Answers to Multiple Choice Questions

Chapter 2: *Principles of Thermal Comfort*

Q. 1: *B*; the blood flow; constrict the blood vessels; blood (Page 26).

Q. 2: *A*; X = 98˚F; Y = 1% (Page 25, Figures 2.1 and 2.2).

Q. 3: *C*; While it is true that shivering and sweating are slow in response, wasteful, and inexact, they are both outside the range of the vaso-motor control mechanism and therefore not within the comfort zone (Pages 26-27).

Q. 4: *C*; Care must be taken to avoid exposure of the skin to air movement in hot, dry climates (not hot humid climates) to avoid skin complaints, such as dermatitis, due to drying out of the skin (Page 28).

Q. 5: *C*; 73˚ F (≈ 23˚ C) (Page 28).

Q. 6: *B*; If there is air movement then the temperature required for comfort will need to be higher than 80° because the body will lose more heat (Page 30).

Q. 7: *E*; All of the above (i.e., A, B, C and D) are contributing factors (Page 30).

Q. 8: *A*; Surface temperature is not one of the six parameters of thermal stress. The other three are air movement, rate of work performed, and clothing worn (Page 32).

Q. 9: *E*; All of the above (i.e., A, B, C and D) are valid parameters for the measurement of physiological strain (Page 32 and Figure 2.10).

Q. 10: *E*; All of the above (i.e., A, B, C and D) are correctly stated (Page 33).

Q. 11: *C*; Yes, severe temperature gradients that may occur due to differences in temperature at different heights of a building space will cause discomfort. A slight temperature gradient may be tolerated as long as the floor is at a higher temperature than the ceiling. The head is more vulnerable to higher temperatures than the feet (Page 38).

Q. 12: *A*; Of the three indices listed only Wet Bulb temperature is based on physical factors. Both Effective Temperature and Predicted 4-Hour Sweat Rate are based on physiological strain (Page 32).

Q. 13: *D*; All of the above statements (i.e., A, B, C and D) are incorrect. The comfort temperature for hot dry conditions is about 6° higher than for hot humid conditions. The just acceptable upper thermal comfort limits for hot humid and hot dry conditions are around 82° and 88°, respectively (Pages 25-26 and 46).

Q. 14: *C*; As a general rule, different temperatures at different heights of a building space should be avoided. However, if a slight temperature gradient does exist then the higher temperature is more easily tolerated at floor level than at ceiling level, because the head is more exposed and therefore more vulnerable to higher temperatures than the feet (Page 38 and Question 11).

Chapter 3: *Thermal Control by Building Design*

Q. 1: *E*; The time lag is related to the heat capacity of the wall. Since the heat capacity of a material is a function of the specific heat and the density of the material, heavy weight construction will have the longest time lag (Pages 46 and 70).

Q. 2: *C*; The air movement facilitates the evaporation of moisture from the skin, thereby producing an additional cooling effect due the conversion of sensible heat into latent heat of evaporation (Page 48).

Q. 3: *E*; The ability of a material to store heat is referred to as its heat capacity, which is a product of its specific heat and density (Page 70).

Q. 4: *D*; After solar radiation has passed through glass it is absorbed by the objects within a building space. As these objects heat up, they become radiators themselves and produce much ***longer*** wavelength radiation. This ***longer*** wavelength radiation cannot pass through the glass for the heat to escape from the space to the outside (Page 50).

Q. 5: *A*; Horizontal sunshading devices are most effective when the altitude of the sun is high, which is true for the south orientation in the Northern Hemisphere and the north orientation in the Southern Hemisphere (Pages 50-51).

Q. 6: *E*; Egg-crate sunshading devices are best for south-east and south-west orientations where the altitude of the sun is quite high for most of the day. The vertical sections of the egg-crate arrangement provide some protection from the lower sun altitude in the morning or afternoon by virtue of the bearing angle of the sun (not discussed directly, see Pages 50-51).

Q. 7: *C*; Due to the low altitude of the sun only vertical sunshading devices will be effective. Since the bearing of the sun changes movable vertical devices will be most effective. However, movable devices are also more expensive to install and maintain then fixed devices (Pages 50-51).

Q. 8: *A*; Although there are problems in the use of heat absorbing glass for office buildings where persons are required to sit close to a window wall, these can be largely overcome if a sheet of ordinary glass is fitted parallel to but on the ***inside*** of the heat absorbing glass (Page 51).

