Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2018/2019

| | | |
|---|---|---|
| COURSE NAME | : | ERGONOMICS & ANTHROPOMETRICS |
| COURSE CODE | : | BPP 10202 |
| PROGRAMME CODE | : | BPP |
| EXAMINATION DATE | : | JUNE / JULY 2019 |
| DURATION | : | 2 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS |

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

**Q1** (a) Defined static anthropometry.

(2 marks)

(b) State the importances of anthropometrics data for a design engineer.

(5 marks)

(c) Ministry of Education planned to build more primary schools inline with population growth of Malaysian. These schools will be equipped with science laboratories. Basic furniture in the labs are workbenches but there were lot of complaints from the teachers about the height from the previous projects as shown in **Figure Q1(a)** and **Figure Q1(b)**. Please refer **APPENDIXES I and II.**

(i) Explain the problems occurred for both design as shown in **Figure Q1(a)** and **Figure Q1(b)**.

(5 marks)

(ii) Suggest appropriate design to overcome the problems stated in **Q1(c)(i)**.

(8 marks)

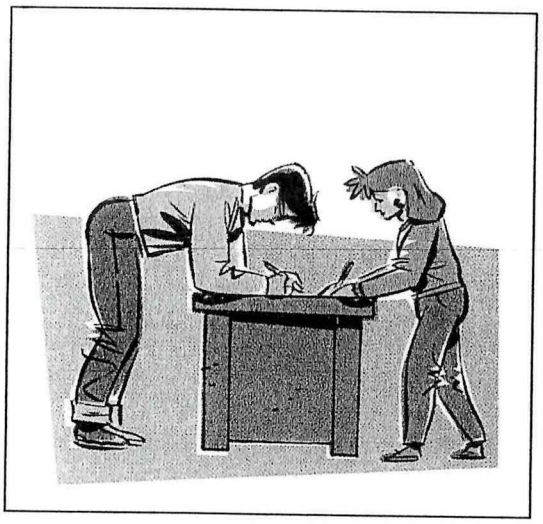


**Figure Q1(a)**

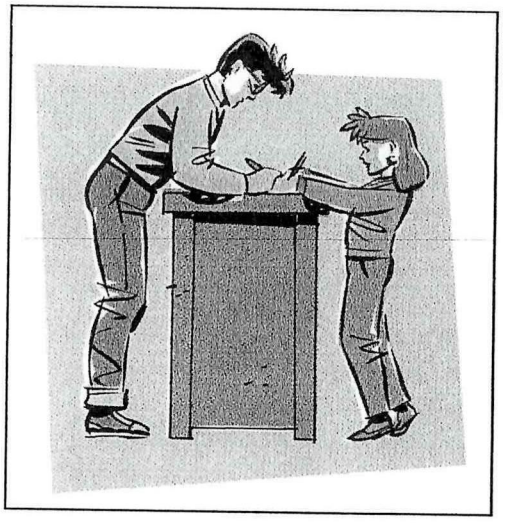


**Figure Q1(b)**

**Q2** Zahid is a worker in packaging department at Kimberly Clark plant, Kluang. He is involved in a task which involves occasional box lifting at bench height and above at a rate of F = 6/min. The horizontal location of the box is 40 cm in front of the mid foot position. The vertical distance lifted is 30 cm, and the starting height is 100 cm above the floor.

(a) Calculate the maximum allowable load (kg) which should be lifted, using the revised NIOSH equation (1991) for the Recommended Weight Limit (RWL):

$$RWL = 23\ \{25/H\}\{1 - (0.003\ |V-75|)\}\{0.82 + 4.5/D\}\{FM\}\{CM\}\{1 - (0.003A)\}$$

Assume that the total time spent lifting does not exceed one hour/day, the boxes afford a good grip, and the lift is symmetrical.

