PHY103 TUTORIAL

Tutorial 1

1. The tendon in a man's leg is $10\,cm$ long and $0.45\,cm$ in diameter. How much will it be stretched by force of $5\,N$ if the young's modulus for the tendon is $1.6\,X\,10^8\,N/m^2$?
2. A specimen of oil having an initial volume of $500\,cm^3$ is subjected to a pressure of $10^6\,N/m^2$ and the volume decreases by $0.15\,cm^3$. What is the bulk modulus for the oil?
3. A metal wire $75.0\,cm$ long and $0.130\,cm$ in diameter stretches $0.0350\,cm$ when a load of $8.00\,Kg$ is hung on its end. Find the stress, the strain and the Young's modulus for the material of the wire
4. A solid cylindrical steel column is $4.0\,cm$ long and $9.0\,cm$ in diameter. What will be its decrease in length when carrying a load of $80000\,Kg$? $Young's\ modulus$ (Y) = $1.9\,X\,10^{11}Pa$
5. A bulk modulus of water is $2.1\,GPa$. Compute the volume contraction of $100\,ml$ of water subjected to a pressure of $1.5\,MPa$.
6. By how much will a wrought iron bar $0.006\,m^2$ in cross section area and $2\,m$ long shorten under a compressive load of $2500\,N$, if the Young's modulus of wrought iron is $1.83\,X\,10^{11}$N/m^2?
7. When a $400\,g$ mass is hung at the end of a vertical spring, the spring stretches $35\,cm$. What is the spring constant of the spring, and how much further will it stretch if an additional $400\,g$ mass is hung from it?

Tutorial 2

1. The mattress of a water bed is 2m long by 2m wide and 30cm deep. Find the weight of the water in the mattress.
2. Find the pressure due to the fluid at a depth of 76 cm in still (a) water ($\rho_w = 1.00\ g/cm^3$) and (b) mercury ($\rho = 13.6\ g/cm^3$)
3. Atmospheric pressure is about 1.0 X 10^5 Pa. How large a force does the still air in a room exert on the inside of a window pane that is 40 cm X 80 cm?
4. You have just purchased a chain claimed to be pure gold. The chain weighs 60 g and it displaces 4.0 cm3 of water when fully immersed. Is it pure gold? (s.g of gold = 19.3)
5. State Archimede's principle
6. How high would water rise in the pipes of a building if the water pressure gauge shows the pressure at the ground floor to be 270 KPa.
7. A man's brain is approximately 0.33 m above his heart. If the density of human blood is 1.05 X 10^3 Kg/m^3, determine the pressure required to circulate blood between the heart and the brain.
8. In a car lift used in a service station compressed air exerts a force on a small piston that has circular cross section and radius of 5.00 cm. This pressure is transmitted by a liquid to the piston that has a radius of 15.0 cm. What force must the compressed air exert to lift a car weighing 13300 N what air pressure produces this force.
9. State Pascal's Principle
10. The area of a piston of a force pump is 8 X 10^{-4} m^2. What force must be applied to the piston to raise oil (d = 780 Kg/m^2) to a height of 6.0 m? Assume the upper end of the oil is open to the atmosphere.

11. A swimmer whose body's surface area is approximately 1.6 m2 lies at a depth of 3 m below the water surface. How much force is exerted on his body due to water pressure?
12. A hydraulic lift has a narrow cylinder of area 19.64 cm2 and wide cylinder of area 1256.8 cm. Calculate the force that must be applied to the liquid in the small cylinder to lift a car 1950 Kg.
13. A solid aluminum cylinder has a measured mass of 67 g in air and 45 g when immersed in turpentine. What is the buoyant force?
14. The xylem tubes which transport sap to the top of a tree can be considered as uniform cylinders. If the transport of sap is entirely due to capillarity, determine the diameter of the tubes which will move sap up a tree which is 25 m tall. (Take the specific gravity and surface tension of sap as 1.0 and 5 X 10^{-2} N/m and contact angle with the tubes as 45^0
15. A piece of alloy has a measured mass of 86 g in air and 73 g when immersed in water. Find its volume and its density.
16. Two (glass) capillary tubes of diameters 0.05 mm and 2.00 mm are dipped in a pool of water. How high will the water rise in each of the tubes? (Taking surface tension as and contact angle between glass and water 7.3 X10^{-2} N/m and 0^0 respectively)

Tutorial 3

1. In an uncalibrated mercury thermometer, the length of the mercury thread above the bulb, in the capillary, is 18mm at a temperature of melting ice and 138mm at a temperature of steam. When placed in hot liquid, the length of the mercury thread is 118mm. Calculate the temperature of the liquid.
2. At what temperature will the Celsius and Fahrenheit temperature scales record the same reading?
3. A malaria patient has a body temperature of 39.5^0C. Convert this temperature to (a) ^0F (b) K
4. A steel rod increases its length by 5mm when the temperature increases by 10^0C. What is the initial length of the rod if the coefficient of linear expansion for steel is $1.1\text{x}10^{-5}$ per ^0C?
5. How much heat must be added to a $4.0\text{x}10^{-3}$kg steel ball bearing in order to increase its temperature by 30K if the specific heat capacity of steel is $4.49\text{x}10^2$J/Kg.K? And how much will the temperature of the ball increase if it were made of gold of specific heat capacity $1.29\text{x}10^2$J/Kg.K rather than steel?
6. A $2.0\text{x}10^{-2}$ kg ice at 0^0C is dropped into a vacuum bottle originally holding 0.4 kg of water at 35^0C. Assuming that any loss or gain of heat by the vacuum bottle is negligible, determine (a) the heat to melt the ice and (b) the final temperature after thermal equilibrium is attained
7. What is the absolute temperature of boiling water and melting ice?
8. Determine the temperature whose Fahrenheit and Kelvin scales have the same reading.
9. A scientist uses a γ scale for measuring temperature. In this scale water melts at $10^0\gamma$, and boils at $130^0\gamma$. The scientist measures the temperature at which sodium melts to be $127^0\gamma$. Express this temperature in Kelvin.

