UNIVERSITY OF SWAZILAND
FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCE

MAIN EXAMINATION 2008/09

TITTLE OF PAPER: PHYSICS FOR HEALTH SCIENCES

COURSE NUMBER: HSC107

TIME ALLOWED: TWO HOURS

INSTRUCTIONS:

1. ANSWER ANY FOUR QUESTIONS
2. EACH QUESTION CARRIES 25 MARKS
3. MARKS FOR EACH SECTION ARE IN THE RIGHT HAND MARGIN
4. GIVE CLEAR EXPLANATIONS AND USE CLEAR DIAGRAMS IN YOUR SOLUTIONS. MARKS WILL BE LOST WHERE IT IS NOT CLEAR HOW THE EQUATIONS USED WERE OBTAINED

THIS PAPER HAS SEVEN PAGES INCLUDING THE COVER PAGE

THE LAST PAGE CONTAINS DATA THAT MAY BE USEFUL IN SOME QUESTIONS

DO NOT OPEN THE PAPER UNTIL PERMISSION HAS BEEN GIVEN BY THE CHIEF INVIGILATOR

QUESTION 1

(a) A body starting at the origin moves according to the velocity-time graph shown in Figure 1.Calculate the distance traveled at the discontinuities and sketch the distance-time graph for this motion. **(10 marks)**

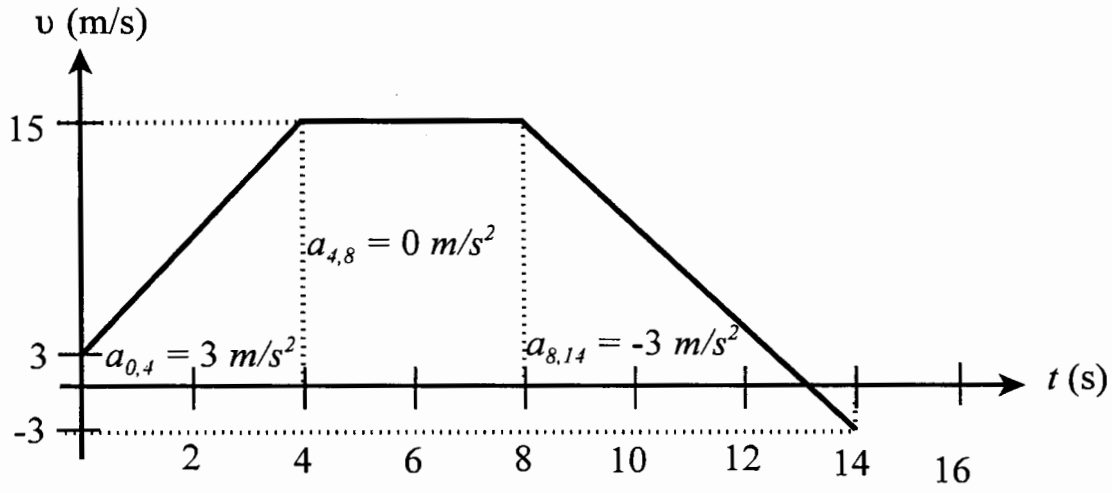

Figure 1.

(b) A golf ball is hit with an initial velocity of 60 m/s and hits a tree at some height with zero vertical velocity. The initial velocity of the golf ball makes an angle of 40° with the horizontal.

(i) At what height does the golf ball hit the tree? **(6 marks)**

(ii) How much time does it spend in flight before hitting the tree? **(4 marks)**

(iii) What is the horizontal distance from where the ball was hit to the tree? (Find the range of the ball) **(5 marks)**

QUESTION 2

(a) The systems shown in Figure 2 is in equilibrium. Find the tensions T_1, T_2, T_3 and the mass m_2.The pulley is frictionless. **(14 marks)**

