

**DEA 3500: HUMAN FACTORS: THE AMBIENT ENVIRONMENT (Fall 2018)**

**NAME:** \_\_\_\_\_

**HOMEWORK I: PRINT THIS OUT AND HAND IT IN BY THE DUE DATE**

**Due Date: Tuesday September 18<sup>th</sup> in class**

**NOTE: Consult the course text and class notes, as well as the IAQ readings to complete this homework.**

1. Indicate whether the following statements are true or false:

a. warm air always contains more moisture than cold air	True	False
b. warm air is always less humid than cold air	True	False
c. moist cold air is heavier than dry warm air	True	False
d. still air is always less humid than moving air	True	False
e. moisture will condense from the air above 100% SVP	True	False
  
2. Indicate which of the following statements are true or false:

a. at an air temperature of 35.6°C and a radiant temperature of 98.1°F all body heat is lost to the environment through conduction processes	True	False
b. at an air temperature and radiant temperature of 22.8°C most body heat is radiated to the environment through convection processes	True	False
c. at an air temperature of 85.0°F and radiant temperature of 52.2°C most body heat is lost to the environment through sweat evaporation	True	False
d. at an air temperature of 17.2°C and radiant temperature of 66.9 °F most body heat is lost to the environment through convection processes	True	False
e. at an air temperature of 35.6°C and radiant temperature of 98.0°F most body heat is lost to the environment through convection processes	True	False
  
3. Name a physical thermal variable that can be measured with the following instruments:
  - a) hygrometer or sling psychrometer \_\_\_\_\_
  - b) dry bulb thermometer \_\_\_\_\_
  - c) globe thermometer \_\_\_\_\_
  - d) hot-wire anemometer \_\_\_\_\_
  
4. Clothing plays a major role in determining thermal comfort. What is the clothing insulation value in clo units for each of the clothing ensembles below?: (total = 0.835x(clothes)+.161)
  - a. indoor summer clothes for a man comprising a T-shirt, underpants, light weight trousers, bare feet = \_\_\_\_\_
  - b. outdoor summer clothes for a woman comprising light-weight dress, bra and panties, bare legs and feet = \_\_\_\_\_
  - c. outdoor winter clothes for a man comprising heavy jacket, underpants, heavy sweater, light-weight long-sleeve shirt, light weight trousers, socks, shoes (oxfords) = \_\_\_\_\_
  - d. indoor winter clothes for a woman comprising light-weight slacks, light-weight blouse, heavy sweater, bra and panties, stockings, shoes (pumps) = \_\_\_\_\_



10. Indicate whether the following statements are true or false:

A person will be comfortable:

- |   |      |       |
|---|------|-------|
| a. at 40% humidity, with medium activity and clothing, at 15.5 °C       | True | False |
| b. at 60% humidity, with medium activity and light clothing, at 73.9 °F | True | False |
| c. at 50% humidity, sedentary, with light clothing, at 21.7 °C          | True | False |
| d. at 20% humidity, with high activity, medium clothing, at 12.8 °C     | True | False |

11. Air velocity and air temperature affect the percentage of people dissatisfied with feeling a draught around their head region. Using this knowledge complete the following:

( $v$  = mean air velocity in m/s;  $T_a$  = air temperature; %D = percent dissatisfied) :

- $T_a = 73^\circ\text{F}$ ,  $v = 1 \text{ ft/s}$ , %D = \_\_\_\_\_
- $T_a = 26^\circ\text{C}$ ,  $v = 0.1 \text{ m/s}$ , %D = \_\_\_\_\_
- $v = 0.3 \text{ m/s}$ , %D = 60%,  $T_a =$  \_\_\_\_\_ °C
- $T_a = 20^\circ\text{C}$ , %D = 4%,  $v =$  \_\_\_\_\_ m/s

12. Heat stress produces a number of physiological changes. Using the information in your readings complete the following to illustrate some of these changes:

- $ET^* = 26.6^\circ\text{C}$ , work activity = 300 k cal/hr, core temperature = \_\_\_\_\_ °C
- $ET^* = 29^\circ\text{C}$ , work activity = 180 k cal/hr, core temperature = \_\_\_\_\_ °F
- core temperature = 38°C, work activity = 420 k cal/hr,  $ET^* =$  \_\_\_\_\_ °C
- heart rate (white females) = 90 bpm, air temperature = \_\_\_\_\_ °C
- air temperature = 32°C, heart rate (black males) = \_\_\_\_\_ bpm
- the approx. mean core temperature for men working at 300 k cal/hr in a hot climate for 5 days = \_\_\_\_\_ °C
- when the mean core temperature of men working at 300 k cal/hr in a hot climate is 38.5°C, the approx. mean pulse rate = \_\_\_\_\_ bpm

