



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

COURSE NAME : HUMAN FACTOR ENGINEERING  
COURSE CODE : BDD 41103  
PROGRAMME CODE : BDD  
EXAMINATION DATE : JULY 2022  
DURATION : 3 HOURS  
INSTRUCTION : 1. ANSWER ANY **FIVE (5)** FROM **SIX (6)**  
QUESTIONS PROVIDED  
2. THIS FINAL EXAMINATION IS A **ONLINE**  
ASSESSMENT AND CONDUCTED VIA  
**OPEN BOOK**

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THIS PAPER CONSISTS OF **EIGHT (8)** PAGES

**Additional instruction:** Some questions use the last three-digit (L3D) value of individual student matrix number. For example, if the matrix number is CD180023 then the L3D value is 23 (since the last three digits is 023). Some data require multiplication of the L3D value, for example 10(L3D) means 10 x L3D.

**Q1 (a)** The word ergonomics comes from the Greek word “ergon” which means work and “nomos” which means laws. It’s essentially the “laws of work” or “science of work”. According to the International Ergonomics Association (IEA), there are three broad domains of ergonomics: physical, cognitive, and organizational. Differentiate each of the three broad domains of ergonomics by providing detail explanations how they can be achieved. Use appropriate examples to support your explanations.

(9 marks)

**(b)** Anthropometry is the science that defines physical measures of a person's size, form, and functional capacities.

**(i)** Compare between the static (*structural*) dynamic (*functional*) anthropometry.

(4 marks)

**(ii)** Determine the important of anthropometry in term of designs and demonstrate **THREE (3)** examples related to normal anthropometric measurements of a workforce.

(7 marks)

**Q2 (a)** Lifting has been the subject of research for many years. The reasons that triggered this interest in lifting are its believed association to low back pain. **Figure Q2(a)** shows a low-back biomechanical model of static coplanar lifting and given the following the kinematic and anthropometric data as shown in **Table 1**. Taking a moment around L5/S1 joint and equating it to zero, analyze and evaluate the muscle force ( $F_m$ ), Spine compressive force ( $F_c$ ), and spine shear force ( $F_s$ ).

(8 marks)

**Table 1:** Kinematic and anthropometric data

Items	Value
Load in hand	450 N
Upper body weight above L5/S1 joint	350 N
Distance of erector spinae muscle from the center of spine (E)	6.5 cm
distance of the load from the center of spine at L5/S1 (h)	30 cm
distance of the upper body center of gravity from center of spine at L5/S1 joint (b)	20 cm
Upper body angle with horizontal ( $\alpha$ )	55°



- (b) Cumulative trauma disorders (CTDs) refer to physical signs and symptoms due to chronic musculoskeletal injuries where the causes appear to be related to aspects of repetitive work. Employers should train their employees in the signs and symptoms of CTDs so that they can recognize problems before they progress into more serious injuries. Evaluate and recommend the best treatment for CTDs by providing detail explanations how they can be achieved. Use appropriate examples to support your explanations.

(8 marks)

- (c) In 2008, under Department of Occupational Safety and Health (DOSH) Malaysia has establish the Guidelines for Manual Handling at Workplace. These Guidelines are intended to assist employer, employee, occupational safety and health practitioner and others in identifying and recognizing the risk involving manual handling tasks as well as to provide information on how to choose the effective options to reduce the risks. Create and develop a flowchart process overview of initial manual handling risk assessment according to this guideline.

(4 marks)

- Q3** (a) Heat stress can increase stress and fatigue which can lead to serious health conditions for workers working in hot environments and may increase workplace accidents. Explain and describe **TWO (2)** legal requirements that related to Heat Stress Management at Workplace in Malaysia.

(4 marks)

- (b) Hearing loss is a common problem caused by noise, aging, disease, and heredity. People with hearing loss may find it hard to have conversations with friends and family. Proposed and recommend **SIX (6)** best ways to reduce hearing loss at workplace.

