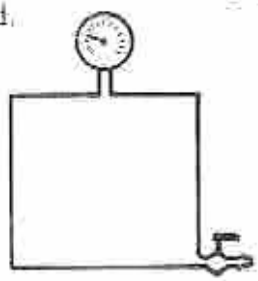
197. How many molecules are there in 1.0 cm^3 of air under conditions of normal pressure (101.3 kPa) and temperature (27° C)? What is the velocity of the molecules?

198. What is the RMS velocity of a molecule of oxygen at 50° C and 2.5 atmos pressure given the molecular weight of oxygen is 32 and one atmos is 101×10^5 $N.m^{-2}$.

199. 5.20 L of a certain gas weighs 12.82 g at 10° C and a pressure of 95 Pa. What is its molecular weight? Use R = 0.0821 L atmos.$mol^{-1}.K^{-1}$.

200. A sealed evacuated container is filled with four gases — carbon dioxide, nitrogen, oxygen, argon — at 101 kPa (normal air pressure = 1 atmos). One gas at a time is removed by means that cause a negligible change in volume, and the pressure is recorded.

Removed	Pressure
Carbon dioxide	98 kPa
Oxygen	52 kPa
Nitrogen	3.5 kPa



(a) What is the partial pressure of each gas?

(b) What percentage volume of the mixture is oxygen?

HEAT

201. 250 mL of water at 80° C is mixed with 355 mL of water at 30° C. What will the final temperature be?

202. 200 g of copper (which has a specific heat (SHt) of 385 $J.kg^{-1}.K^{-1}$) at 100° C is placed into 500 mL of water (SHt = 4 180 $J.kg^{-1}.K^{-1}$) at 20° C in an insulated container. What is the resulting temperature of the water?

NOTE: 500 mL water = 0.500 kg

203. 2 300 J of heat raise the temperature of 200 g of copper from 10° C to 40° C. Calculate the specific heat of copper.

(a) in $cal.g^{-1}.°C^{-1}$ (b) in $J.kg^{-1}.K^{-1}$

204. A piece of lead weighing 150 g is heated from 20° C to 120° C. If the specific heat of lead is 130 $J.kg^{-1}.K^{-1}$, how much heat is absorbed?

205. A block of copper of mass 400 g is heated from 20° C to 100° C.

(a) If the heat capacity of copper is 390 $J.kg^{-1}.K^{-1}$ calculate the energy it absorbs.

(b) It is put into an insulated container with 500 g of oil in it. The temperature of the oil rises from 20° C to 30° C. What is its specific heat capacity?

206. A piece of aluminium alloy electrical cable of mass 5.0 kg is warmed by 5.0 min of electrical current to 6.0° C above the temperature of the surroundings.
   (a) What quantity of heat did the current generate (SHt = 903 $J.kg^{-1}.K^{-1}$)
   (b) What current flowed if the voltage on the line was 1 200 V?

207. 100 g of ice is taken from a freezer where it was kept at –8° C. It is heated till it becomes steam at 105° C. How much heat is absorbed? ($H_f = 3.36 \times 10^5$ $J.kg^{-1}$ $H_v = 2.26 \times 10^6$ $J.kg^{-1}$ $C_{ice} = 2\,060$ $J.kg^{-1}.°C^{-1}$ $C_{water} = 4\,180$ $J.kg^{-1}.°C^{-1}$ $C_{steam} = 2\,020$ $J.kg^{-1}.°C^{-1}$)

208. How long will it take a 1 000 W electric jug element to raise the temperature of 2.5 L of water from 20° C to boiling point (SHt of water = 4 200 $J.kg^{-1}.°C^{-1}$)?

209. A saucepan of negligible mass contains 0.5 kg of ice at 0° C. The saucepan is dragged at a constant velocity against a frictional force of 46 N over a distance of 4 000 m. If all the work done is converted to heat, which, in turn is used to melt the ice, will the ice have melted? If so, what will be the temperature of the water? If not, how much ice will have melted? (Take heat of fusion of ice to be 3.36×10^5 $J.kg^{-1}$ and SHt of water to be 2 180 $J.kg^{-1}.°C^{-1}$.)

210. An aluminium tray of mass 150 g contains 750 mL of water at 20° C. Put in an empty freezer compartment of a fridge it freezes solid in 12 min. At what rate is heat being absorbed by the freezer? (SHt of aluminium = 880 $J.kg^{-1}.°C^{-1}$. SHt of water = 4 200 $J.kg^{-1}.°C^{-1}$. Latent heat of fusion of water = 335 000 $J.kg^{-1}$).

211. 5.1 g of ethanol (C_2H_5OH) is burned to CO_2 and H_2O in a copper calorimeter. The mass of the calorimeter is 1 800 g and the mass of water it contains is 1 500 g. If the temperature of the water is raised by 22° C, determine the heat of combustion of the ethanol in $kcal.mol^{-1}$. (SHt copper = 0.093 $cal.g^{-1}.°C^{-1}$, molecular weight of ethanol = 46.)

212. A piece of iron wire of mass 61.6 g is heated to 422° C and is put into a copper calorimeter which has a mass 206.4 g and contains 100 mL of water at a temperature of 4° C. The temperature rises to 22° C. Given that the specific heat of water is 4.18×10^3 $J.kg^{-1}.K^{-1}$ and of copper is 386 $J.kg^{-1}.K^{-1}$, calculate the specific heat of iron.

WAVES

213. Calculate the wavelength of a radio station (4KQ) with a frequency of 693 kHz.

214. Waves are timed approaching a beach at 12 per minute. Wavelength is estimated to be 8 m. What is the speed of the waves?