Q. 9: *C*; Most of the heat transfer through the roof in warm to hot climates is by radiation. Since the radiation is directed into the building the upper surface of the reflective foil must face an air space. However, the foil itself will heat up and become a radiator and therefore thermal insulation is required on the underside of the foil (Page 52-53).

Q. 10: *A*; Based on experimental data collected in South Africa it appears that is no additional thermal benefit gained from ceiling heights above 8 FT in small to medium-sized building spaces (Page 53).

Q. 11: *E*; All of the statements are correct (Page 54).

Q. 12: *D*; A third factor is the inclination of the incident surface (Page 54).

Q. 13: *C*; The air movement soaks up perspiration and increases the cooling effect through latent heat of evaporation (Page 48).

Q. 14: *B*; When wind impinges on a building shell, a region of ***high pressure*** is normally produced on the windward surface of the building. As the air is deflected around the building it accelerates, thereby causing regions of ***suction*** (i.e., negative or low pressure) to be set up just behind the windward surface on the side walls and along the entire ***lee wall*** (Page 58).

Q. 15: *E*; All of these factors have bearing on the air-flow pattern in a building space (Pages 59-60).

Q. 16: *E*; Both statements B and C are incorrect (Page 60). To achieve cooling in buildings by natural means under hot-humid conditions the air-flow must be directed toward the occupants of the building so that they can lose heat through latent heat of evaporation. Since air is typically sucked out of rather than pushed through a building it would be counterproductive to have larger openings on the windward wall than on the lee wall.

Q. 17: *A*; In both the Northern and Southern Hemispheres the sun rises in the east and sets in the west. However, in the Northern Hemisphere the sun path is inclined to the south, while in the Southern Hemisphere the sun path is inclined to the north (Page 53, Figure 3.13).

Q. 18: *D*; Due to the short distance between the source of light that simulates sunlight and the model, the light rays are not parallel. This problem can be at least partially alleviated by fitting the light source with a lens (Page 56).

Chapter 4: *Heat Flow and Thermal Insulation*

Q. 1: *D*; There were four errors, which are corrected as follows. Although heat is a form of energy, it is a physical quantity which is measured ***objectively***. In the British system of units, heat is expressed in terms of the ***British Thermal Units (BTU)***. Heat may appear in either of two (2) forms, namely: (1) ***Latent Heat***, which is the thermal energy used during a change of state of a substance while the temperature remains unaltered; and, (2) ***Sensible Heat***, which is associated with a change of temperature of the substance involved. Heat is said to pass from one system to another if the two systems are at different temperatures. This heat transfer always occurs from a region of high temperature to a region of low temperature. (Pages 68-71)

Q. 2: *B*; Thermal conduction is the direct transmission of heat between two materials ***in direct contact with each other***. All substances will conduct heat, the rate of transfer depending on the ***thermal conductivity*** of the substances (Page 67).

Q. 3: *B*; For the assumptions of steady state conditions to apply the temperature difference between the indoor and outdoor environments should be large, little heat should be absorbed by the building envelope, and short term changes in temperature should be small (Page 72).

Q. 4: *E*; The thermal conductivity of a material is influenced by all of the stated factors, namely density, porosity (see *structure* on Page 73), temperature, and moisture content (Pages 73-74).

Q. 5: *A*; Polyurethane foam has a thermal resistance (*R Value*) of 6.25, which is higher than any other building material known to the author at this time (Page 79, Figure 4.15).

Q. 6: *A*; In hot-arid climates there is usually a relatively large diurnal temperature range (i.e., difference between daytime and night time temperatures). Therefore, the building shell can be used as a heat sink to absorb heat during the day, thereby shielding the building interior. At night windows and doors are opened to allow the building shell to be cooled by the lower night time temperature concurrently from the outside and the inside surfaces (Page 47).

Q. 7: *B*; (See Chapter 3, Pages 46-49).

Q. 8: *E*; All of the statements are incorrect. The word ***Wet*** should be placed in the rectangular box labeled "1". The words ***Hot and Wet*** should be placed in the circle labeled "2". As we move in the direction of the circle labeled "D" thermal conditions will become increasingly cold, but the psychrometric chart tells us nothing about wind conditions. Even if the relative humidity is 100% it may not be raining (Page 89).

