IE-341

Section 1, CRN: 30512/513/514

Section 2, CRN: 30515/516/517

Section 3, CRN: 46950/951/952

First Semester 1435-36 H (Fall-2014) – 3(2,1,2)

"HUMAN FACTORS ENGINEERING

Sunday, Oct 19, 2014 (25/12/1435H)

Homework 1 ANSWERS

Name:	Student Number:	Section:
	4	Sun / Mon / Wed

Place the correct LETTER in the box at the right of each question [0.5 Points Each]

1. **HF engineering concerned with dynamic human-machine interaction is called …**   `B`

    A. human capabilities

    B. ergonomics (*see slide 1-2*)

    C. human psychology

    D. human sociology

    E. anthropometry

2. **What is a "hierarchical" system?**   `E`

    A. it is a system having an immediate boundary

    B. it is a system where the components have no relation to one another

    C. it is a system consisting of only a few components

    D. it is a system that serves only one objective

    E. it is a system consisting of several levels of subsystems (*see slide 1-10*)

3. **Human Factors became a profession after** …   `E`

    A. emphasis moved from military to industry

    B. the PC revolution

    C. the *Chernobyl* disaster

    D. the first world war

    E. the second world war (*see slide 1-6*)

4. **Door that opens as soon as you approach it is an example of what type of system?**

   C

   A. manual, open-loop system

   B. semiautomatic, open-loop system

   C. automated, open-loop system (*see slides 1-9,13*)

   D. mechanical, closed-loop system

   E. manual, closed-loop system

5. **Majority of people working in HF are in …; majority of HF Society members are …**

   A

   A. private business; Psychology members (*see slides 1-9,13*)

   B. academics; Psychology members

   C. private business; Engineering members

   D. academics; Engineering members

   E. government; Psychology members

6. **What is the reliability of a system consisting of 3 components connected in *series*,**

   having respective reliabilities of 85%, 80%, 65%?

   D

   A. 98.95%

   B. 97.90%

   C. 1.05%

   D. 44.20% $Rel_{sys} = \prod_{i=1}^{n=3} Rel_{comp,i} = 0.85 * 0.8 * 0.65 = \mathbf{44.20}\%$

   E. 55.80%

7. **Repeat the previous problem with the same 3 components connected in *parallel*.**

   A

   A. 98.95% $Rel_{sys} = 1 - (1 - Rel_{comp,1})(1 - Rel_{comp,2})(1 - Rel_{comp,3})$

   $= 1 - (0.15 * 0.2 * 0.35) = 1 - 0.0105 = \mathbf{98.95}\%$

   B. 97.90%

   C. 1.05%

   D. 44.20%

   E. 55.80%

8. **The probability of *success* for an ATM machine which is operated an average of 3,000 times every month, and is known to fail 10 times in one year is …**

   A. 99.72%

   B. 99.67%

   C. 99.97% $p_{success} = \frac{n_{success}}{n_{total}} = \frac{(3000 * 12) - 10}{3000 * 12} = \frac{35,990}{36,000} = \mathbf{99.97}\%$

   D. 0.03%

   E. 0.33%

   `C`

9. **"Popliteal height" is the …**

   A. thickness of the thighs

   B. distance from the bottom of the foot to the lowest point in the elbows

   C. distance from the bottom of the foot to the highest point in the thighs

   D. distance from the bottom of the foot to the top of the knees

   E. distance from the bottom of the foot to the bottom of the thigh at the knees (*see slide 2-I-6*)

   `E`

10. **The following should decrease when converting static to dynamic anthrop. data …**

    A. hip height (*see slide 2-I-14*)

    B. elbow height

    C. sitting knee height

    D. popliteal height

    E. shoulder height (in the case of extensive motion)

    `A`

11. **It is recommended to using anthropometric data in the following order…**

    A. determine important dimensions; determine population; determine design principle (*see slide 2-I-22*)

    B. determine population; determine important dimensions; determine design principle

    C. determine design principle; determine population; determine important dimensions

    D. determine important dimensions; determine design principle; determine population

    E. determine population; determine design principle; determine important dimensions

    `A`

C

12. Research done on horizontal work surface area focuses on what main issue?

A. work surface area should allow comfortable elbow height during work

B. work surface area should allow comfortable forearm movement during work

C. work surface area should allow comfortable arm reach during work (*see slide 2-II-4*)

D. work surface area should allow comfortable hand movement during manual work

E. work surface area should allow comfortable elbow movement during manual work

Questions 13-14. Examine the table below, including recommended standing work-surface heights for different tasks and answer the questions to follow.