(6 marks)

- (c) Zamri has workers as packers with manual assembly process that required he movements above the shoulder and bending his hips and waist while access materials such as labels or bubble wrap rolls beneath the work surface as shown in **Figure Q3(c)**. He forced to bend down to access the materials, which is one of the most problematic work positions, particularly if any weight or physical manipulation below the waist is involved. Design and propose an ergonomic workstation in term of eliminating extreme movements and bending posture while performing his work activity.

(10 marks)

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**Q4**

**Table 2** shows the hand discomfort data due to repetitive use of hand tools particularly those that compress the palm of the hand and are held with a pinch or precision grip may result in the development of carpal tunnel syndrome and other musculoskeletal disorders of the hand, wrist, and arm.

**Table 2:** Hand discomfort data due to repetitive use of hand tools

Area	Experience ache, pain and discomfort	Uncomfortable level	Interference level
A	4 times	Slightly	Not at all
B	3 times	Moderate	Substantially
C	Several times	Moderate	Slightly
D	1-2 times	Very	Slightly
E	Once Every day	Very	Substantially
F	2 times	Slightly	Not at all

**Table 3:** Weighting rating scores and multiplying frequency score

Frequency score (0,1.5 , 3.5, 5, 10)	Never = 0 1-2 times/week = 1.5 3-4 times/week = 3.5 Once Every day = 5 Several times every day = 10
Discomfort score (1,2,3)	Slightly = 1 Moderate = 2 Very = 3
Interference score (1,2,3)	Not at all = 1 Slightly = 2 Substantially = 3

- (a) Determine and explain **FOUR (4)** work factors can affect the health and performance of hand tool users. (4 marks)
- (b) Using Cornell Hand Discomfort Questionnaires (CHDQ) as shown in **Figure Q4(b)**, assess and analyze hand discomfort data. (6 marks)
- (c) By using weighting rating scores and multiplying frequency score as shown in **Table 3**, evaluate and analyze the final score. (6 marks)
- (d) Proposed and develop **FOUR (4)** tips for better power tool ergonomics (4 marks)

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**Q5**

**Table 4** shows the data for critical measurements of the lifting task. NIOSH developed the Lifting Equation to help predict the risk of lifting injuries. The Lifting Equation defines a Lifting Index (LI) based on the Recommended Weight Limit (RWL) for specific lifting tasks that most workers could perform in an eight-hour day without increasing the risk of developing low back pain.

**Table 4:** Critical measurements of the lifting task

Item	Value	Factor
Horizontal Distance (H)	40cm	0.63
Vertical Multiplier (VM)	50cm	0.93
Distance Multiplier (DM)	100cm	0.87
Asymmetric Multiplier (AM)	60 degrees	0.81
Frequency Multiplier (FM)	One hour (lifting while standing) with 30 sec time between lifts	0.91
Coupling Multiplier (CM)	Fair (lifting while standing)	1.0
Weight	23kg + L3D	

- (a) Determine and justify when should be used the NIOSH Lifting Equation. (4 marks)
  
- (b) The Lifting Equation defines a Recommended Weight Limit (RWL), a recommendation of the heaviest load a healthy worker could lift without increasing the risk of developing low back pain. Develop and create the formula to calculate RWL with six critical measurements of the lifting task. Use appropriate sketch to support your explanations. (6 marks)
  
- (c) Based on **Table 4**, evaluate and analyze the Recommended Weight Limit (RWL). Use the last three-digit (L3D) value of individual student matrix number for weight 23kg + L3D (6 marks)
  
- (d) Based on result **Q5(c)**, develop and recommend the **FOUR (4)** suggestions to improve manual lifting at workplace. (4 marks)

**Q6**

An ergonomic assessment, also called an ergonomic risk assessment (ERA), is an objective measure of the risk factors in your work environment that may lead to musculoskeletal disorders or injuries among your workforce. In Malaysia, an ergonomics assessor known as an Ergonomic Trained Person (ETP) that recognized by Department of Occupational Safety & Health (DOSH).