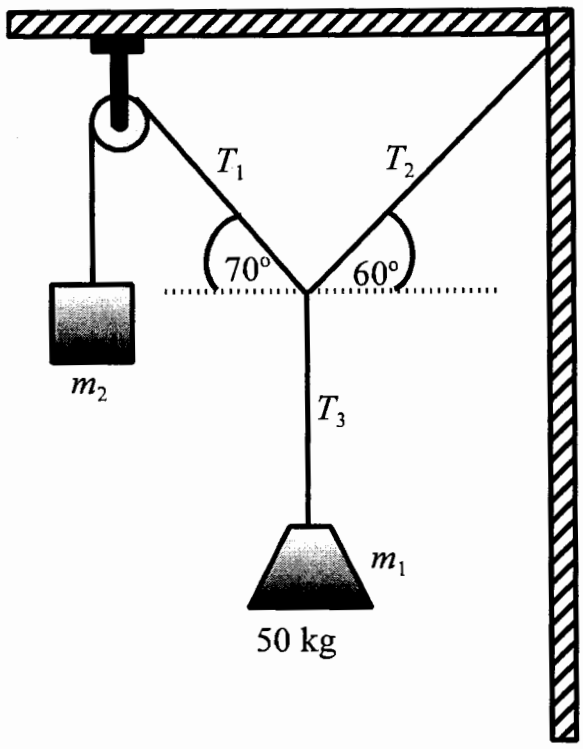

Figure 2.

(b) The two blocks in Figure 3 are connected by a cord of negligible mass that pass over frictionless pulleys. The coefficient of kinetic friction between the mass m_2 and the inclined surface is 0.2. The acceleration of the system is such that m_1 moves downward and m_2 moves up the inclined plane.

(i) Make a force diagram for each body. **(6 marks)**

(ii) Write down the equations of motion for each body. **(5 marks)**

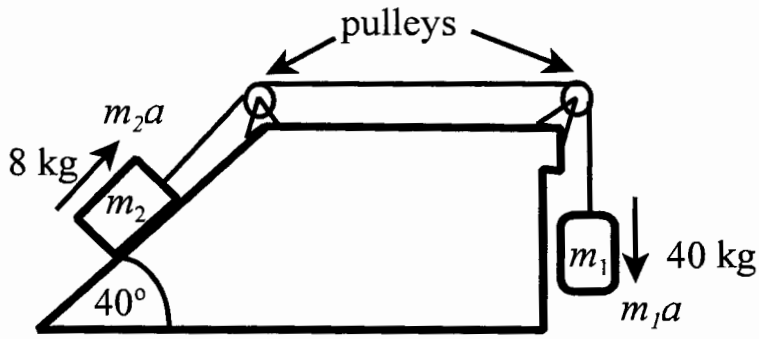

Figure 3.

QUESTION 3

(a) The system in Figure 4 is released from rest with the 30 kg block 5 m above the floor. The two masses are connected by a frictionless pulley of negligible mass. Use the principle of conservation of energy to find the velocity with which the 30 kg block hits the floor.**(9 marks)**

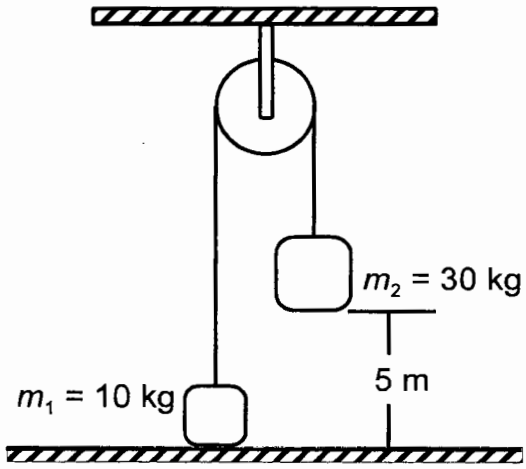

Figure 4.

(b) An industrial worker of mass 90 kg climbs up a constructed building at construction site to a height of 30 m. How much energy in food calories does he use to climb up. **(6 marks)**

(c) A bullet of mass m = 100 g moving with an initial speed υ_0 = 220 m/s strikes a stationary block of mass M = 10 kg and embeds itself in the block. What is the final velocity V_f of the block and bullet after the collision? **(10 marks)**

QUESTION 4

(a) The systolic/diastolic pressures for a person are 140/90.

