

National Exams May 2002
98-Ind-B5, Ergonomics

Name: _____

Instructions:

- ◆ There are five (5) pages to this exam with two (2) parts and a total of seven (7) questions. You must answer all of the 7 questions.
- ◆ Complete all questions on the exam provided. If additional space is required, use the extra pages included with the exam.
- ◆ This is an open book exam; all notes, books and a computer/calculator are permitted.
- ◆ Answer all question in the exam booklets provided. Please use point form to answer all questions.
- ◆ If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made;
- ◆ Any non-communicating calculator is permitted.
- ◆ No pagers, cellular telephones, Blackberries or other communication devices are permitted in this exam.
- ◆ The numbers in brackets indicate the marks assigned to each part of the question.

Marking Scheme

<i>Question Number</i>	<i>Total Possible</i>	<i>Grade</i>
Part A: General		
1.	7 marks	
2.	12 marks	
3.	8 marks	
4.	8 marks	
5.	15 marks	
6.	15 marks	
Part B: Case Study	35 marks	
Total	100 marks	

Part A: Medium Answer Questions.

[7 marks] 1. Fitts Law

- a) [2] Explain and illustrate Fitts Law.
- b) [5] Discuss the limitations of Fitts Law (e.g., where it can be applied and where it cannot).

[12 marks] 2. You have been asked to create a new control and display system for a vending machine that would dispense hot and cold drinks. The vending machine would be located in public spaces, and the control and display system should accommodate a wide range of users (children, adults, people with various disabilities).

- a) [2] Generate a list of typical tasks that users would carry out with this device.
- b) [10] Create a paper mock-up of the control and display system for the vending machine. Ensure that you can accommodate as many potential users as possible (e.g., you need alternatives for each control and display). Justify your reasoning for each design decision.

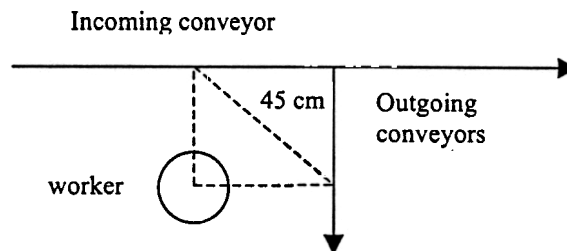
[8 marks] 3. Discuss the following quote with respect to human error, accident prevention, and designing safe products and controlling hazards.

“it is easier to bend metal than to twist arms” (Sanders & McCormick, 1993)

[8 marks] 4. List four factors that contribute to repetitive strain injuries (RSI), and how each factor contributes to RSI.

[15 marks] 5. Determine the NIOSH recommended weight limit (RWL) and Lifting Index for the following situation:

A worker unloads parcels (e.g., postal parcels such as gifts, mail-order merchandise, bulk literature, etc.), maximum weight is 10 kgs, from an incoming conveyor. The incoming conveyor is at a height of 91 cm. The worker transfers the parcels onto one of two conveyors based on the destination label on the parcel. Parcels arrive at a speed of 20 per minute. Each conveyor leads to a truck heading to a destination. Conveyor 1 is located at a level of 121 cm, conveyor 2 is located at a level of 161 cm directly above conveyor 1. Conveyors 1 and 2 are located 90° to the incoming conveyor (see diagram for dimensions). The horizontal distance between the hands while lifting and the mid-point between the ankles is 45 cm. The average vertical distance of the hands from the floor is 111 cm. The maximum height of a parcel is 20 cm and the worker can usually grasp the parcel ¼ of the way down from its top but the grasp is only fair due to the inconsistent size and orientation of the incoming parcels. It is estimated that the worker must twist his or her torso about 80° while transferring a parcel from the incoming to highest outgoing conveyor.



