UNIVERSITY OF SWAZILAND
FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL SCIENCE

SUPPLEMENTARY 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 with an initial velocity of 4 m/s is accelerated at 2 m/s^2 for 4 s. It then moves at constant velocity for 5 s after which it is accelerated at -3 m/s^2 for 3 s. Sketch

(i) the acceleration-time graph, **(6 marks)**

(ii) the velocity-time graph, and **(7 marks)**

(iii) the distance-time graph for this motion. **(8 marks)**

(b) A body is shot vertically with a speed of 15 m/s. What is its velocity at $t = 2$ s, and what is its direction of motion at that time? **(4 marks)**

QUESTION 2

(a) A body of mass m is placed on an inclined plane with friction and it slides down the plane. The coefficient of kinetic friction between the plane and the body is 0.5.

(i) Make a complete resolved force diagram for the body. **(6 marks)**

(ii) Write down the force equations for the body. **(4 marks)**

(iii) Find the acceleration of the body down the plane. **(5 marks)**

(iv) What is the normal force on the body? **(2 marks)**

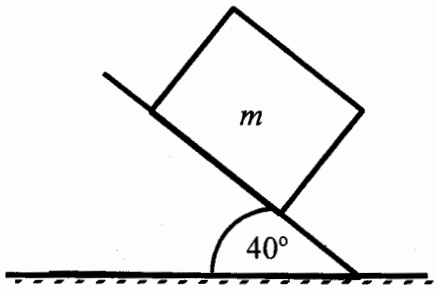

Figure 1.

(b) A worker has to lift a box of mass m = 120 kg to a storage bin a certain height from the ground. The worker uses a pulley system as shown in Figure 2. What is the force F that must applied by the worker to lift the box at constant velocity? **(5 marks)**

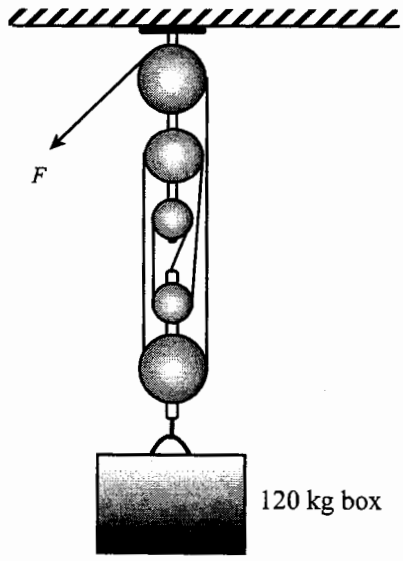

Figure 2.

(c) Give the name of the force that cause objects to move in a circular motion and give its equation in terms of the mass of the body m, the tangential velocity of the body υ and the radius of the circle of motion r. **(3 marks)**

QUESTION 3

(a) Consider a body of mass $m = 50$ kg that has to be taken up a height $h = 10$ m.

(i) How much potential energy is gained by the body when moved over the height h? **(3 marks)**

(ii) What is the energy calculated in (i) in food calories? **(2 marks)**

(iii) If the body is let go and free falls over the height h, what will be its velocity when it hits the ground? **(4 marks)**

(b) A bullet of mass $m = 150$ g moving with an initial speed $\upsilon_0 = 300$ m/s strikes a stationary block of mass $M = 12$ kg and goes through the block with a velocity of 50 m/s. What is the final velocity V_f of the block after the collision? **(10 Marks)**

(c) A flywheel of moment of inertia $I = 95$ kg m^2 is accelerated from $\omega_0 = 0$ rpm to ω 1000 rpm in 3 s. What is the angular acceleration of the wheel? **(6 marks)**

QUESTION 4

(a) In a certain day the height h of the mercury column in the barometer is 76.1 cm. What is the atmospheric pressure on such a day? Show clearly how you obtain your solution. **(10 marks)**

(b) State Archimedes principle and discuss how it is applied to floating bodies. **(5 marks)**

(c) A block of ice of mass $m_b = 200$ g at a temperature $T_i = 0$ °C is placed in an insulated water bath containing water of mass $m_w = 3$ kg at a temperature $T_w = 20$ °C. What is the final temperature T_f reached by the system? **(10 marks)**

QUESTION 5

(a) An sound source produces sound at an average power of $P_{av} = 250$ W.

(i) What is the sound intensity a distance of 5 m? **(3 marks)**

(ii) What is the sound level at a distance of 5 m? **(3 marks)**

(iii) Is the sound level safe for the human ear at the distance of 5 m? **(2 marks)**

(b) The near point of a person is 3 m. What must be the focal length of the spectacle lenses for the person to read a book at a distance of 25 cm? Also state with justification whether the spectacle lenses are diverging or converging. **(6 marks)**

(c) Consider the circuit shown in Figure 3.

(i) What is the current through each resistor, I_1, I_2 and I_3, respectively? **(3 marks)**

(ii) What is the total current through the network? **(2 marks)**

(iii) What is the effective resistance of the network? **(2 marks)**

(iv) What would be the effective resistance of the network if the three resistors were connected in series? **(2 marks)**

(v) What would be the total current through the network if the resistors were connected in series.? **(2 marks)**

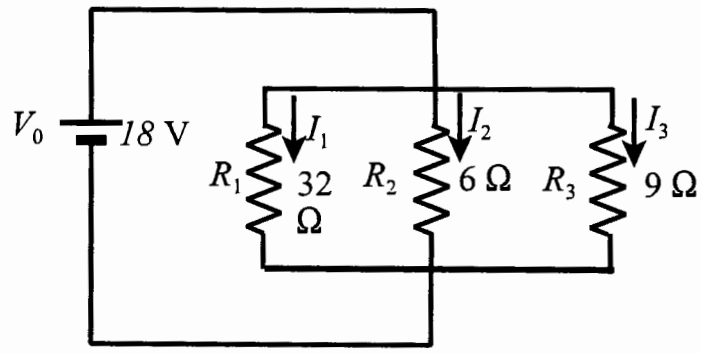

Figure 3.

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

Coulomb constant $k_e = \dfrac{1}{4\pi\varepsilon_0} = 8.99 \times 10^9$ Nm^2/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