10. A glass flask of volume $100cm^3$ is filled to the brim with liquid whose cubical coefficient of expansion is $1x10^{-3}$ per ^0C. The flask and its liquid content are originally at 20^0C. Determine the volume of liquid which will overflow upon heating the flask to 50^0C if the coefficient of linear expansion of glass is $8x10^{-6}$ per ^0C?
11. $500cm^3$ of water is to be heated from room temperature (28^0C) to 100^0C in order to prepare hot cup of coffee. (a) What is the minimum heat required? (b) How long will it take to heat the water with a 1000W heating coil which has a heating efficiency of 70%?
12. A 40kg metal slab at temperature 600^0C is taken from a furnace and plunged into 300kg of oil originally at 25^0C. The final temperature of the oil/slab is 40^0C. Determine the specific heat capacity of the metal if that of oil is 2100J/kg. ^0C.
13. A 100g ice-block at -20^0C is dumped into a thermally insulated container of water at 0^0C. How much water is frozen if the specific heat of ice is 2302 J/Kg. ^0C and latent heat of fusion is $3.35x10^5$ J/Kg?

Tutorial 4

1. Determine the quantity of heat which is conducted in 30 minutes through an iron plate 2.0cm thick and 0.10 m^2 in area if the temperature of the two sides 0^0C and 20^0C. The coefficient of thermal conductivity of iron is 0.12ca/s.cm. ^{0}C.
2. The inside surface of a wall of a home is maintained at constant temperature of 25^0C while the inside air is at 15^0C. How much heat is lost by natural convection from the 8.0m x 4.0 m in 24 hours if the average convection coefficient is 3.49 J/s.m^2 ^{0}C?
3. One end of a 30 cm long aluminum rod is exposed to a temperature of 500^0C while the other end is maintained at 20^0C the rod has a diameter of 2.5 cm. if heat is conducted through the rod at the rate of 142 kcal/hr, calculate the thermal conductivity of aluminum.
4. A thin hot plate which measures 20 cm x 20 cm is maintained at a temperature of 100^0C. It is suspended in air at 25 ^{0}C. Determine the heat transferred by convection from both sides of the plate to the surrounding air in one hour if the coefficient of convective heat transfer is 5.0 J/s.m^2. ^{0}C.
5. Determine the electric power that must be supplied to the filament of a bulb operating at 3000K. The total surface area of the filament is 8 x 10^{-6} m^2 and its emissivity is 0.92.
6. A 10 cm diameter metal sphere of emissivity 0.9 is located in a room whose walls are maintained at a temperature 27 ^{0}C. At what rate must energy be supplied to the sphere in order to maintain its temperature at 100 ^{0}C? (neglect heat loss by convection)

Tutorial 5

1. For each of the following Adiabatic processes, find the internal energy
   (a) A gas does 5J of work while expanding adiabatically.
   (b) During an adiabatic compression, 80J of work is done on a gas.
2. A 50 kg mass is placed on a piston fitted to a gas cylinder. If 149J of heat energy is supplied to the gas cylinder, increasing its internal energy by 100J, determine the height to which the mass on the piston is raised.
3. A Carnot engine is operated between two heat reservoirs at temperatures 400K and 300K. If the engine receives 2000 cal from the 400 K reservoir, (a) how many calories does it reject to the lower temperature reservoir? (b) What is the thermal efficiency of the engine?
4. In each of the following situations, find the change in the internal energy of the system.
   (a) A system absorbs 500 cal of heat and at the same time does 420 J of work.
   (b) A system absorbs 300 cal of heat and at the same time 420 J of work is done on it.
   (c) 1200 calories is removed from a gas held at constant volume. Give your answers in kilojoules.
5. What is the maximum efficiency of an engine which operates between two reservoirs at temperatures of 25 ^{0}C and 40 ^{0}C.
6. A Carnot engine operating between two reservoirs at temperatures 0^0C and 100^0C receives 10 kJ of heat from the high temperature reservoir. Calculate
   (a) The heat rejected to the low temperature reservoir.
   (b) The work done by the engine
   (c) The thermal efficiency

