

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** : 225-602 Human Factors Engineering

**Room** : A 401

ทูลจร็ดในการสอบ โทษขันด่ำปรบดกในรายวิชานั้น  
และพัทการเรียน 1 ภาคการศึกษา

**DIRECTIONS :**

1. Only short note on an A4 piece (both sides), dictionary and calculator are allowed.
2. 22 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 skeletal system of human being and show me the position of :-

3.2 Humerus

3.3 Radius

3.4 Ulna

3.6 Femur

3.7 Lumbar 5/ Sacrum 1

(15 points)

2. What are the roles of glucose and oxygen on muscular work.

(Hint: clear diagram should be shown.) (10 points)

3. What is the circadian fatigue? How does it affect to work performance?

(10 points)

4. There are six functional states which the human organism could claim in any moment. These states vary from *the extreme of sleep* to a *state of alarm*. Show the names of all six states and the recommended state for a man before start working. (5 points)

5. Compare five differences of *the capacity and limitation of human and machine* in working systems. (10 points)

*According to the statements from item 6 to 18, some of them are true and some are false. Please read and analyze carefully then put the letter "T." for the true item and put "F" for the false one in your answer book. (15 points)*

*( you will get 1 point if your answer is correct.*

*you will get -1 point if your answer is not correct.*

*you will get 0 point for the blank item.)*

6. The mandible is the only movable bone in the adult skull.

7. Tendons are the cords or bands, which attach the muscles to the bones.

8. Ligaments are the strong, flexible bands that hold the short bones to the long bones.
9. During muscle contraction, mechanical energy is developed at the expense of the reserves of chemical energy in the muscle.
10. The source of energy most widely used by living organisms is adenosine di-phosphate.
11. The low-energy phosphate compounds are continuously converted back to high-energy state in the muscles with consuming energy gained from digested foodstuffs.
12. Static effort is characterized by an alternation of contraction and extension, or tension and relaxation.
13. A muscle performing dynamic work is flushed with blood and retains the energy-rich sugar and oxygen contained in it, while at the same time waste products are removed.
14. "Tilting the head strongly forwards or backwards" is an example of rhythmic effort.
15. "Putting the weight on one leg while the other works a pedal" is an example of postural effort.
16. The static work can be maintained for several hours per day without symptoms of fatigue if the force exerted does not exceed about 20% of the maximum force of the muscle involved.
17. Avoiding static efforts, including standing or sitting still over long periods of time, is an important human engineering task.
18. One guideline for work layout is " Avoid keeping an arm outstretched either forwards or sideways."



19. Since natural postures and natural movements are necessary part of efficient work, it is essential that the workplace should be suited to the body size and mobility of the operator.

20. For standing work, both pulling and pushing forces are greatest in the horizontal plane and lowest in the vertical plane.

21. A carton weighing 40 kg is being picked up from floor by Mr. Gorge. His posture is shown in Figure 1—the angle between upper body line and the horizontal level is 0 (zero) degree. At hip joint, the Femur bends at 60 degree angle with the horizontal line. At the L5/S1 joint, the trunk makes a 30 degree angle with the horizontal line. The distances of B and H in the figure are given-- H = 0.3 m, and B = 0.2 m.

If it is found that the moment produced at hip joint is 150 N-m and then resulted in his intra-abdominal pressure of  $0.3 \text{ N/cm}^2$  while Gorge is lifting the object. The weight of his upper-body part is 25 kg and cross section area of inter-abdomen is  $460 \text{ cm}^2$  ( $D_a = 460 \text{ cm}^2$ ).