Type of task (standing)	Sex	in	cm
Precision work (with elbows supported)	Males	42.0–49.5	107–126
	Females	37.0–45.5	94–116
Light assembly work	Males	34.5–42.0	88–107
	Females	32.0–38.0	81–96
Heavy work	Males	31.5–39.0	80–99
	Females	29.0–35.0	74–89

13. Respectively, the 5th and 95th %ile female light assembly work-surface height is …

A. $74\ cm$; $89\ cm$

B. $89\ cm$; $74\ cm$

C. $96\ cm$; $81\ cm$

D. 81 cm; 96 cm

E. $94\ cm$; $116\ cm$

14. For Q13 above, what should be the height for a fixed work surface height?

A. $81\ cm$

B. 96 cm (*see slide 2-II-13*) (note, design for fixed height should be based on maximum/tallest individual)

C. $88\ cm$

D. $107\ cm$

E. $99\ cm$

Questions 15-16. Examine the figure below showing a view of the driver's seat of a truck cab, with dimensions corresponding to the letters below, and answer the questions to follow.
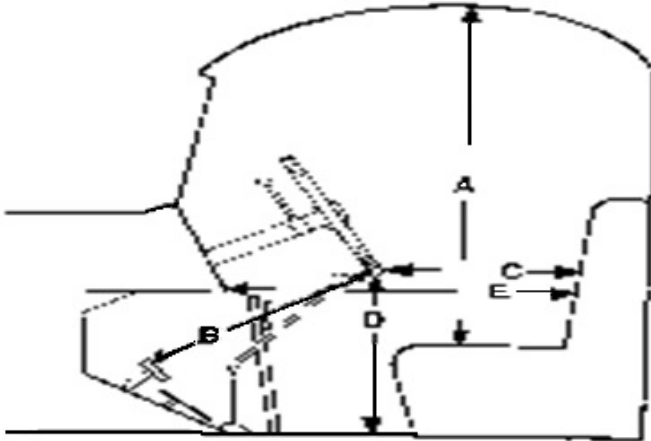
15. **Cab dimension A is …, corresponds to body dimension …, and should be used for …** `E`

   A. seat-to-roof clearance; 35 (vertical grip-reach, sitting); 95th percentile individual

   B. seat-to-roof clearance; 8 (seated height); 5th percentile individual

   C. seat-height clearance; 8 (seated height); 95th percentile individual

   D. seat-height clearance; 35 (vertical grip-reach, sitting); 5th percentile individual

   E. seat-to-roof clearance; 8 (seated height); 95th percentile individual (*see "anthropometry exercise" handout*)

16. **The only dimension(s) designed for a minimum individual is/are … since …** `B`

   A. B and D; tall individuals don't have a problem bending their legs

   B. E; tall individuals don't have a problem bending their arms (*see "anthropometry exercise" handout*)

   C. C; tall individuals don't have a problem bending their arms

   D. E and C; tall individuals don't have a problem bending their arms

   E. A; tall individuals can just bend their head a little while driving

17. **Which of the following carries importance according to the information theory?** `C`

   A. breaks in the car stop the car from traveling when pressed

   B. traffic signal switching from green to yellow to red

   C. printer indicating that it needs to be repaired (*see slide 3-I-3*)

   D. hot-water tap gives hot water when switched on

   E. a gun fires a bullet when the trigger is pulled

C

18. **In the Information Theory, a *Bit* is defined as …**

    A. reduction in certainty resulting produced by two events being equally likely

    B. reduction in certainty from two or more events not being equally likely

    C. reduction in uncertainty produced by two events being equally likely (*see slide 3-I-3,4*)

    D. reduction in uncertainty produced by two events not being equally likely

    E. reduction in uncertainty produced by two or more events being equally likely

D

19. **How much information is involved with throwing a *twelve*-sided die (see below)?**

    A. 6.00 Bits

    B. 2.58 Bits

    C. 0.28 Bits

    D. 3.58 Bits $H = \log_2 N = \log_2 12 = \frac{\log 12}{\log 2} = \frac{1.079}{0.301} = 3.58\ Bits$

    E. 1 Bit

20. **Calculate the redundancy involved with a coin, given a man cheats the coin such that**