Tutorial 6

1. A fixed mass of gas is 2000cm^3. If the pressure is reduced to $\frac{1}{5}$ of its original value while the temperature remains constant, what is its new volume?
2. The gauge pressure at S.T.P. of a certain amount of gas occupying a volume of $0.05\ m^3$at a temperature of $27\ ^0$C is$1.99\ X\ 10^5\ Pa$. Calculate the new gauge pressure if the volume is decreased to $0.02\ m^3$ and the temperature increased to $127\ ^0$C
3. Gas in a tank has a gauge pressure of $2.202\ X\ 10^5\ Pa$ and volume $4\ m^3$ at $27\ ^0$C. Calculate the gauge pressure when the gas is compressed to $0.025\ m^3$ and the temperature has risen to 40 ^{0}C.
4. Gas occupying a container has a pressure of $1.5\ atms$ at $45\ ^0$C. Calculate the gauge pressure when the container and its content are cooled to $0\ ^0$C. Assume the change in volume of container is negligible.
5. The average kinetic energy of a molecule of a gas depends on ----------
   (a) Pressure (b) Temperature (c) Time (d) Volume
6. A certain mass of hydrogen gas occupies $370\ L$ at 16 ^{0}C and $150\ Pa$ Find its volume at $-21\ ^0$C and $420\ Pa$
7. What is the root mean square speed of a nitrogen molecule at 0^0C given that $k = 1.38\ X\ 10^{23}\ J/K$, N_0 = 6.022 X 10^{23} molecule/mol. and M = 28 g/mol?
8. A 2.0 g droplet of liquid nitrogen is present in a 30 cm3 tube as it is sealed off at very low temperature. What will be the nitrogen pressure in the tube when it is warmed to 20 ^{0}C? (M for nitrogen is 28 g/mol., R = 8.314J/mol.K)
9. Determine the volume occupied by 4.0 g of oxygen (M = 32 g/mol.) at S.T.P

10. 18.5 g of nitrogen occupies 5 L at 27 ^{0}C. If nitrogen has a mass of 28 g/mole, calculate the pressure of the gas, assuming it is an ideal gas.
11. Calculate average translational kinetic energy of a nitrogen molecule at 27 ^{0}C
12. Calculate the root-mean-square speed of helium atom at 40 ^{0}C. Assume helium gas consists of single helium atoms and helium is 4.0 Kg/Kmole.

GENERAL TUTORIAL A

1. Kinetic energy of molecule is highest in which state of matter.
   (a) Solid (b) Liquid (c) Gas (d) Solid and Gas

2. A bulk modulus of a liquid is 3.2 Gpa, compute the volume constraction of 100 cm^3 of the liquid subjected to a pressure of 1.6 Gpa.
   (a) 50 cm^3 (b) 0.5 cm^3 (c) 5.0 cm^3 (d) 0.05 cm^3

3. Calculate the density of a fluid in a container of height 30 cm which has a pressure of 6.2 pa.
   (a) 0.021 kg/m^3 (b) 106 kg/m^3 (c) 4.83 kg/m^3 (d) 2.1 kg/m^3

4. A water bed is 5cm long 2m wide and 50cm deep find weight of the bed.
   (a) 50 N (b) 490 N (c) 500 N (d) 500 N (d) 5 N

5. A hydraulic lift has an area of 19.64 cm^2 and wide area of 1256.8 cm^2. Calculate the force applied to the area to lift a car 1960 kg.
   (a) 30.47 N (b) 12.65 N (c) 280 N (d) 112 N

6. A solid aluminum cylinder has a measured mass of 67 g in air and 45g when immersed in kerosine. Calculate its buoyant force.
   (a) 0.657 N (b) 0.400 N (c) 22 N (d) 0.216 N

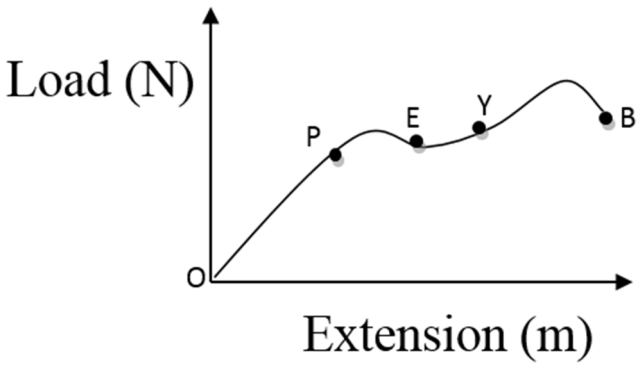
7. When heat is absorbed or released during a phase change it is called?
   (a) Heat capacity (b) specific heat capacity (c) latent heat (d) substance heat

8. The measure of an object ability to emit infrared rays is called
   (a) Radiation (b) convention (c) emissivity (d) radiation power

9. Which of this is an adiabatic process
   (a) $\Delta Q = \Delta W$ (b) $\Delta U = -\Delta W$ (c) $\Delta Q = \Delta U$ (d) $\Delta W = 0$

10. Calculate the internal energy of a system when the work done on the system is 10 J and heat generated is 25 J.

    (a) - 15 J (b) 15 J (c) 35 J (d) - 35 J



From the graph of Load Vs Extension shown above answer question 1 and

11. Point **P, E, Y** and **B** are

(a) Proportionality limit, Elastic limit, Yield point and Breaking point
(b) Elastic limit, Yield point, Breaking point and Proportionality limit
(c) Yield point, Proportionality limit, Elastic limit, and Breaking point
(d) Breaking point, Proportionality limit, Yield point and Elastic limit

12. Region **OE** and **EB** are called

(a) Breaking region and Plastic region respectively
(b) Elastic region and Plastic region respectively
(c) Plastic region and Elastic region respectively
(d) Inelastic region and Plastic region respectively