- a) Calculate the abdominal force ( $F_a$ ). (2 points)
- b) Calculate the muscle force ( $F_m$ ). (3 points)
- c) Calculate the reaction force at L5/S1 joint. (5 points)
- d) Show your comment on this task and your suggestion for improving this lifting work. (10 points)

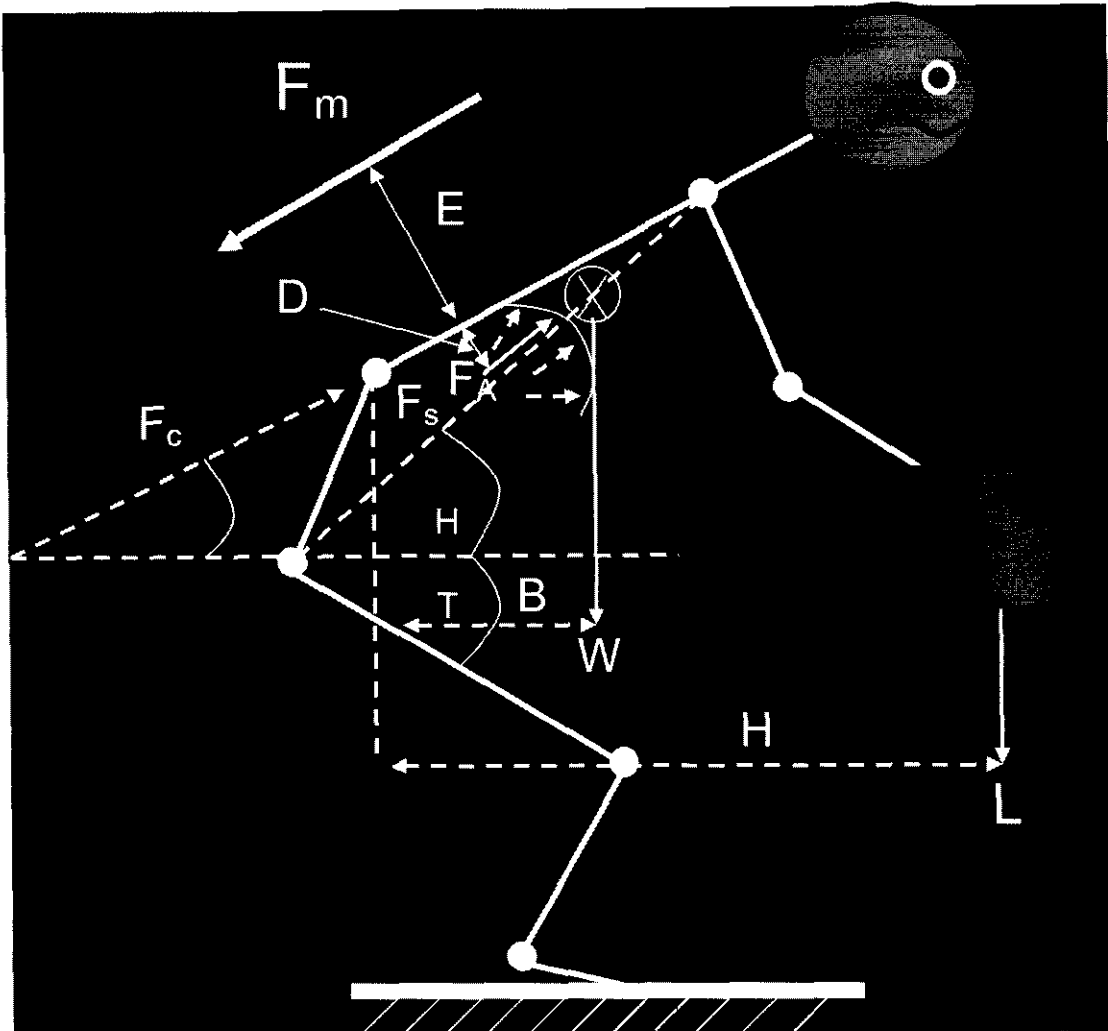


Figure 1: The posture of Mr. Gorge for Question # 21.

22. Cartons weighing 40 lbs are to be picked up from the floor and placed on a roller conveyor 20" above floor level. Hand holds are located 18" above the floor and 15" 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. (15 points).

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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