- (a) Describe and explain **FOUR (4)** duties and responsibilities of an Ergonomics Trained Person (ETP).  
(4 marks)
- (b) There are two approaches for initiating an Ergonomic Risk Assessment (ERA) including proactive and reactive approach. Create and develop a framework for ERA by providing detail explanations how they can be achieved.  
(6 marks)
- (c) Compare and differentiate between Initial ERA and Advanced ERA in term of an Ergonomic Trained Person (ETP).  
(4 marks)
- (d) All ERA activities, information and outcomes should be finalized and documented in the form of a report. Construct and determine the content of Initial ERA and Advanced ERA report.  
(6 marks)

- END OF QUESTION -

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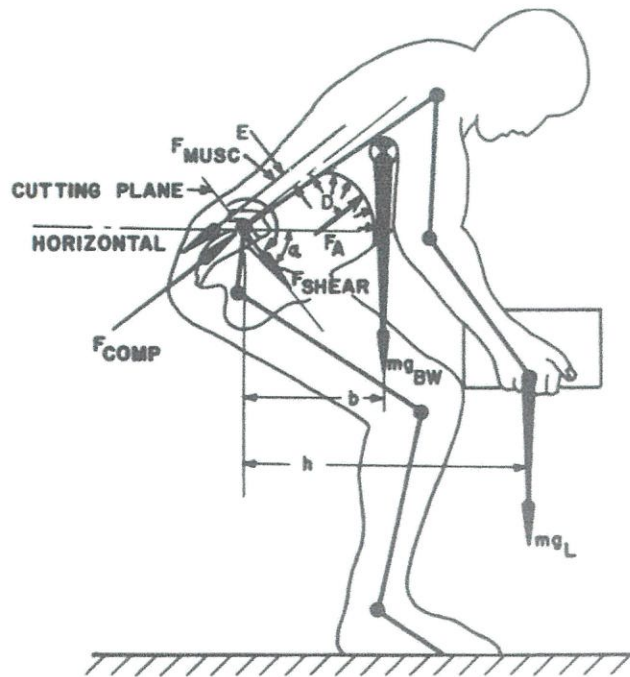


Figure Q2(a)

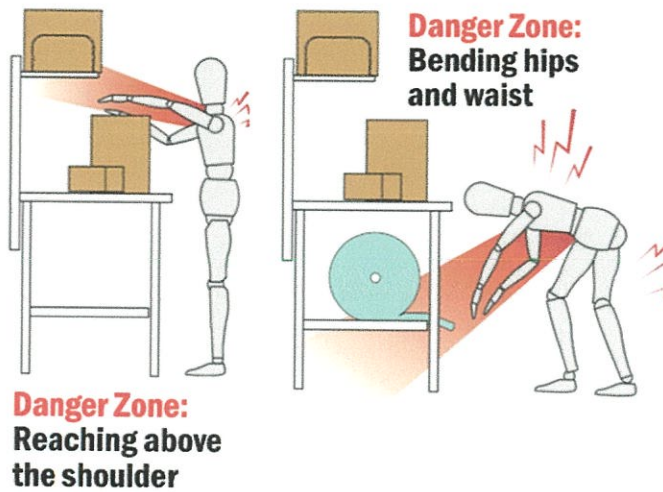


Figure Q3(c)

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The shaded areas in the diagrams below show the position of the body parts referred to in the questionnaire. Please answer by marking the appropriate box.

**Complete only for RIGHT HAND**

	Never	1-2 times last week	3-4 times last week	Once every day	Several times every day	Slightly uncomfortable	Moderately uncomfortable	Very uncomfortable	Not at all	Slightly interfered	Substantially interfered
Area A (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area B (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area C (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area D (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area E (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Area F (Shaded area)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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**Figure Q4(b)**

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