13. By how much will a wrought iron bar $0.001\ m^2$ in cross section area and $1\ m$ long shorten under a compressive load of $1000\ N$, if the Young's modulus of wrought iron is $5.0\ X\ 10^{10}$N/m^2?
(a) $2.0\ X\ 10^{-12}\ m$ (b) $1.20\ X\ 10^{-7}$ m (c) $3.0\ X\ 10^{-10}\ m$ (d) $2.9\ X\ 10^{-11}\ m$

14. The density of an Aluminum foil 2.70 g/cm^3. What will the density be in kg/m^3?
(a) 270 kg/m^3 (b) 2700 kg/m^3 (c) 27000 kg/m^3 (d) 270000 kg/m^3

15. Which of the following statement is correct about Pascal's principle in operation of hydraulic press
(a) Pascal's Principle state that when the pressure of any part of a confined fluid (liquid or gas) is changed, the pressure on every other part of the fluid is also changed by the same amount.
(b) Pascal's Principle state that when the temperature of any part of a confined fluid (liquid or gas) is changed, the temperature on every other part of the fluid is also changed by the same amount.

(c) Pascal's Principle state that when the pressure of any part of a confined solid is changed, the pressure on every other part of the solid is also changed by the same amount.
(d) Pascal's Principle state that deformation of elastic body is directly proportional to force applied provided that the limit of proportionality is not exceeded

16. The xylem tubes which transport sap to the top of a tree can be considered as uniform cylinders. If the transport of sap is entirely due to capillarity, determine the diameter of the tubes which will move sap up a tree which is 25 m tall. (Take the specific gravity and surface tension of sap as 1.0 and 5 X 10-2 N/m and contact angle with the tubes as 45^0)

(a) $5.01\ X\ 10^{-5}\ m$ (b) $1.20\ X\ 10^{-5}$ m (c) $6.89\ X\ 10^{-5}\ m$ (d) $2.89\ X\ 10^{-7}\ m$

17. A scientist uses a γ scale for measuring temperature. In this scale water melts at $10^0\gamma$, and boils at $130^0\gamma$. The scientist measures the temperature at which sodium melts to be $127^0\gamma$. Express this temperature in Kelvin.
(a) 370.65 K (b) 180.31 K (c) 150.65 K (d) 380.69 K

18. A vertical spring has a length of 25cm when a 150g mass is hung from its end and its length is 30cm with 250g hanging from it. What is the spring constant?
    a) 19.6N/cm
    b) 19.6n/m
    c) 109.6N/m
    d) 19.6N/m
    e) 19.6N/km

19. An iron rod stretches 1mm when a mass of 200kg is hung from its lower end. What is the Young's modulus if the rod is 3m long and $0.4cm^2$ in cross section?

    a) 16.3N/m
    b) 153.3N/m
    c) $163.3N/m^2$
    d) $163.49N/m^2$
    e) $163.3N/cm^2$

20. A steel wire with 1.5mm diameter has a length of 2.5m, about how much will the wire stretches when a load of 6.0kg is attached to its end. [Y= 195MPa]

    a) 4.26cm
    b) 4.26m
    c) 4.26km
    d) 5.26cm

e) $4.26cm^2$

21. A metal cylinder of mass 60kg and 3m long stands vertically on one end of area 22cm2. What pressure does the cylinder exert on the floor?

    a) 2.67×10^{-5} N
    b) 2.67×10^{-5} P
    c) 2.67×10^{5} Pa
    d) 2.607×10^{-3} Pa
    e) 2.67J

22. A truck weighing 4500kg is to be lifted using hydraulic lift. If the diameter of the large piston of the lift is 3m, what pressure must be applied?
    a) $6239N/mm^2$
    b) $6239J/m^2$
    c) $6239N/km^2$
    d) $6239N/cm^2$
    e) $6239N/m^2$

23. Under a pressure of 20atm, hydrogen may be liquidified at -235^oC. What is the Temperature on the Fahrenheit scale?
    a) 391^oF
    b) -391^oF
    c) -391^oC
    d) -391K
    e) -391F

24. What is the temperature of liquid hydrogen at 20K on Fahrenheit scale?
    a) 423^oF
    b) -43^oF
    c) -423F
    d) -423K
    e) -423^oF

25. A block of gelatin is 60 mm by 60 mm by 20 mm when unstressed. A force of .245 N is applied tangentially to the upper surface causing a 5 mm displacement relative to the lower surface. The block is placed such that 60X60 comes on the lower and upper surface. Find the shearing stress, shearing strain and shear modulus
    (a) ($68.1\ N/m^2$, .25 , $272.4\ N/m^2$)
    (b) ($68\ N/m^2$, .25 , $272\ N/m^2$)

(c) (67 N/m^2 , .26 , 270.4 N/m^2)
(d) (68.5 N/m^2 , .27 , 272.4 N/m^2)

26. A steel wire of diameter 4 mm has a breaking strength of $4X10^5N$. The breaking strength of similar steel wire of diameter 2 mm is
(a)$1X10^5N$.
(b) $4X10^5N$.
(c) $16X10^5N$.
(d) none of the these

27. What is the SI unit of modulus of elasticity of a substance?
(a) Nm^{-1}
(b) Nm^{-2}
(c) Jm^{-1}
(d) Unit less quantity

28. A thick uniform rubber rope of density 1.5 gcm^{-3} and Young Modulus $5X1010^6$ Nm^{-2} has a length 8 m. when hung from the ceiling of the room, the increase in length due to its own weight would be ?