(6 marks)

(b) Calculate the maximum allowable load (kg) which should be lifted, using the original NIOSH Action Limit equation:

$$AL\ (kg) = 40\ (15/H)\ [1 - (0.004\ |V - 75|)]\ (0.7 + 7.5/D)\ (1 - F/F_{max})$$

Assume $F_{max} = 18$

(6 marks)

(c) Suggest **THREE (3)** good postures and positions (sketching) for Zahid to complete the lifting task; start, during and end of the process.

(8 marks)

**Q3** (a) Stress comes in a variety of forms from a variety of causes, and exhibits a variety of symptoms.

(i) Define stress.

(2 marks)

(ii) Discuss **TWO (2)** environmental stressors which may affect on worker's current performances.

(8 marks)

(iii) Kin Yuen work as a machine operator which requires physical work. He works on 8-hour shift basis. Energy-expenditure rate of his physical work is 6.5 kcal/min. NIOSH-recommended 8-hour work capacity limits are 5 kcal/min for healthy males.

Calculate rest period as a fraction of total work time.

Given $R = \dfrac{(PWC - E_{job})}{(E_{rest} - E_{job})}$

PWC = physical work capacity
$E_{job}$ = energy-expenditure rate required to perform the job
$E_{rest}$ = energy-expenditure rate at rest (1.5 kcal/min for seated rest)

(4 marks)

(iv) Calculate total rest period on 8-hour shift.

(2 marks)

(b) The result of extensive research on work physiology have shown that energy expenditure rate of a work is linearly related to the amount of oxygen consumed by the body and to heart rate. Heart rate, the number of heart beats per minute, is commonly used physiological measure of physical workload.

Explain the relationship between heart rate and physical workload.

(4 marks)

**Q4** (a) The musculoskeletal system has about 400 muscles, which make up about 40 to 50 percent of the body weight.

(i) Explain what are muscles made of.

(5 marks)

(ii) Discuss the function of muscles.

(5 marks)

(b) The following population extremes can influence the design of facilities and equipments:

- $5^{th}$ percentile woman
- $95^{th}$ percentile woman
- $5^{th}$ percentile man
- $95^{th}$ percentile man
- $50^{th}$ percentile member of the population

Determine the number of the preceding population extreme that most influences the designs listed in **Q4(b)(i)** to **Q4(b)(v)**. Briefly explain on your selection.

(i) Light rapid transit (LRT) door.

(2 marks)

(ii) Commercial airline jet (i.e. Boeing 747 aircraft) aisle.

(2 marks)

(iii) Height of the supermarket cashier counter.

(2 marks)

(iv) Maximum shelf height for women's lockers.

(2 marks)

(v) Height of baby cot.

(2 marks)

**Q5** (a) System designers have classified three levels of alerts – warnings, cautions and advisories. Differentiate between all levels with appropriate examples and sketches.

(12 marks)

(b) Explain **THREE (3)** principles that designers may consider when designing multiple displays.

