DEA 350: HUMAN FACTORS: THE AMBIENT ENVIRONMENT (Spring 2008)

NAME:_____

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

Due Date: February 28th in class
NOTE: Consult the course text and readings as well as your class notes to complete this homework.

[5 points per answer]

1. Indicate whether the following statements are true or false:
   a. cold air holds less moisture than warm air — True False
   b. warm air is always more humid than cold air — True False
   c. dry warm air is heavier than moist cold air — True False
   d. still air is always more humid than moving air — 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 36.7°C 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 126.0°F 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 19.4°C most body heat is lost to the environment through convection processes — True False
   e. at an air temperature of 96°F and radiant temperature of 98.0°F most body heat is lost to the environment through convection processes — True False

3. Name an instrument used to measure the following physical thermal variables:
   a) radiant temperature _____
   b) absolute humidity_____
   c) air velocity_____
   d) air temperature_____
   e) relative humidity_____

4. Clothing plays a major role in determining thermal comfort. What is the clothing insulation value in clo's for each of the clothing ensembles listed?: (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 short sleeve shirt, light weight trousers, socks, shoes (oxfords) = _____

d. indoor winter clothes for a woman comprising light-weight dress, heavy sweater, bra and panties, stockings, shoes (pumps) = _____

5. Convert the following temperatures to either °C or °F (to 1 decimal place):
   a. 20.6°F = _____ °C b. 35.8°C = _____ °F
   c. 51.3°F = _____ °C d.104.6°F = _____ °C

6. The effective temperature combines air temperature, humidity, and air movement to create a scale of equal sensations of warmth or cold. Complete the following. (T_a = air temperature; T_w = wet bulb temperature; RH = relative humidity; ET* = effective temperature):
   a. T_a = 80°F, RH =50%, ET* = _____°C
   b. T_a = 24.5°C, RH = 40%, ET* = _____°C
   c. RH = 10%, ET* = 29.4°C, T_a = _____°C
   d. T_a = 27.8°C, ET* = 26.7°C, RH = _____ %
   e. T_a = 22.0°C, RH = 80%, ET* = 23.8°C, T_w = _____ °C
   f. T_a = 80.0°F, T_w = 70°F, RH = _____ %

7. Indicate whether each of the following statements about insulation is true or false: (circle answer)

a. high clo value fabric always have high moisture permeability	True	False
b. the square of the U values is the reciprocal of the R value	True	False
c. light colors are good heat absorbers	True	False
d. heat is not synonymous with temperature	True	False
e. moving air has a lower thermal resistance than still air	True	False

8. For the following values of natural wet bulb temperature (NWB), globe temperature (GT), and dry bulb temperature (DB) calculate the wet-bulb globe temperatures (WBGT) and the Botsball index:
   a. NWB = 29.4°C, GT = 25.7°C WBGT (indoors) =_____°C
   b. NWB = 77°F, DB = 75.2°F, GT = 28°C, WBGT (outdoors) =_____°C
   c. BB = 27.55°C, WBGT = _____°F
   d. WBGT = 18.8°C, BB = _____°F

9. 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 23.3 °C	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

10. 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) :

a. T_a = 73°F, v = 1 ft/s, %D = _____
b. T_a = 26°C, v = 0.1 m/s, %D = _____
c. v = 0.3 m/s, %D =60%, T_a = _____ °C
d. T_a = 20°C, %D = 4%, v =_____m/s

11. Heat stress produces a number of physiological changes. Using the information in your readings complete the following to illustrate some of these changes:
    a. ET* = 26.6°C, work activity = 300 k cal/hr, core temperature = ____ °C
    b. ET* = 29°C, work activity = 180 k cal/hr, core temperature = ____ °F
    c. core temperature = 38°C, work activity = 420 k cal/hr, ET* = ____ °C
    d. heart rate (white females) = 90 bpm, air temperature = ____ °C
    e. air temperature = 32°C, heart rate (black males) = ____ bpm
    f. the approx. mean core temperature for men working at 300 k cal/hr in a hot climate for 5 days = _____°C
    g. 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 =_____

12. Indicate whether the following statements are true or false:
    a. heat illness is highest among construction workers — True False
    b. heat stress can occur in cold environments — True False
    c. metabolism increases 20% with a 2 ºC rise in mean body temperature — True False
    d. heat stress produces cardiovascular changes — True False

13. List three physiological changes accompanying heat acclimatization:
    a._____
    b._____
    c._____

14. Indicate whether the following statements are true or false:
    a. the body's first response to heat stress is increased sweating — 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. It is recommended that people drink 25 oz. of water every hour in a hot environment — True False