(a) .86m
(b) .2m
(c) .1m
(d) .096m

29. A 2 kg load is hung from the end of a spring. The spring then stretches a distance of 10 cm. If, instead, a 6 kg load is hung from the same spring, how much will the spring stretch? (Assuming that none of this load stretches the spring beyond elastic limit).
(a) 0.03 cm
(b) 0.3 cm
(c) 3.0 cm
(d) 30 cm

30. A scientist uses a γ scale for measuring temperature. In this scale water melts at $10^0\gamma$, and boils at $130^0\gamma$. The scientist measures the temperature at which sodium melts to be $127^0\gamma$. Express this temperature in Kelvin.
(a) 370.65 K
(b) 180.31 K
(c) 150.65 K
(d) 380.69 K

31. Which of the following is a good conductor of heat?

(a) Brick
(b) Water
(c) Argon
(d) Silver

32. A solid cylindrical steel is 6.0 cm long and has a radius of 5×10^{-2}m. What will be its decrease in length when carrying a load of 90000 kg? (Young modulus of steel is 1.9×10^{11}Pa
(a) 9.36×10^{-8}m
(b) 3.5×10^{-5}-m
(c) 8.5×10^{-5}m
(d) 10.5×10^{-5}m

33. On a cold day, why does a metal doorknob feel colder than the wooden door?
(a) Conduction of heat
(b) Convection of heat
(c) Radiation
(d) None of the above.

34. A piece of alloy has a measured mass of 100 g in air and 48 g when immersed in water. Determine its volume and density

(a) $5.2 \times 10^{-5}m^3$ and 1.92×10^3 Kg/m^3

(b) $2.24 \times 10^{-5}m^3$ and 3.57×10^3 Kg/m^3

(c) $13.0 \times 10^{-5}m^3$ and 0.6×10^3 Kg/m^3

(d) 130.0×10^{-5}m and 0.06×10^3 Kg/m^3

35. Which of the following thermometers can be used for taking very accurate measurement of temperature?
(a) Mercury in glass thermometer
(b) Alcohol in glass thermometer
(c) Constant volume thermometer
(d) Electrical in glass thermometer

36. The density of mercury is 13.6 g/cm^3 and that of alcohol is 0.8 g/cm^3. In which of these substances will a solid cube of brass (density is 8.6×10^3 Kg/m^3) sink?
(a) Mercury
(b) Alcohol
(c) Both

37. What is the mass of ammonia (NH_3) molecule in kilogram?
    a. 2.82×10^{-26} kg
    b. 3.52×10^{-26} kg
    c. 0.82×10^{-26} kg
    d. 2.56×10^{-26} kg
38. Consider a 40kg young man to be a huge molecule. What is his mass in atomic unit?
    a. 3.6×10^{28}u
    b. 7.9×10^{-26}u
    c. 3.6×10^{-26} u
    d. 2.82×10^{28}u
39. A monoatomic gas of mass 2.1212g occupies 1.49L when the temperature is 0 ^{0}C at a pressure of 810.6kPa. What is the gas?
    a. Helium
    b. Hydrogen
    c. Oxygen
    d. Carbon
40. The temperature of the hydrogen molecules (H^2) is 373.15K (100^{o}C). Calculate the root-mean-square speed of the hydrogen molecules at this temperature.
    a. $3.15kms^{-1}$
    b. $2.15kms^{-1}$
    c. $2.755kms^{-1}$
    d. $3.52kms^{-1}$
41. Determine the thermodynamic temperature at which the Celsius temperature is ¾ the Fahrenheit temperature.
    a. 204.58K
    b. 215K
    c. 307K
    d. 305K
42. What is the maximum amount of work that a Carnot engine can perform per kilojoules of heat input it it absorbs heat at 427oC and exhausts heat at 177^{o}C?
    a. 1.49kJ
    b. 3.59kJ
    c. 1.89kJ
    d. 1.33Kj

43. With a weight of 25 kg, a spring stretches 6 cm. Its elastic limit is reached with a weight of 150 kg. How far did the spring stretch?

44. When the weight hung on a spring is increased by 60 N, the new stretch is 15 cm more. If the original stretch is 5 cm, what is the original weight?

45. The elastic limit of a spring is reached with a weight of 90 kg. In this situation, the final stretch is 20 more the original. If the original weight is 75 less the final weight, what is the final stretch?

46. State Archimedes' principle and deduce it from the laws of liquid pressure.

47. During a bout with flu, an 80 kg man ran a fever of 39^0C (102.2^0F) instead of the normal body temperature of 37^0C (98.6^0F). Assuming the human body is mostly water, how much heat is required to raise his temperature by that amount? (specific heat of water is 4190J/kg.k)

48. A steel rod increases its length by 5mm when the temperature increases by 10^0C. What is the initial length of the rod if the coefficient of linear expansion for steel is 1.1×10^{-5} per ^{0}C?

49. Determine the workdone by an ideal Carnot engine, if it takes 2092kJ of heat from the source at 317 ^{0}C, does some external work and delivers the remaining energy to a heat sink at 117 ^{0}C. How much heat is delivered to the sink?

50. A heat engine absorbs 400J of heat from a hot reservoir, performs work and exhaust 350J to a cold reservoir. Determine its efficiency?

51. In a gas of Deuterium nuclei, nuclear fusion reaction will occur provided that the nuclei possess an average kinetic energy of at least 0.72MeV. What will the air temperature be at height 1100m?

