Midterm 2, Chapters 11-21

Take a deep breath, read carefully and answer the questions by filling the letter bubble of the correct answer IN THE SCANTRON.

1. How many elements there are in a sample of two atoms, one with 2 protons and 3 electrons, and another one with 2 protons and 1 electron?
   A) 1 element
   B) 2 elements

2. An atom with 2 protons and 1 electron would be an example of
   A) a negative ion
   B) a positive ion
   C) an isotope
   D) a positron

3. A Carbon-12 atom is a standard carbon atom with 6 protons and 6 neutrons, how many neutrons does the Carbon-14 isotope has?
   A) 2
   B) 8
   C) 14
   D) 7

4. All of the matter that we know (dark matter excluded) is made out of quarks and leptons (the electron is type of lepton).
   A) True
   B) False

5. What is the charge of the anti-proton?
   A) Negative
   B) Positive

6. Can we say that Dark Matter produces positive gravity (attractive) and Dark Energy negative gravity (repulsive)?
   A) True
   B) False

7. The *liter* is a unit measure for
   A) Volume
   B) Mass
   C) Density
   D) Area

8. If the density of water is 1 g/cm^3 how many liters you need to get 3 kg of water? (1 liter = 1000 cm^3)
   A) 3
   B) 3000
   C) .3
   D) .003

9. When you hang a 100 g mass from an elastic hair tie, the hair tie stretches 2 cm. If you remove the 100 g mass and hang another object of unknown mass, the hair ties stretches 6 cm. What is the mass of the object? (Assume the hair tie obeys Hooke's law and doesn't stretches beyond its elastic limit).
   A) 200 g
   B) 100/3 g
   C) 600 g
   D) 300 g

10. What is the value of the elastic constant *k* of the hair tie in the above problem? (1 N = 1 kg m/s^2)
   A) 50 N/cm
   B) 5 N/cm
   C) .05 N/cm
   D) 0.5 N/cm

11. If you are standing with both feet and suddenly lift one foot off the ground, what happens to the pressure between you and the ground?
   A) The pressure doubles
   B) The pressure halves
   C) The pressure stays the same

12. An object displaces 3 liters of water and weights 4 kg. Does the object floats?
   A) Yes
   B) No

13. _____ is the average translational kinetic energy of the molecules in a substance/object.
   A) Heat
   B) Temperature
   C) Specific heat capacity
   D) Latent heat

14. _____ is the transfer of energy due to differences in Temperature?
   A) Heat
   B) Temperature
   C) Specific heat capacity
   D) Latent heat

15. The energy absorbed by an object through heat goes all into raising the translational kinetic energy of the object's molecules.
   A) True
   B) False

16. When an object absorbs energy through heat, the _____ of the object tells you how much energy goes into temperature vs. other types of internal energy.
   A) Heat
   B) Temperature
   C) Specific heat capacity
   D) Latent heat

17. The specific heat capacity of object A is twice the specific heat capacity of object B. When object A absorbs 10 Joules of energy through heat, its temperature raises 2°C. How much energy does object B needs to absorb for is temperature to raise 2°C. (A and B have the same mass)
    A) 5 Joules
    B) 20 Joules
    C) 100
    D) 0.1 Joules

18. Imagine your self on the beach in a hot sunny day, most (if not all) of the heat you are absorbing comes from the sun. Which heat transfer mechanism is making you gain energy?
    A) Conduction
    B) Convection
    C) Radiation

19. You still at the beach and you feel a cooling onshore breeze. Which heat transfer mechanism is taking energy away from you?
    A) Conduction
    B) Convection
    C) Radiation

20. Although the cooling breeze felt nice it wasn't enough and you decide to take a dip in the ocean. As soon as you touch the water you instantly feel cooler, which heat transfer mechanism is cooling you off?
    A) Conduction
    B) Convection
    C) Radiation

21. We and all objects are constantly loosing small amounts of heat in the form of _____ as we emit electromagnetic waves in the infrared range of the electromagnetic spectrum?
    A) Conduction
    B) Convection
    C) Radiation

22. What variable/s play a role on determining when and how phase transitions happen?
    A) Temperature
    B) Pressure
    C) Properties of the Material/ Substance
    D) All of the above

23. Evaporation can only happen on the surface of liquids.
    A) True
    B) False

24. What is the heat transfer required for 2 liters of water to go from 50°C, to Ice at 0°C? (The specific heat capacity and heat of melting for water are given in the equation sheet.)
    A) 100 kilo calories
    B) 180 kilo calories
    C) 160 kilo calories
    D) 260 kilo calories

25. In the above problem energy is being transferred from _____.
    A) water to the environment.
    B) the environment to water.