Chapter 5: *Solar Energy: The Beckoning Opportunity*

Q. 1: *B*; (Page 93, Figure 5.3).

Q. 2: *B*; (Page 91, Figure 5.2).

Q. 3: *B*; 100 to 300 BTU/SF-HR is the best answer although Figure 5.3 suggests a slightly lower range of 100 to 200 BTU/SF-HR. There are locations on earth where the insolation can exceed 200 BTU/SF-HR under favorable conditions (Page 93).

Q. 4: *E*; Even Las Vegas is unlikely to receive much more than 1100 BTU/SF of solar radiation on an optimally angled collector surface on a sunny Winter day (Page 93, Figure 5.3).

Q. 5: *B*; (Page 93).

Q. 6: *E*; Statements A, B and C are incorrect. Passive solar systems are more reliable than Active systems because they do not normally incorporate collector components that are subject to corrosion and weathering and therefore need to be maintained. Passive systems can certainly incorporate mechanical components (e.g., the Roof Pond system described on Page 109-110 and

Figure 5.23). Active solar systems nearly always require a back-up auxiliary system. (Chapter 5 throughout)

Q. 7: *A*; (Page 95, Figure 5.6).

Q. 8: *B*; (Page 95, Figure 5.6).

Q. 9: *E*; The collector will need to be drained, because when water freezes it expands and would likely burst the pipes in the collector system (Page 95 indirectly).

Q. 10: *B*; Heat capacity is the product of the density and the specific heat of a material. Since the specific heat of water is *1* and the density is *62* the heat capacity is *62 BTU/CF - °F* (Page 96 and Figure 5.8).

Q. 11: *A*; (Page 97-98).

Q. 12: *C*; (Page 97-98).

Q. 13: *A*; (Pages 97-98).

Q. 14: *E*; Rock and water storage systems are comparable in cost, with advantages and disadvantages in each case. Therefore, the selection of either system for a particular application depends on the actual conditions and design objectives.

Q. 15: *D*; Since the question uses the phrase "… *no more than*", a conservative answer is expected. Therefore, if as a rule of thumb *1 SF* solar collector is required to heat 1 to 10 gallons of water, then no more than *40 SF* of a single-glazed collector should be required to heat 40 gallons of water (Page 97).

Q. 16: *E*; The correct answer is *Latitude + 15°*. Seasonal sun angles vary with the latitude (not the longitude) of the location (Page 102, Figure 5.15).

Q. 17: *C*; (Page 102, Figure 5.15).

Q. 18: *D*; Taking 65° as the standard base temperature for Degree Day (DD) calculations then a temperature of -10°F will be equal to 75 DD (i.e., 65 – (-10) = 75) (Page 100).

Q. 19: *A*; 50,000 divided by 500 is equal to 100 (Page 99-100 and Figure 5.12).

Q. 20: *E*; The concept of the Skytherm roof pond passive solar system is to utilize the heat capacity of the water on the roof to maintain a fairly constant comfort temperature in the building interior. The main mechanism for achieving this consists of insulating panels that are used to cover or expose the roof ponds depending on external conditions and whether there is a need to reduce or increase the temperature of the interior building spaces (Page 109-110 and Figure 5.23).

Chapter 6: *Light, Color, and Vision*

Q. 1: ***E***; The visible spectrum extends from approximately 350 to 750 millimicrons (not microns). A millimicrons is one thousandth of a micron (Page 122-124 and Figure 6.9).

Q. 2: ***D***; (Page 123).

Q. 3: ***D***; Cones are responsible for color vision, which is confined to approximately a 15° arc in the fovea region. Rods are concentrated in the para-fovea region (Pages 124-125).

Q. 4: ***B***; Light, sound and the thermal environment are all physical stimuli that are subject to human perception. While these stimuli can be quantified objectively through measurement with instruments such as light meters, sound level meters and thermometers, these objective measurements are not necessarily an accurate indication of how these stimuli are perceived by an individual person. For example, in the case of vision the human perception of the intensity of a particular light source will depend as much on the ambient illumination as on the intensity of the light source.

Q. 5: ***C***; Yes, vision speed does increase with higher levels of illumination, but to improve visibility will also require the brightness of the object being viewed to be *increased* not decreased (Page 125).