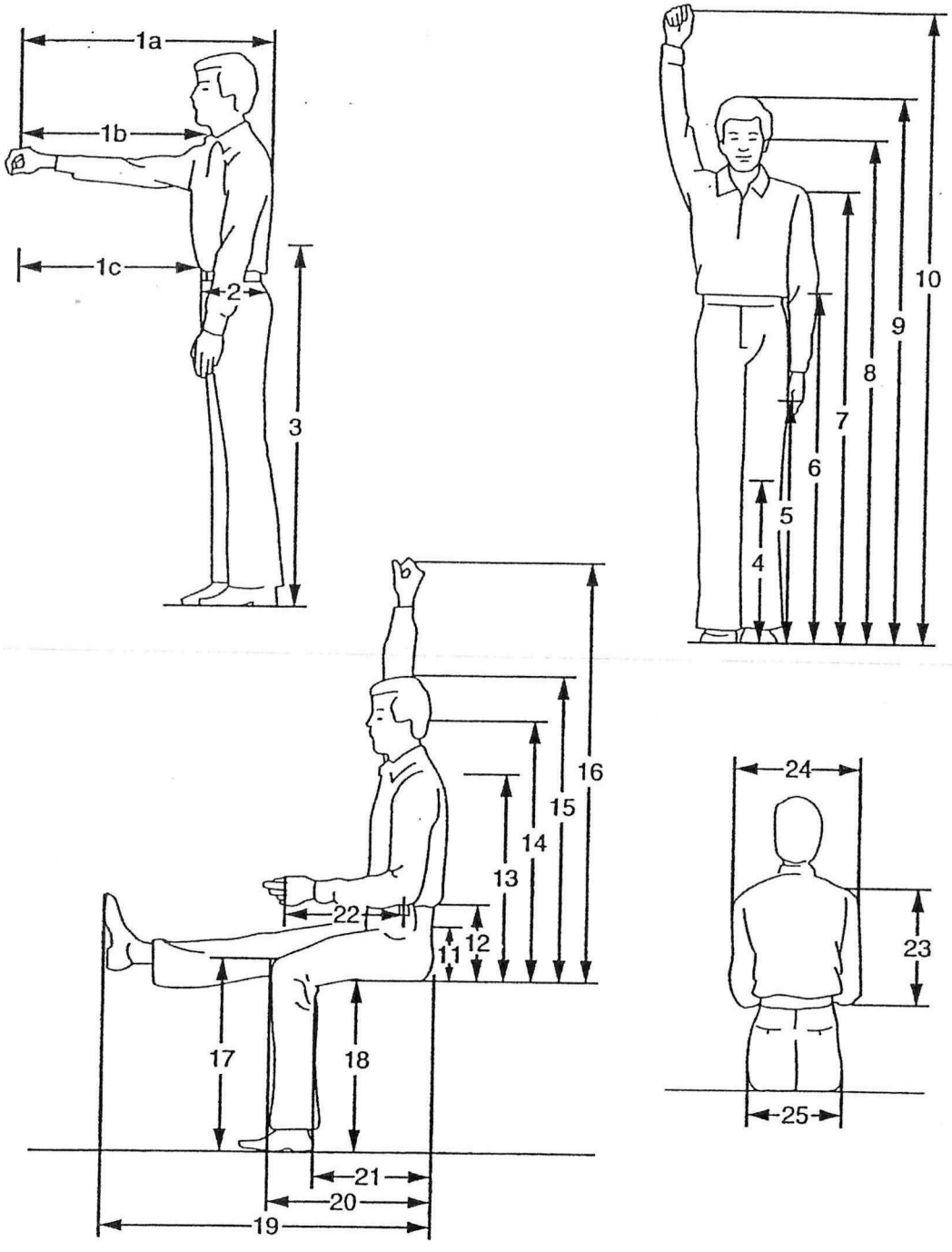
(8 marks)

**- END OF QUESTIONS –**

**EXAMINATION**

SEMESTER / SESSION : SEMESTER II /2018/2019
COURSE : ERGONOMICS & ANTHROPOMETRICS

PROGRAM CODE: BPP
COURSE CODE: BPP10202



**FINAL EXAMINATION**

SEMESTER / SESSION : SEMESTER II /2018/2019 PROGRAM CODE : BPP
COURSE : ERGONOMICS & ANTHROPOMETRICS COURSE CODE: BPP 10202