15. Indicate whether the following statements are true or false:
    a. heat exhaustion is the third stage of heat illness — True False
    b. heat stroke is characterized by profuse sweating — True False
    c. heat stress tolerance improves with increased fitness — True False
    d. old age reduces the effects of heat stress — True False

16. Indicate whether the following statements are true or false:
    a. the heat index measures heat-humidity combinations True False
    b. exhaustion from physical works takes longer in temperate climates True False
    c. thermal stress always improves visual reaction times True False
    d. after a brief exposure to thermal stress impairs simple task performance True False

17. Name three factors that preclude establishing an absolute safe heat exposure level:
    a._____
    b._____
    c._____

18. Indicate whether the following statements are true or false:
    a. frequent rest breaks in a hot environment help reduce heat stress True False
    b. exhaustion from physical works takes longer in cold climates 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

19. 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 core temperature True False
    d. fit people shiver more efficiently than unfit people True False
    e. the 'dive reflex' protects the heart against cold stress True False

20. Indicate whether the following statements are true or false:
    a. at 20°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 40% decrease in maximal exercise True False
    c. in air at 41°F the hands are painfully cold True False
    d. manual tracking performance is impaired at 40°F True False

21. 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 twice as long as people wearing 2 clo True False
    b. men have colder hands than women True False
    c. gloves increase hand temperature more for men than women True False
    d. a manual assembly task (Purdue Pegboard Test) performed after 120 minutes exposure to -18°C conditions can be completed twice as quickly with auxiliary heat than with no heat True False

22. Name the indoor air pollutants you might expect to find from each of the following:

a.	plywood can emit formaldehyde	True	False
b.	particle board can emit ozone	True	False
c.	people normally exhale 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 volatile organic compounds	True	False

23. Say which of the following pollutants might be the cause of an acute outbreak of headache, lethargy, and drowsiness?

a.	Carbon monoxide	Yes	No
b.	Ozone	Yes	No
c.	Carbon dioxide	Yes	No
d.	Formaldehyde	Yes	No
e.	Mycotoxins	Yes	No

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

a.	the threshold limit value is the concentration of an indoor air pollutant which will not cause any health problems	True	False
b.	time-weighted average pollutant measures approximate a person's exposure to indoor air pollutants	True	False
c.	indoor air quality is defined by the absence of hazardous particles or gases in the air inside buildings	True	False
d.	indoor air quality standards for pollutants are based on the rate of carbon dioxide removal by ventilation	True	False

25. 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.	congested nose	Yes	No
f.	irritated skin	Yes	No

26. Say what symptoms that progressively worsen over the course of a work day at the start of a work week but then get better by weeks end could indicate?

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

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

    a. _____
    b. _____

28. 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:_____

29. Name two building related illnesses that can have serious, even life-threatening consequences?

    a. _____
    b. _____

30. In a typical indoor air quality investigation, what are the three types of equipment that are used at a minimum?

    a._____
    b._____
    c._____

31. Indicate three major sources of indoor air contaminants.

    a. _____
    b. _____
    c. _____

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

    a. _____
    b. _____

33. Indicate the three main reasons for ventilating buildings.

    a. _____
    b. _____
    c. _____

34. Name three factors that can cause complaints often mistakenly blamed on contaminated air?

    a. _____
    b. _____
    c. _____

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

a. _____
b. _____
c. _____

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

a. studies by the EPA indicate that as many as 20 percent of all American homes may have elevated level of radon	True	False
b. radon is only a problem in the basements of buildings	True	False
c. fungi generally require a RH above 85%	True	False
d. fungal spores are small enough to penetrate to the alveolar region of the lungs	True	False
e. bacteria require a RH above 90%	True	False
f. endotoxin is in the cell walls of gram negative bacteria	True	False

37. Name two mechanisms by which fungi are known to cause illness?

a. _____
b. _____

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

a. fungal spores require 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 higher in air-conditioned buildings	True	False
b. cats can be a significant source of indoor allergens	True	False
c. 25% of people are allergic to dust mites	True	False
d. respirable dust always causes eye irritation	True	False

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

a. environmental tobacco smoke is a hazardous indoor air pollutant	True	False
b. better ventilation air mixing always reduces indoor air pollutant levels	True	False
c. fiberglass from ceiling tiles can irritates the eyes, nose and skin	True	False
d. cockroach allergen is the most common indoor allergen	True	False