Q. 6: ***D***; Luminance is the intensity per unit *area* (not distance) of a surface seen from a *particular* direction (Pages 127-128 and Figure 6.16).

Q. 7: ***D***; All of the stated units are correct (Pages 126-127).

Q. 8: ***E***; Shadows are a form of contrast that aid in the detection of motion, ascertaining the location of objects, and discriminating between textures, but are to be avoided if we want to see fine details such as examining the inside of a watch. Shadows are also restful to our eyes.

Q. 9: ***B***; Our subjective perception of the brightness of an object depends on the Adaptation Level, which is produced by the average luminance of all surfaces in the visual field (Pages 131-133).

Q. 10: ***D***; (Pages 127 and Figure 6.16, 127-128 and Figure 6.15, 135 and Figure 6.19).

Q. 11: ***D***; Only statement *B* is incorrect; - ultra-violet radiation is on the *left-hand side* of the visible spectrum (Pages 123-124 and Figure 6.9).

Q. 12: ***E***; When a yellow light source is incident on a yellow surface then most of the yellow light is reflected and the surface will appear more yellow. A good brightness ratio between the task area and the immediate surround is 3:1, and the brightness ratio between the task area and the background should be at least 5:1. Finally, specular or mirror-like reflection is produced by a shiny surface and not a matte surface. (Pages 129-130 and Figure 6.19, 132-133 and Figures 6.24 and 6.26).

Q. 13: ***A***; It is true that the subjective phenomena of perceptual constancy, apparent brightness and adaptation level are related. However, perceptual constancy allows us to continue to recognize an object even though both the lighting conditions and the viewing angle of the object have changed. A more correct statement for *A* would be: *Perceptual Constancy allows us to track moving objects despite changes in Apparent Brightness*. (Pages 134-135).

Q. 14: ***E***; All of the statements are incorrect: (*A*) reflected glare is a form of Disability Glare and not Discomfort Glare (also, only extreme light sources such as lasers can cause permanent eye damage); (*B*) Contrast between day light and interior light, such as a window at the end of a dimly lit corridor, will produce Disability Glare and not Discomfort Glare; and, (*C*) Discomfort Glare, not Disability Glare, is more common in building interiors because artificial light sources typically are not sufficiently bright to produce Disability Glare. (Pages 136-138).

Q. 15: ***B***; The size of the room and the color of the immediate surround of the glare source have little (if anything) to do with the degree of Discomfort Glare (Page 136).

Q. 16: ***A***; Only the last sentence of the statement is incorrect. The color spectrum of the light source has little (if anything) to do with the occurrence of Disability Glare (Page 138).

Chapter 7: *Daylight Design Principles*

Q. 1: ***A***; Even under clear sky or overcast sky conditions daylight varies in intensity throughout the day (Page 145).

Q. 2: ***B***; Due to neighboring high-rise buildings in an urban environment windows on the lower floors are unlikely to have much direct exposure to the sky, which is the source of daylight (Page 146 and Figure 7.2).

Q. 3: ***D***; (Page 155-156 and Figure 7.13).

Q. 4: ***C***; The sky is considered to be the source of daylight for design purposes, since direct uncontrolled sunshine would be a source of glare and heat (Page 145).

Q. 5: ***E***; (see Chapter 6, Page 122 and Figure 6.9).

Q. 6: ***B***; Typically, the available external daylight level is based on the illumination level available on an unobstructed horizontal surface out-of-doors for 80% of the working day from 8 am to 5 pm (Page 152).

Q. 7: ***A***; The values given in *B*, *C* and *E* are far to high for an overcast rainy day. Even 800 fc (the value given in *D*) is unlikely to be available for 80% of the daylight hours.

Q. 8: ***A***; The amount of daylight available for 80% of working hours will be higher than the daylight available for 90% of working hours. Therefore, the values proposed by *B* and *C* are definitely incorrect. The increase in daylight is likely to be at least 10% but certainly less than 100% (the value proposed by *D*).

Q. 9: ***A***; (Page 156 and Figure 7.13).

Q. 10: ***C***; The Daylight Factor is purposely expressed as a percentage of the daylight available out-of-doors, because the external illumination level varies continuously (Pages 155-156).

Q. 11: ***C***; At high incidence angles the equivalent thickness of glass that the light has to penetrate is increased and therefore more light is absorbed by the glass (Page 158).