13. Indicate whether the following statements are true or false:

- |  |      |       |
|--|------|-------|
| a. heat illness is always lowest among construction workers            | True | False |
| b. people who work in cold environments can be at risk for heat stress | True | False |
| c. metabolism increases 10% with a 2 °C rise in mean body temperature  | True | False |
| d. heat stress produces cardiovascular changes                         | True | False |
| e. heat stroke can be fatal  | True | False |

14. List three physiological changes accompanying heat acclimatization:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

15. Indicate whether the following statements are true or false:

- |   |      |       |
|---|------|-------|
| a. the body's first response to heat stress is decreased heart rate | True | False |
| b. recovery from physical work is faster in hot environments        | True | False |
| c. heat stress sweating can exceed 7L per hour                      | True | False |
| d. you should drink 25 oz. of water every hour in a hot environment | True | False |
| e. the body's heat is lost through the evaporation of sweat         | True | False |

16. Indicate whether the following statements are true or false:
- |   |      |       |
|---|------|-------|
| a. heat exhaustion is the first sign of heat illness                | True | False |
| b. profuse sweating is a characteristic of heat stroke (not stress) | True | False |
| c. heat stress tolerance improves with increased fitness            | True | False |
| d. young children are most likely to suffer from heat stress        | True | False |
| e. hypohydration can result from excessive sweating                 | True | False |
17. Indicate whether the following statements are true or false:
- |   |      |       |
|---|------|-------|
| a. the heat index measures heat-humidity combinations                 | True | False |
| b. exhaustion from physical work takes longer in cold climates        | True | False |
| c. thermal stress always diminishes visual reaction times             | True | False |
| d. a brief exposure to thermal stress impairs simple task performance | True | False |
18. Name three factors that preclude establishing an absolute safe heat exposure level:
- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
19. Indicate whether the following statements are true or false:
- |  |      |       |
|--|------|-------|
| a. frequent rest breaks in a hot environment help reduce heat stress | True | False |
| b. the body is less able to regulate temperature as it ages          | True | False |
| c. the wind-chill index measures heat-humidity combinations          | True | False |
| d. cooled vests work better than hoods to reduce heat stress         | True | False |
20. Indicate whether the following statements are true or false:
- |   |      |       |
|---|------|-------|
| a. cold injuries are 5 times more frequent in warehousing than sanitation | True | False |
| b. core vasoconstriction is the body's first defense against cold stress  | True | False |
| c. shivering helps to warm the body's skin temperature                    | True | False |
| d. unfit people shiver less efficiently than fit people                   | True | False |
| e. the 'dive reflex' protects the heart against cold stress               | True | False |
21. Indicate whether the following statements are true or false:
- |   |      |       |
|---|------|-------|
| a. at 19°C mean-hand temperature the hands are uncomfortably cold   | True | False |
| b. 5 minutes of exercise and a 3°C drop in body temperature produces a 70% decrease in maximal exercise ability | True | False |
| c. in air at 41°F the hands are always painfully cold   | True | False |
| d. tracking task performance shows impairment at 4°C  | True | False |
22. Indicate whether the following statements are true or false:
- |  |      |       |
|--|------|-------|
| a. people wearing 3 clo of insulation can tolerate a cold environment at 0°C about six times as long as people wearing 2 clo   | True | False |
| b. men can have colder hands than women  | True | False |
| c. gloves increase hand temperature more for women than men  | True | False |
| d. a manual assembly task (Purdue Pegboard Test) performed after 120 minutes exposure to -18°C conditions can be completed half as quickly with auxiliary heat than with no heat | True | False |

23. Products and materials can emit indoor air pollutants. Indicate whether each of the following statements about emissions are true or false:

- |   |      |       |
|---|------|-------|
| a. some kinds of particle board can emit formaldehyde               | True | False |
| b. gypsum dry wall can emits radon                                  | True | False |
| c. people normally exhale high concentrations of carbon monoxide    | True | False |
| d. photocopiers can emit volatile organic compounds                 | True | False |
| e. air streams from forced-air heating systems can contain bacteria | True | False |
| f. paint, caulk, adhesives can emit ozone                           | True | False |
| g. some natural woods can emit volatile organic compounds           | True | False |

24. Name the main human effect of exposure to a high concentration of each of the following pollutants.

- |                    |       |
|--------------------|-------|
| a. Carbon monoxide | _____ |
| b. Ozone           | _____ |
| c. Carbon dioxide  | _____ |
| d. Formaldehyde    | _____ |
| e. Mycotoxins      | _____ |

25. Say if each of the following statements is true or false.

- |  |      |       |
|--|------|-------|
| a. the threshold limit value is the highest concentration of an indoor air pollutant which will cause any health problems      | True | False |
| b. time-weighted average pollutant values approximate a person's exposure to indoor air pollutants over ea period of time      | True | False |
| c. indoor air quality is defined by the absence of hazardous particles, fibers, organisms or gases in the air inside buildings | True | False |
| d. indoor air quality standards for pollutants are always based on the rate of carbon dioxide dilution by ventilation          | True | False |