| | *Males* | | *Females* | | *Population Percentiles, 50/50 Males/Females* | | |
|---|---|---|---|---|---|---|---|
| *Measurement* | *50th percentile* | *±1S.D* | *50th percentile* | *±1S.D.* | *5th* | *50th* | *95th* |
| **Standing** | | | | | | | |
| 1. Forward Functional Reach | | | | | | | |
| a. includes body depth | 32.5 | 1.9 | 29.2 | 1.5 | 27.2 | 30.7 | 35.0 |
| at shoulder | (31.2) | (2.2) | (28.1) | (1.7) | (25.7) | (29.5) | (34.1) |
| b. acromial process to function pinch | 26.9 | 1.7 | 24.6 | 1.3 | 22.6 | 25.6 | 29.3 |
| c. abdominal extension to functional pinch | (24.4) | (3.5) | (23.8) | (2.6) | (19.1) | (24.1) | (29.3) |
| 2. Abdominal Extension Depth | 9.2 | 0.8 | 8.2 | 0.8 | 7.1 | 8.7 | 10.2 |
| 3. Waist Height | 41.9 | 2.1 | 40.0 | 2.9 | 37.4 | 40.9 | 44.7 |
| | (41.3) | (2.1) | (38.8) | (2.2) | (35.8) | (39.9) | (44.5) |
| 4. Tibial Height | 17.9 | 1.1 | 16.5 | 0.9 | 15.3 | 17.2 | 19.4 |
| 5. Knuckle Height | 29.7 | 1.6 | 2.80 | 1.6 | 25.9 | 28.8 | 31.9 |
| 6. Elbow Height | 43.5 | 1.8 | 40.4 | 1.4 | 38.0 | 42.0 | 45.8 |
| | (45.1) | (2.5) | (42.2) | (2.7) | (38.5) | (43.6) | (48.6) |
| 7. Shoulder Height | 56.6 | 2.4 | 51.9 | 2.7 | 48.4 | 54.4 | 59.7 |
| | (57.6) | (3.1) | (56.3) | (2.6) | (49.8) | (55.3) | (61.6) |
| 8. Eye Height | 64.7 | 2.4 | 59.6 | 2.2 | 56.8 | 62.1 | 67.8 |
| 9. Stature | 68.7 | 2.6 | 63.8 | 2.4 | 60.8 | 66.2 | 72.0 |
| | (69.9) | (2.6) | (64.8) | (2.8) | (61.1) | (67.1) | (74.3) |
| 10. Functional Overhead Reach | 82.5 | 3.3 | 78.4 | 3.4 | 74.0 | 80.5 | 86.9 |
| **Seated** | | | | | | | |
| 11. Thigh Clearance Height | 5.8 | 0.6 | 4.9 | 0.5 | 4.3 | 5.3 | 6.5 |
| 12. Elbow Rest Height | 9.5 | 1.3 | 9.1 | 1.2 | 7.3 | 9.3 | 11.4 |
| 13. Midshoulder Height | 24.5 | 1.2 | 22.8 | 1.0 | 21.4 | 23.6 | 26.1 |
| 14. Eye Height | 31.0 | 1.4 | 29.0 | 1.2 | 27.4 | 29.9 | 32.8 |
| 15. Sitting Height, Normal | 34.1 | 1.5 | 32.2 | 1.6 | 32.0 | 34.6 | 37.4 |
| 16. Functional Overhead Reach | 50.6 | 3.3 | 47.2 | 2.6 | 43.6 | 48.7 | 54.8 |
| 17. Knee Height | 21.3 | 1.1 | 20.1 | 1.9 | 18.7 | 20.7 | 22.7 |
| 18. Popliteal Height | 17.2 | 1.0 | 16.2 | 0.7 | 15.1 | 16.6 | 18.4 |
| 19. Leg Length | 41.4 | 1.9 | 39.6 | 1.7 | 37.3 | 40.5 | 43.9 |
| 20. Upper-Leg Length | 23.4 | 1.1 | 22.6 | 1.0 | 21.1 | 23.0 | 24.9 |
| 21. Buttocks-to-Popliteal Length | 19.2 | 1.0 | 18.9 | 1.2 | 17.2 | 19.1 | 20.9 |
| 22. Elbow-to-Fit Length | 14.2 | 0.9 | 12.7 | 1.1 | 12.6 | 14.5 | 16.2 |
| | (14.6) | (1.2) | (13.0) | (1.2) | (11.4) | (13.8) | (16.2) |
| 23. Upper-Arm Length | 14.5 | 0.7 | 13.4 | 0.4 | 12.9 | 13.8 | 15.5 |
| | (14.6) | (1.0) | (13.3) | (0.8) | (12.1) | (13.8) | (16.0) |
| 24. Shoulder Breadth | 17.9 | 0.8 | 15.4 | 0.8 | 14.3 | 16.7 | 18.8 |