Q. 12: ***A***; (Page 165, Figure 7.23 and Chapter 3, Page 52).

Q. 13: ***B***; Statement *D* is incorrect because it applies to visual light meters (i.e., photometers) and not photoelectric cells. While statements *A* and *C* are correct, these are not the principal reasons why photoelectric cells are commonly preferred to photometers. The difficulty with photometers is that the judgment whether the operator controlled light source is equivalent to the measured light source requires considerable experience in the use of photometers (Page 153).

Q. 14: ***C***; (Page 152, Figure 7.7).

Q. 15: ***D***; The first three statements are correct since wavelength-hue, saturation-chroma-purity, and brightness-value-luminance, are respectively synonymous terms in color theory (Page 147).

Q. 16: ***B***; (Page 149).

Chapter 8: *Artificial Lighting*

Q. 1: ***E***; It must be noted that the ideal temperature of 6,000°K refers to the *color temperature* and not the operating temperature (Page 174 and Figure 8.7).

Q. 2: ***C***; (Page 171 and Figure 8.2).

Q. 3: ***D***; (Pages 179-181).

Q. 4: ***B***; Ideally, the color rendition should be very similar to the lighting conditions under which the artist produced the painting (Page 175).

Q. 5: ***B***; (Pages 176-177 and Figure 8.10 on Page 175).

Q. 6: ***C***; An increase in the vapor pressure of the gas in the lamp will decrease the rate of evaporation of the filament (Page 176).

Q. 7: ***C***; The spectral distribution of the light from a filament (incandescent) lamp favors the infra-red region is therefore not very similar to daylight (Page 177).

Q. 8: ***C***; However, this does not obviate the need for a very large potential difference to be created electrically to initiate the discharge (Page 177).

Q. 9: ***A***; Filaments are required in incandescent lamps and not in discharge lamps (Page 177 and Figures 8.13 and 8.14).

Q. 10: ***A***; The unique yellow radiation, which makes the low-pressure sodium lamp so efficient, renders it virtually unusable even for exterior lighting due to very poor color rendition properties (Pages 178-179 and Figure 8.16).

Q. 11: ***B***; Quite the opposite is true. The electrical circuit of a fluorescent lamp is designed to limit the current and increase the potential difference (voltage) when the lamp is first switched on, so that the discharge can be initiated (Page 180 and Figure 8.19).

Q. 12: ***A***; All of the statements (i.e., 1 to 6) are correct (Figures 8.18 and 8.21 on Pages 179 and 181, respectively).

Q. 13: ***D***; By virtue of their geometry the vertical louvers reduce the depth of the luminaire that would otherwise be required to shield the fluorescent tubes from direct sight (Page 183 and Figure 8.24).

Q. 14: ***C***; The direct-indirect luminaire provides a good balance between diffuse background illumination via reflection from the ceiling and direct illumination on the surface of the conference table (Pages 184-185 and Figure 8.26).

Q. 15: ***D***; Of the three applications high bay factory lighting would be the most demanding. However, in the color corrected form the mercury vapor lamp would normally be acceptable for this kind of interior application (Page 178 and Figure 8.15).

Q. 16: ***B***; (Figure 8.18 on Page 179 and Figure 8.21 on Page 181).

Chapter 9: *The Nature of Sound*

Q. 1: ***C***; Sound vibrations are in the form of *longitudinal* waves, not transverse waves (Page 201).

Q. 2: ***D***; Sound waves are propagated by the elastic vibration of particles about their mean positions in simple harmonic motion, and not by the mass movement of the medium. While statements *B* and *C* are also correct, they do not describe the *propagation* of sound waves as definitively as statement *D* (Pages 201-203).

Q. 3: ***A***; The velocity of sound in a medium is directly proportional to the elasticity and indirectly proportional to the density of the medium (Page 202).

Q. 4: ***D***; The human ear is sensitive to an enormous range of sound intensities (Pages 203-205 and Figure 9.15 on Page 210 and Page 208).

Q. 5: ***A***; (Page 203 and Figure 9.4 on Page 202).

Q. 6: ***C***; The perception of sound, heat and light by the human senses is *subjective* (Pages 210-211).

Q. 7: ***C***; Both the *phon* and the *sone* are subjective measures of sound (Pages 210-211).

Q. 8: ***C***; Due to the very wide range of sound intensities that the human ear is sensitive to it was considered useful to adopt a logarithmic scale (Page 204).