(i) What are these gauge pressures in pascal? **(3 marks)**

(ii) What is these pressures in absolute pressure. **(3 marks)**

(c) A block of mass m_b = 300 g at a temperature T_b =130 °C is placed in an insulated water bath containing water of mass m_w = 800 g at T_w = 20 °C. The final temperature reached by the system is T_f = 45 °C. What is the specific capacity of the block c_b? **(10 marks)**

(d) Discuss which is more dangerous, to be burnt by 1 kg of water at 100 °C or 1 kg of steam at 100 °C. You can use a diagram to illustrate your answer. **(9 marks)**

QUESTION 5

(a) An industrial machine produces a sound at an average power of $P_{av} = 500$ W. What is the sound level at a distance of 10 m from the source? Explain whether this sound level safe for the human ear? **(7 marks)**

(b) Light enters a slab of fused quartz of refractive index 1.458 at an angle of 70° with the normal as shown in Figure 5. The slab is surrounded by air. Determine whether the light ray is transmitted to air on the sides or is trapped in the slab so that it escapes at the other end. **(8 marks)**

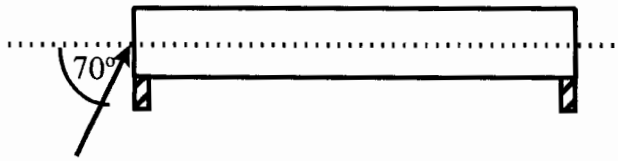

Figure 5.

(c) Consider the network shown in Figure 6.

(i) What is the effective resistance of R_1 and R_2? **(3 marks)**
(ii) What is the effective resistance of R_3 , R_4 and R_5? **(3 marks)**
(iii) What is the effective resistance of the network? **(2 marks)**
(iv) What is the total current through the network? **(2 marks)**

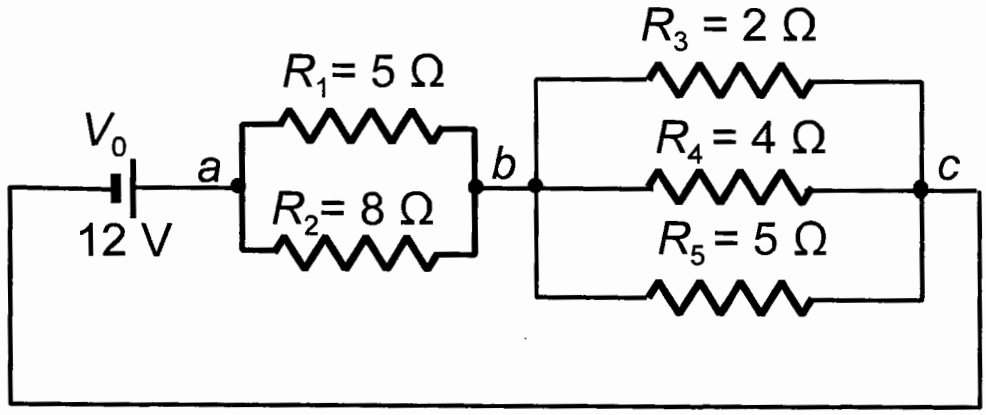

Figure 6.

GENERAL DATA SHEET

Speed of light in vacuum $c = 2.9978 \times 10^8$ m/s
Speed of sound in air = 343 m/s
Gravitational acceleration = 9.80 m/s^2
Universal gravitational constant $G = 6.67 \times 10^{-11}$ N m^2/kg^2
Density of mercury (Hg) = 1.36×10^4 kg/m^3
Density of water = 1000 kg/m^3
Standard atmospheric pressure = 1.013×10^5 Pa
Gas constant $R = 8.314$ J/(K mol)
Avogadro's number $N_A = 6.022 \times 10^{23}$ mol^{-1}
Threshold of hearing $I_0 = 10^{-12}$ W/m^2
1 calorie = 1 c = 4.186 J
1 food calorie = 1 Calorie = 1C = 10^3 calories = 4.186×10^3 J

c(*water*) = 4186 J/(kg K) c(*ice*) = 2090 J/(kg K) c(*steam*) = 2079 J/(kg K)
L_f(*ice*) = 3.33×10^5 J/kg L_v(*water*) = 2.260×10^6 J/kg

$$k_e = \frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9 \text{ Nm}^2/\text{C}^2$$

Charge of an electron = -1.6×10^{-19} C
Charge of a proton = $+1.6 \times 10^{-19}$ C
1 atomic mass unit = 1 amu = 1 u = 1.66×10^{-27} kg
Electron mass, $m_e = 9.109 \times 10^{-31}$ kg
Proton mass, $m_p = 1.673 \times 10^{-27}$ kg
Neutron mass $m_n = 1.675 \times 10^{-27}$ kg