52. If 2 moles of an ideal diatomic gas is increased from a volume of $2m^3$, isothermally at temperature of 500K to $5m^3$. a. How much work was done by the gas? b. How much heat was supplied to gas? ($R=8.314Jmol^{-1}kg^{-1}$)

53. What is the change in the internal energy of the system which (i) absorbs 2000J of heat and produces 500J of work? (ii)Absorbs 1100J of heat and 400J of work is done on it?

54. The design of a Carnot-type engine is such that it operates between 450 and 350K. Assuming that the engine actually produces 1.0kJ of mechanical energy per kilocalorie of heat absorbed, compare the actual efficiency with the theoretical maximum efficiency.

55. For a temperature rise of 55 ^{0}C, a rod of 5m long is found t have expanded by 0.081cm in length. What is the linear expansivity for the material?

    …….(2.9X10-6K^{-1}

56. How much heat is required to heat 0.5kg of Aluminum at 30 ^{0}C to its melting point and then convert it all to liquid? Melting Point of Aluminum is 660 ^{0}C …… (ANS: 450.5kJ)

57. 1kg of water at 220^{o}C is poured into a metal dish of 0.7kg in mass. An iron bar weigh s 0.5kg at 120^{o}C is dropped into the water and the final temperature reads 24.9^{o}C. What is the material of the dish? [Specific heat Capacity of water, c_w= 4.184Kj/kgK; Specific heat Capacity of Iron c_i=0.46kJ/kgK

    …….(ANS: 0.40Kj/kg.^{o}C)

GENERAL TUTORIAL B

1 The dimensions of viscosity in terms of M,L,T is ?

- $ML^{1}T^{-1}$
- $M^{-1}LT^{-1}$
- $ML^{-1}T^{-2}$
- $ML^{-1}T^{-1}$

2. A man is sitting in a boat which is floating on a pond. The man drinks some water from pond. What happens to the water level in the pond? The water level will

- Rises
- falls
- remains unchanging
- Not enough information

3. A body floats in water with 40% of its volume outside water.When the same body floats in some liquid,60% of its volume remains outside the liquid. The relative density of the liquid is

- 1.5
- 1.2
- .6
- None of these

4. A closed compartment containing gas is moving with some acceleration in horizontal direction. Then the pressure in the compartment is? Neglect the effect of gravity

- lower in the front side
- same everywhere
- lower in the rear side
- Not enough information

5. A object of relative density 10 is released from rest on the surface of a lake.if the viscous effect are ignored ,the object sinks in the water with an acceleration ?

- 10g
- 9g/10
- 11g/10
- None of these

6. Machine parts are jammed in winter due to

- Increase in surface tension of lubricant
- Decrease in viscosity of lubricant
- Decrease in surface tension of lubricant
- increase in viscosity of lubricant

7. A horizontal pipeline carries water in a stream line flow? At point A along the pipe,the cross-sectional ared is $10cm^2$,the water velocity is 1m/s amd pressure is 2000Pa.What is the pressure at point B where cross-sectional area is 5.0 cm^2

- 500 Pa
- 400 Pa
- 300Pa
- None of the above

8. A big drop of water is broken into large number of small drops? The surface energy would

- Remains unchanged
- will increase
- will decrease
- Not enough information

9.A U tude containing a liquid is acclerated horizontally with constant acceleration a .The separation between the limb's is L. The Difference in the height of the liquid in the two arms would be

- $L(a/g)^{1/2}$
- aL/gL
- L/2
- a^2L/g^2L

10.A block of wood has a mass 25 g. When a 5g metal piece with a volume $2cm^3$ is attached to the bottom of the block,the wood barely floats in water what is the volume of the V of the wood

- $20cm^3$
- $38cm^3$
- $28cm^3$
- None of these

11. A solid sphere of radius R,made up of a material of bulk modulus K is surrounded by a liquid in a cylinderical container. A massless piston of area A floats on the surface of the liquid.When a

mass M is placed on the piston to compress the liquid,the fractional change in the radius of the sphere is

- Mg/2AK
- 3Mg/AK
- Mg/3AK
- Mg/AK

12. A small hole is there near the bottom of the water filled container. The speed of the water ejected depends on

- Density of the liquid
- acceleration due to gravity
- height of the liquid above the hole
- All of the above

13. if the hollow bob of a simple pendulum be filled with mercury that drains out slowly,its time period

- increases continously
- decreases continously
- remains same
- first increases and then decreases

14. Water leaves a faucet with a downward velocity of 3 m/s. As the water falls below the faucet,it accelerates with acceleration g. The cross-section area of the water stream leaving the faucet is 1.0 cm^2. What is the cross-sectional area of the stream .5m below the faucet?