Q. 9: ***D***; (Page 204).

Q. 10: ***A***; (Page 210).

Q. 11: ***C***; Studies have shown that the ability to perceive the direction of sound is due to the different arrival times of the sound at the two ears and the slightly different sound levels (not directly covered in the text; see Mehta 1999, 36).

Q. 12: ***A***; The basilar membrane and the cochlea bone are located in the *inner ear* and not the middle ear (Page 212). Statements *B*, *C*, and *D* are correct.

Q. 13: ***A***; Very high noise levels can permanently damage the fine hair cells embedded in the basilar membrane that is wound around the cochlea (Page 213).

Q. 14: ***B***; The upper limit is around *85 dB* and not 95 dB. Since an increase of 3 dB constitutes a doubling of sound, the difference between 85 dB and 95 dB is much larger than the numerical values would appear to suggest (Page 215). Remember that SPLs in dB are based on a logarithmic scale (Pages 204 and 206).

Q. 15: ***A***; (Pages 215-216).

Q. 16: ***D***; A difference of 12 dB would be ideal, but a difference of 10 dB is considered to be quite satisfactory (Page 215).

Q. 17: ***D***; Statement *B* is incorrect because *300 Hz to 1,200 Hz* is not an octave band (Page 206). An octave band is defined as the range of frequencies whose upper limit is twice its lower limit (Pages 208-209).

Q. 18: ***A***; (Page 216).

Q. 19: ***A***; A doubling of sound pressure becomes an increase of 3 dB on the logarithmic SPL scale (Pages 206-208).

Q. 20: ***D***; As a rule of thumb the addition of two SPLs that are 8 dB or more apart is approximately equal to the louder of the two sounds (Page 206).

Chapter 10: *Room Acoustics*

Q. 1: ***C***; Some of the mechanical energy of the sound wave is converted into heat energy due to the friction that is generated as the air moves back and forth inside the pores of the sound absorbing material (Page 232).

Q. 2: ***A***; (Page 231).

Q. 3: ***D***; Both *porous absorbers* and *volume absorbers* convert sound energy into heat (through friction), while *panel absorbers* are based on the principles of diaphragmatic action of an airtight membrane (Page 232).

Q. 4: ***D***; During resonance the movement of the panel will increase thereby converting more sound energy into mechanical energy through the diaphragmatic action of the panel membrane (Page 232).

Q. 5: ***A***; The wavelengths of sound and light are very different. The wavelength of light is very short (i.e., ranging from 0.00011 to 0.00019 IN), while the wavelength of sound ranges from about ½ IN to 30 FT (Figure 8.7 on Page 174 and Figure 9.3 on Page 202, as well as the footnote on Page 227).

Q. 6: ***C***; While the rigidity of the boundary is also a factor, it is only secondary to the weight of the boundary (Page 228).

Q. 7: ***C***; (Pages 229-230).

Q. 8: ***C***; The structure factor is unrelated to the stiffness of the material. Instead it provides a measure of the internal pore configuration of the material (Page 232).

Q. 9: ***D***; Panel absorbers are not nearly as effective as porous absorbers (Pages 234-235).

Q. 10: ***E***; Acoustic ceilings combine the action of porous absorbers and panel absorbers, with the holes providing the properties of a porous absorber. The NRC is defined as the average of the absorption coefficients at 250, 500, 1000, and 2000 Hz (Page 235 and Page 231).

Q. 11: ***D***; The validity of statements *A* and *B* can be readily tested by inspection of equation 10.3 on Page 236 and in Figure 10.10 on Page 235.

Q. 12: ***B***; Speech Interference Level is the average of the SPLs in the three octave bands of 600-1200 Hz, 1200-2400 Hz, and 2400-4800 Hz (Pages 237-238).

Q. 13: ***E***; The communicating sound should be at least 10 dB above the background noise level (see Chapter Nine, Page 215).

Q. 14: ***D***; (Page 248).

Q. 15: ***C***; (Page 251).

Q. 16: ***B***; For good speech intelligibility the Reverberation Time should be quite short, around 1 sec (Pages 251-254 and Figure 10.26).