D

    one side is *three times* as likely to occur as the other.
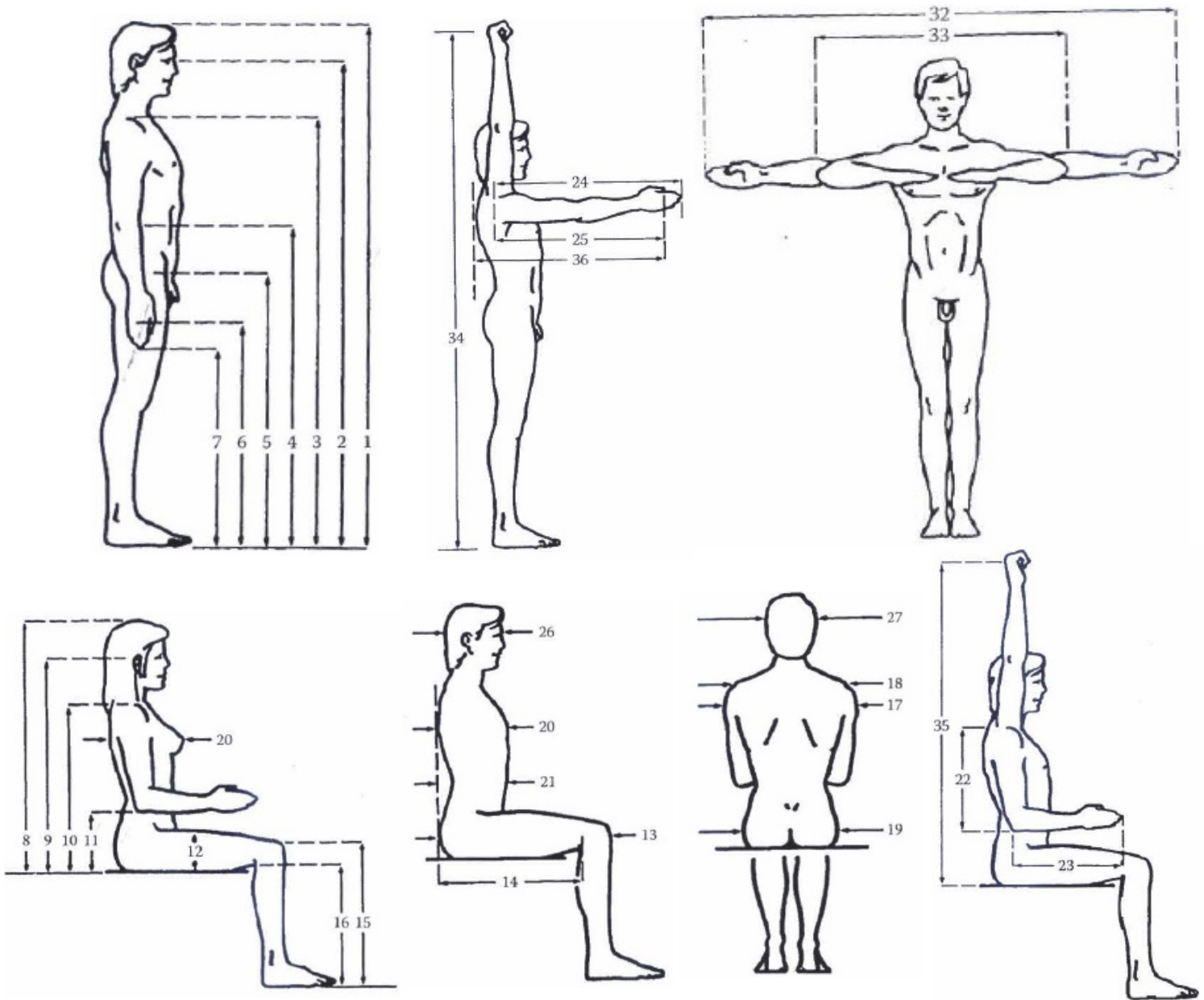
    A. 81.13%

    B. 8.17%

    C. 91.50%

    D. 18.87% $p_1 + 3p_1 = 1$

    $\Rightarrow 4\,p_1 = 1$

    $\Rightarrow p_1 = 0.25$

    $p_2 = 3p_1 = 0.75$

    $$Red. = 1 - \frac{H_{ave}}{H_{max}} = 1 - \frac{\sum_{i=1}^{N=2} p_i \left(\log_2 \frac{1}{p_i}\right)}{\log_2 N = 2} = 1 - \frac{p_1 \left(\log_2 \frac{1}{p_1}\right) + p_2 \left(\log_2 \frac{1}{p_2}\right)}{\log_2 2}$$

    $$= 1 - \frac{0.25(\log_2 4) + 0.75(\log_2 1.33)}{1} = 1 - \left[\frac{1}{4}\left(\frac{\log 4}{\log 2}\right) + \frac{3}{4}\left(\frac{\log 1.33}{\log 2}\right)\right]$$

    $$= 1 - [0.500 + 0.311] = 1 - 0.8113 = 0.1887 = \mathbf{18.87\%}$$

    E. 25.00%

$$H_{max} = \log_2 N \qquad H_{ave} = \sum p_i \log_2 \left(\frac{1}{p_i}\right) \qquad \% R = \left(1 - \frac{H}{H_{max}}\right) * 100$$

Rules:

- You must prepare and submit the homework **individually**.

- All work must be neatly typed and printed.

- Use **proper English**.

- Show all work.

- **BOX** your answer(s) and include the **units** (if applicable).

- **Due date**: the first class of Week 7 (beginning of class). NO late homework will be accepted.