- .50 cm^2
- .9 cm^2
- .1 cm^2
- .69 cm^2

15. Water rises to a height of 13.6 cm in a capillary tube dipped in water.When the same tube is dipped in mercury ,it is depressed by $3(2)^{1/2}$. The angle of contact in water =0 The angle of contact in mercury =135^0 Given : Relative density of mercury =13.6 Find out the ratio of the surface tensions of mercury and water

- 6
- 5
- 11
- None of these

16. Which of the following equations is <u>not</u> correct:

a) Force = mass x acceleration

- b) Density = Volume /Mass
- c) Pressure = density x acceleration x height
- d) Pressure = Force /Area

17. Air pressure at sea level is 14.5 lbs/sq. inch. Why do we not feel this pressure pushing on us?

- a) the amount is neglible to the feeling of gravity
- b) we have grown accustomed to it since we were born
- c) the fluids in our body are pushing outward with the same force
- d) the force of gravity negates the feeling of pressure

18. The static fluid pressure at any given depth depends on:

- a) total mass
- b) surface area
- c) distance below the surface
- d) all of the above

19. In the equation for Pressure -- P = rho x g x h, the units for g (SI system) are:

- a) kg/m^3
- b) m/sec
- c) kg-m/sec
- d) m/sec^2

20. What is the pressure at the bottom of a swimming pool that is 3 meters in depth?

- a) $(1.01 \times 10^5) + (1.09 \times 10^5)$ Pa = 2.10×10^5 Pa
- b) $(1.01 \times 10^5) + (3.63 \times 10^4)$ Pa = 1.36×10^5 Pa
- c) $(1.01 \times 10^5) + (7 \times 10^4)$ Pa = 1.71×10^5 Pa

GENERAL TUTORIAL C

Question 1

Object A is 2 kg. It has a temperature of 40°C and has an internal energy of 500000 J. Object B is 2 kg. It has a temperature of 50°C and has an internal energy of 400000 J. Which of the following statements is correct?

A Heat flow from object A to object B.
B Heat flow from object B to object A.
C No heat flow between object A and object B.
D There is not enough information to determine the direction of heat flow.

Question 2

2 kg of ice at 0°C is floating on 5 kg of water at 0°C. Which of the following statements is true?

A Heat flow from ice to water
B Heat flow from water to ice
C No heat flow between ice and water
D There is not enough information to determine the direction of heat flow.

Question 3

Conduction is a transfer of thermal energy via

A Vibration of the particles
B Differences in densities
C Movement of particles from one place to another
D Radiation of wave

Question 4

Convection is transfer of thermal energy due to

A Vibration of the particles
B Expansion of fluid
C Movement of particles from one place to another
D Radiation of wave

Question 5

What is radiation?

A Transfer of thermal energy by wave which does not require a material medium
B Transfer of thermal energy by vibration of nucleus
C Transfer of thermal energy by the movement of free electrons
D Transfer of thermal energy by movements of molecules due to a difference in densities.

Question 6

Give a reason why Aluminum is a better conductor than wood?

A Aluminum has a higher density than wood.
B Aluminum has a higher specific heat capacity than wood
C Aluminum has more free electrons than wood

D Aluminum has a higher mass than wood

Question 7

Conduction happens in

A Solid only
B Liquid only
C Solid and liquid only
D Solid, Liquid and gas.

Question 8

Convection happens in

A Liquid only
B Gas only
C Liquid and gas only
D Solid, liquid and gas

Question 9

Which of the following statements about radiation is true?

1. Radiation can pass through solids
2. Radiation can pass through liquids
3. Radiation can pass through gases

A 3 only
B 2 and 3 only
C 1 and 3 only
D 1, 2 and 3

Question 10

Which of the following heat transfer processes can take place in vacuum?

1. Conduction
2. Convection
3. Radiation

A 1 only
B 3 only
C 1 and 2 only
D 1, 2 and 3

Question 11

Which of the following heat transfer processes is/are caused by the movement of particles?

1. Conduction
2. Convection
3. Radiation

A 1 only
B 3 only
C 1 and 2 only
D 1, 2 and 3

Question 12

Which of the following about conduction is/are true?

1. Conduction can transfer thermal energy faster in denser medium.
2. Conduction cannot happen together with convection.
3. Conduction can transfer thermal energy faster through good electrical conductors.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 13

The white porcelain lid of a cup of hot drink is to

1. reduce loss of thermal energy by evaporation.
2. reduce loss of thermal energy by radiation.
3. reduce loss of thermal energy by convection.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 14

The wooden handle of a pot

A Prevents the transfer of thermal energy by conduction to the hand.
B Reduces the transfer of thermal energy by conduction to the hand.
C Prevents the transfer of thermal energy by radiation to the hand.
D Reduces the transfer of thermal energy by radiation to the hand.

Question 15

During a barbecue, why do we always cook food on top of the charcoal?

A To increase the rate of heat transfer by conduction.
B To increase the rate of heat transfer by convection
C To increase the rate of heat transfer by radiation
D To increase the rate of heat transfer by evaporation

Question 16

Which of the following about the vacuum flask are correct?

1. The silvered surface reduces loss of thermal energy by radiation.
2. The vacuum in the flask reduces loss of thermal energy by radiation.
3. The stopper reduces loss of thermal energy by convection and evaporation.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 17

Cooling fins are used in refrigerators, car radiator and many other cooling devices to dissipate thermal energy out of the system to the environment. Which of the following statements about the cooling fins are correct?

1. The cooling fins are made of metal to ensure that thermal energy is being conducted quickly out to the environment.
2. The cooling fins are thin for heat to be dissipated to the environment quickly via convection and radiation.
3. Cooling fins are normally black to achieve higher rate of thermal energy radiation.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 18

Petrol storage tanks are not painted black because

A Black is a good conductor of heat.
B Black is a bad conductor of heat.
C Black is a good emitter of radiation.
D Black is a good absorber of radiation.