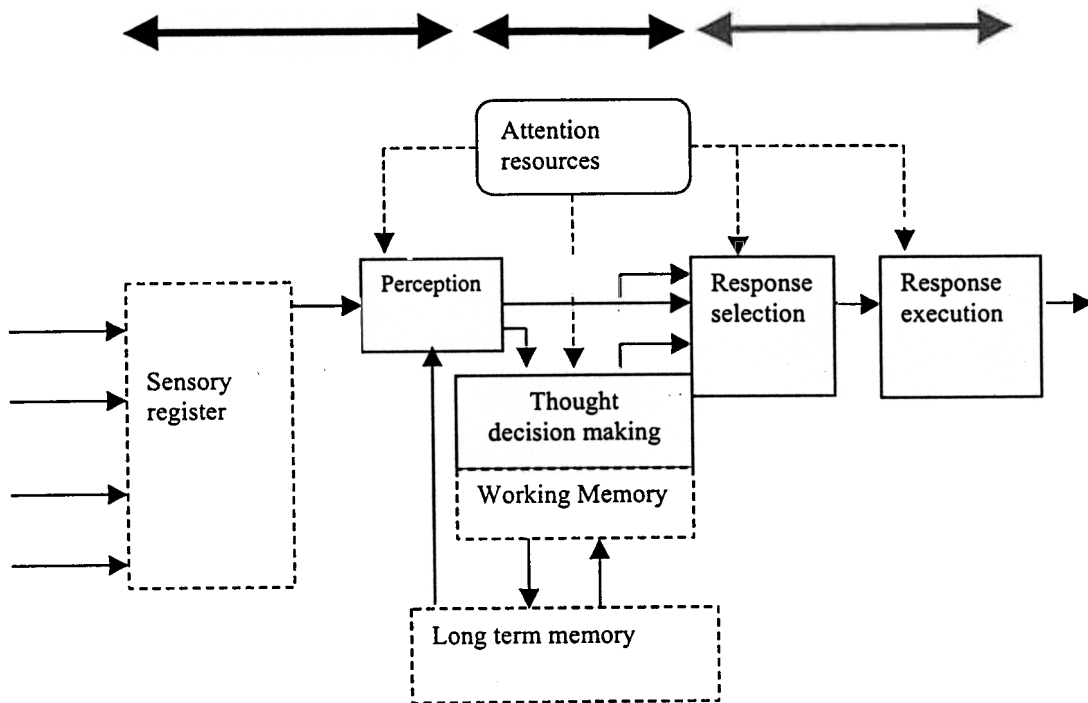
a) [12] Analyze this lifting scenario using the RWL and Lifting Index. Use an illustration.

Note: the NIOSH equation is

$$\text{RWL} = \text{Load Constant (LC)} + \text{Horizontal Multiplier (HM)} + \text{Vertical Multiplier (VM)} + \text{Distance Multiplier (DM)} + \text{Asymmetric Multiplier (AM)} + \text{Coupling Multiplier (CM)} + \text{Frequency Multiplier (FM)}$$

b) [3] If there are problems identified through your analysis, provide one recommendation to solve each problem that you have identified.

[15 marks] 6. This is part of a typical model of human information processing.



- a) [3] Identify and label the missing components.
- b) [4] Explain how this model represents the human cognitive processing system (ensure you describe the function of each component).
- c) [8] Describe how this model explains the cognitive work performed by the parcel handler in Question 5.

[35 marks] Part B: Case study

You have been asked to advise a university on the design of a classroom to accommodate student laptop computers. Students are required to lease and use laptops during class to augment their learning experience. Classes are to be delivered as hands-on practice and as lecture style. It is expected that students with laptops will spend between four and six hours per day in this classroom. Student demographics include: standing stature ranging between 150 - 200 cm and wheelchair users, weight between 45 – 100 kg, age range between 18 and 65 years, and there are male and female students.

The laptops will be loaded with appropriate software and hardware including wireless network capabilities. Assume that the classroom is being completely renovated and you are to advise the project manager on all aspects of ergonomics from physical to environmental. Use diagrams to illustrate your answers.

- a) [5] Describe the types of tasks that students would be carrying out.
- b) [10] Provide recommendations on physical ergonomic accommodations that would be suitable for students. Justify your recommendations. Provide a sketch of an example workstation and label the dimensions (including any required ranges of adjustment). Also, indicate on your sketch the population proportion that you believe will be satisfactorily accommodated by these dimensions.
- c) [10] Provide recommendations on environmental conditions that must be considered for this classroom. Identify the important variables to measure/track for each condition and how these are measured (e.g., instruments used, units of each variable). Specify how to determine the appropriate level of each condition for this workplace. Factors that might influence comfort level for each condition over time and what accommodations must be provided to account for these deviations. Provide examples.
- d) [10] Describe the evaluation process you would carry out during/after the renovation process to ensure that the accommodations are successful. Ensure that you specify what type of evaluation to use at what time during the renovation. Justify the timing and the methodologies selected.