤ 2 Hours		>2 but ≤ 8 Hours	
	V < 30 ‡	V ≥ 30	V < 30	V ≥ 30	V < 30	V ≥ 30
≤0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
>15	.00	.00	.00	.00	.00	.00

†Values of V are in inches. ‡For lifting less frequently than once per 5 minutes, set F = .2 lifts/minute.

**Table 7
Coupling Multiplier**

Coupling Type	Coupling Multiplier	
	V < 30 inches (75 cm)	V ≥ 30 inches (75 cm)
Good	1.00	1.00
Fair	0.95	1.00
Poor	0.90	0.90

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