26. Say whether the following are symptoms of the "sick building" syndrome:

- |                   |     |    |
|-------------------|-----|----|
| a. headache       | Yes | No |
| b. eyestrain      | Yes | No |
| c. backache       | Yes | No |
| d. lethargy       | Yes | No |
| e. stomach ache   | Yes | No |
| f. irritated skin | Yes | No |

27. Say whether each of the following is a building-related illness that can cause death?

- |   |     |    |
|---|-----|----|
| a. Asbestosis                           | Yes | No |
| b. Sick building syndrome               | Yes | No |
| c. Humidifier fever                     | Yes | No |
| d. Legionnaire's disease                | Yes | No |
| e. Aspergillosis (fungal contamination) | Yes | No |
| f. Raynaud's disease                    | Yes | No |

28. What are the two main types of mechanical air-handling systems in large office buildings?

- a. \_\_\_\_\_
- b. \_\_\_\_\_

29. What is the size (maximum diameter in microns of particles) stopped at each of the following points along the respiratory pathway?

- a. bronchial passages: \_\_\_\_\_
- b. nasal mucosa (nose): \_\_\_\_\_
- c. alveoli: \_\_\_\_\_

30. Indicate the major source of each of the following indoor air pollutants.

- a. radon \_\_\_\_\_
- b. carbon dioxide \_\_\_\_\_
- c. carbon monoxide \_\_\_\_\_
- d. formaldehyde \_\_\_\_\_

31. Briefly describe two ways that an investigator can distinguish between "sick building" syndrome (SBS) and building related illness (BRI)?

- a. \_\_\_\_\_  
\_\_\_\_\_
- b. \_\_\_\_\_  
\_\_\_\_\_

32. Indicate the three main reasons for ventilating buildings.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

33. Name three locations where biological growth can occur inside a ventilation system?

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

34. Name three control strategies used in mitigating indoor air quality problems.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

35. Say if each of the following statements is true or false:

- |  |      |       |
|--|------|-------|
| a. the EPA says that radon levels >4 pCi/L are safe      | True | False |
| b. radon is only a problem in the basements of buildings | True | False |
| c. radon can be detected by its very distinctive odor    | True | False |
| d. radon is heavier than air                             | True | False |
| e. fungal growth generally requires a RH below 85%       | True | False |
| f. fungal spores can cause lung disease                  | True | False |
| g. bacteria require a RH below 90% to grow               | True | False |
| h. endotoxin is produced by gram-negative bacteria       | True | False |

36. An IAQ investigation is like detective work – in seeking basic information what four questions should the investigator ask occupants in investigating an indoor air quality problem? (Hint – check out I-Beam General Diagnostic Process)

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

37. Mold thrives in the presence of water. Name 4 ways that indoor mold growth can be controlled

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

38. Say if each of the following statements is true or false:

- |  |      |       |
|--|------|-------|
| a. fungi spores require moisture, food and darkness to thrive          | True | False |
| b. pollens easily penetrate to the alveolar region of the lungs        | True | False |
| c. all fungi produce toxic metabolites (aflatoxins) that cause illness | True | False |
| d. gram-positive bacteria produce the most potent mycotoxins           | True | False |

39. Say if each of the following statements is true or false:

- |   |      |       |
|---|------|-------|
| a. respiratory illness risks are always higher in air-conditioned buildings | True | False |
| b. cats can be a significant source of indoor allergen                      | True | False |
| c. 45% of people are allergic to dust mites                                 | True | False |
| d. respirable dust always causes eye irritation                             | True | False |
| e. indoor floor dust can contain outdoor pesticides                         | True | False |

40. Say if each of the following statements is true or false:

- |   |      |       |
|---|------|-------|
| a. environmental tobacco smoke is a hazardous indoor air pollutant mixture                | True | False |
| b. fresh air ventilation can reduce indoor air pollutant sources                          | True | False |
| c. airborne fiberglass can irritate the eyes, nose and skin                               | True | False |
| d. cockroaches produce an indoor allergen   | True | False |
| e. children are always less susceptible than adults to biological contaminants            | True | False |
| f. dust mites thrive in humid conditions above 70% RH                                     | True | False |
| g. dust mite feces are $< 5\mu$ in size   | True | False |
| h. Asbestos is only dangerous when it is inhaled  | True | False |
| i. Eating iron and calcium reduces lead absorption in the body                            | True | False |
| j. Respirable particles are only dangerous when they are $>10\mu$ in size                 | True | False |
| k. Mental and physical development is impaired by lead levels as low as $1\mu\text{g/dl}$ | True | False |