26. After you drive for a while your tires will gain some energy via friction and heat up. If the air inside the tires absorbs 150 Joules of energy by heat, and does 100 Joules of work by expanding and lifting your car a fraction of a millimeter, what is the net change in the internal energy of the air inside the tires? (Hint: Use the first law of thermodynamics)
    A) 100 Joules
    B) 50 Joules
    C) 250 Joules
    D) 150 Joules

27. You just landed on a new planet and would like to know its gravitational acceleration g. You have a pendulum with length $L = 1$ meter and notice that it oscillates with a period $T = \pi$ seconds. What is g on this planet?
    A) 2 m/s^2
    B) 1 m/s^2
    C) 4 m/s^2
    D) 1/4 m/s^2

28. When an earthquake shakes a building at a frequency of 20 Hz, the building resonates increasing dramatically the amplitude of the oscillations, what is the natural frequency of the building?
    A) 10 Hz
    B) 100
    C) 20 Hz
    D) 200 Hz

29. A surfer wants to know the period of the incoming swell (wave train). When a set of waves comes she counts 3 waves passing by in one minute, what is the period between waves?
    A) 60 seconds
    B) 30 seconds
    C) 20 seconds
    D) 10 seconds

30. For the above question, what is the frequency of the swell?
    A) .05 Hz
    B) 0.1 Hz
    C) .03 Hz
    D) 1/3 Hz

31. If the wavelength of the swell (in question 29) is 200 meters, what is the speed of the waves?
    A) 20 m/s
    B) 10 m/s
    C) 67 m/s
    D) 3 m/s

32. Ocean waves are an example of
    A) transverse waves.
    B) longitudinal waves.

33. Sound waves are an example of
    A) transverse waves.
    B) longitudinal waves.

34. When astronomers observe far away galaxies they see the light being redshifted (i.e. the frequency of the observed light waves is lower than what it should be). That is an indication that far away galaxies are
    A) moving away from us.
    B) moving towards us.
    C) not moving.

35. How many octaves apart is the note E @ 330 Hz from the note E @ 1320 Hz ?
    A) 1
    B) 2
    C) 3
    D) 4

Equations Sheet

Density:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Hooke's Law:

$$F = \text{k} \times \Delta x$$

$$F = mg$$

$$g = 9.8 \ \frac{m}{s^2} \simeq 10 \ \frac{m}{s^2}$$

Pressure:

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Specific Heat Capacity :

$$\Delta T = \frac{\text{Heat Transferred}}{\text{mass} \times \text{Heat Capacity}} = \frac{Q}{mc}$$

$$Q = mc\Delta T$$

$$\text{Water's heat capacity} = c_{\text{water}} = 1\frac{cal}{g^{\circ}C}$$

Heat Required for Phase Transitions (Latent Heat):

$$L = \text{Latent Heat}$$

$$Q = mL$$

$$L_{\text{ice-water}} = 80 \ cal \ ,$$

$$L_{\text{water-steam}} = 540 \ cal$$

First Lay of Thermodynamics:

$$\Delta U = Q - W$$

$$\text{Change in Internal Energy} = \text{Heat added} - \text{Work}$$

Vibrations and Waves:

$$\text{Frequency} = \frac{1}{\text{Period}}$$

$$\text{Wave Speed} = \text{Frequency} \times \text{Wave Length}$$

$$\text{Wave Speed} = \frac{\text{Wave Length}}{\text{Period}}$$

Pendulum:

$$T = 2\pi\sqrt{\frac{L}{g}}$$