Question 19

How does a polar bear keep itself warm?

1. By salivating
2. By having thick fur
3. By having white fur

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 20

Which of the following is false?

A Dog drools (salivates) to allow heat loss by evaporation.
B Elephant sprays water over its body to allow heat loss by evaporation.
C Jack rabbit has enormous ears with many blood vessels to dissipate thermal energy
D Camel has big humps to store water so that it can dissipate thermal energy by convection.

Question 21

Which of the following is false?

A We wear white to keep ourselves warm during winter.
B We wear white to keep ourselves cool during summer.
C Aluminium foil are used to keep food warm.

D Pipes are painted black to minimize transfer of thermal energy.

Question 22

Which of the following will increase the rate of heat transfer?

1. Increase the temperature difference
2. Paint the surface black
3. Increase the surface area

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 23

Which of the following is true about pots?

1. Black pots are used for cooking because they increase the rate of cooking.
2. Silver pots are used for keeping food warm because they decrease the rate of heat dissipation.
3. Pots are made of clay to increase the rate of cooking.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 24

Which of the following can be done to increase the rate of cooking?

1. Use a black pot instead of silver pot.
2. Use a thick pot instead of thin pot
3. Cover the pot with a lid.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 25

Container A and container B are filled with equal amount of hot water and the temperature of the water in the containers is measured with a thermometer some time later. It is observed that container A has a much lower temperature than container B. What are the possible reason(s)?

1. Container A is black and container B is silver.
2. Container A has a lid and container B is not covered.
3. Container A is made of steel and container B is made of clay.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

Question 26

Which of the following is true?

A Sea breeze happens during night time when the sea is cooler than the area.

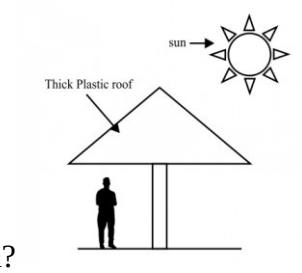
B Sea breeze happens during day time when the land is cooler than the sea.

C Land breeze happens during night time when the land is cooler than the sea.

D Land breeze happens during day time when the sea is cooler than the land.

Question 27

The diagram shows a man standing under a shelter on a sunny day. Given that the man feels hot, which of the following shows the processes of how thermal energy from the sun reaches the man?



A Radiation → Conduction → Radiation

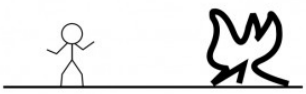
B Radiation → Conduction → Convection

C Radiation → Convection → Radiation

D Radiation → Convection → Convection

Question 28

The diagram shows a man besides a campfire. How does thermal energy from the campfire reach the man?



A By radiation

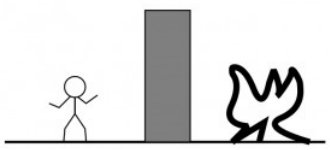
B By convection

C By radiation and convection

D By conduction and convection

Question 29

The diagram shows a brick wall in between a man and a campfire. How does thermal energy from the campfire reach the man?



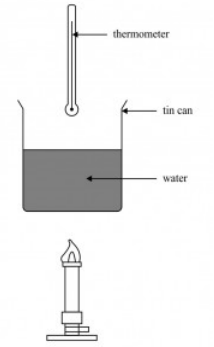
A Radiation → Conduction → Radiation

B Radiation → Conduction → Convection

C Radiation → Convection → Radiation
D Radiation → Convection → Convection

Question 30

The diagram shows water being heated in a tin can. A thermometer hangs directly above it. How does thermal energy from the heat source reach the thermometer?



A Radiation → Conduction → Radiation
B Radiation → Conduction → Convection
C Radiation → Convection → Radiation
D Radiation → Convection → Convection

Question 31

Expanded polystyrene is often used to make containers for storing ice-cream because the trapped air reduces loss of thermal energy by

A Radiation only.
B Conduction only.
C Conduction and convection.
D Conduction, convection and radiation.

Question 32

Which of the following statements about the vacuum flask is incorrect?

A Loss of thermal energy by radiation is minimized by keeping hot water in a double-walled container.
B Loss of thermal energy is minimized by using a cork or plastic stopper to close up the neck of the glass container.
C The vacuum in the double-walled glass container effectively prevents conduction and convection.
D The walls of the glass container are silvered to reduce radiation.

Question 33

The chief mechanism for conduction in a typical metallic conductor involves

A The diffusion of atoms in the conductor from the hot end to the cooler end.
B Atoms near the hot end vibrating with big amplitudes about their fixed positions and transferring their energy to neighbouring atoms located in cooler regions by knocking against them.

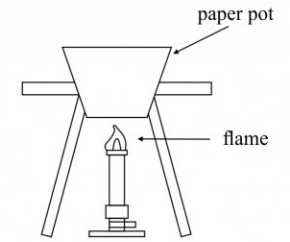
C The diffusion of free electrons from the hot end to the cooler end of the conductor carrying their energy along with them.

D The atoms near the hot end sending out energy to atoms near the cooler end.

Question 34

Some steamboat restaurants use paper pots for their customers to boil the food themselves. What is the reason for the paper not to catch fire when in contact with the flame?

1. The paper is thin and therefore heat is conducted quickly to the water in the paper pot.
2. Water has a boiling point lower than the burning temperature of the paper.
3. The paper is thick enough to withstand the high temperature of the flame.



A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3