Q. 17: ***A***; Note that only the volume and total absorption are represented as variables in equation 10.7 (Page 251).

Q. 18: ***B***; (Page 249 and Figure 10.25 on Page 254).

Q. 19: ***A***; (Pages 254-255 and Figure 10.26).

Q. 20: ***D***; A rectangular or fan-shaped internal plan is most likely to provide a strong first reflection to reinforce the direct sound. The volume of the hall is important and a variable in equation 10.7. Finally, the external appearance of a concert hall is important for aesthetic rather than acoustic reasons (Pages 255-257).

Q. 21: ***D***; Beranek considered *intimacy* to be the most important criterion and gave it a maximum of 40 points out of a total of 100 points on his rating scale for concert halls (Page 256).

Q. 22: ***C***; The reverse is true. Wood paneling is a poor reflector of sound at *low* frequencies, not high frequencies (Page 257).

Chapter 11: ***Noise Control and Insulation***

Q. 1: ***E***; Doubling either the mass or thickness of a single-leaf sound barrier will increase the transmission Loss value by 6 dB (Pages 272-273 and Figure 11.6).

Q. 2: ***B***; While both the loudness of the sound and the background noise level will influence the human perception of the transmitted sound, neither has any direct impact on the actual transmission of the sound through the barrier (Pages 271-274 and in particular Figure 11.7).

Q. 3: ***C***; If the frequency of the transmitted sound is the same or close to the natural frequency of the barrier then resonance will take place. This will increase the vibrations in the panel and therefore greatly reduce the sound insulation provided by the barrier (Pages 275-276).

Q. 4: ***C***; This would be true if it were possible to completely decouple the two leaves of a multi-leaf wall. I practice, particularly in the case of low frequency sound, the air in the cavity acts like a set of springs that loosely couple the two leaves (Page 277).

Q. 5: ***D***; Such situations may occur when either the background noise level within a building must be very low (e.g., broadcasting or television studio, music classrooms, concert halls) or the external noise source is very loud (e.g., sawmill, manufacturing plant, under the flight path of an airport). Particularly in the case of low frequency sound such conditions may require completely discontinuous construction for the walls and roof, and floating floor construction (Page 278). It should be noted that this type of construction is significantly more expensive, not only due to the additional material and on-site labor but also because of the need for continuous detailed site supervision.

Q. 6: ***B***; (Pages 294-295).

Q. 7: ***D***; This will be a very expensive building, essentially requiring the construction of two nested building shells that are completely isolated from each other (Pages 281-286 and Pages 296-297).

Q. 8: ***E***; All of the factors cited in statements *A*, *B*, *C*, and *D* influence the Transmission Loss value of a single-leaf partition (Page 274).

Q. 9: ***A***; Direct air paths are the most serious potential flaw in any sound barrier (Pages 273-274 and Figure 11.8). There are several precautions that can be taken to avoid such flanking paths (Pages 283-286 and Figures 11.20, 11.21 and 11.22).

Q. 10: ***D***; (Page 276).

Q. 11: ***B***; All of the approaches for solid-borne sound insulation essentially depend on isolating the sound source from its surroundings in some way (Page 281).

Q. 12: ***D***; (Page 291).

Q. 13: ***D***; (Page 294 and Section 9.3 in Chapter Nine (Pages 206-208)).

Q. 14: ***C***; All surfaces in a *reverberation chamber* must be highly reflective to absolutely minimize the sound absorption in the chamber (Page 279, Figure 11.13, and in particular footnote 2).

Q. 15: ***C***; STC rating tests are performed in two adjoining *reverberation chambers*, not anechoic chambers (Pages 279-280 and Figure 11.13).

Q. 16: ***B***; The resilient layer within a floating floor assembly must be sufficiently strong and *thick* to retain its resilience under dead and live loads during the useful life span of the building (Pages 281-282 and Figures 11.15, 11.16, 11.17, and 11.18). Therefore, it should *not* be "… as thin as possible".

Q. 17: ***A***; The staggered stud construction actually reduces the structural integrity of the wall because of lack of structural continuity between the opposite faces of the wall. The 2 IN gap between each stud and one side of the wall greatly reduces the strength and rigidity of the wall (Pages 283-284 and Figure 11.19).

Q. 18: ***D***; Note in particular as shown in Figure 11.30 the reduced effectiveness of the free-standing wall as the distance between the noise source and the wall increases (Pages 295-296 and Figures 11.29 and 11.30).