UNIVERSITY OF SWAZILAND

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL HEALTH

SUPPLEMENTARY EXAMINATION 2012/2013

TITLE O F PAPER:	PHYSICS FOR HEALTH SCIENCES
COURSE NUMBER:	HSC107
TIME ALLOWED:	THREE HOURS
INSTRUCTIONS:	ANSWER ANY **FOUR** OUT OF FIVE QUESTIONS
	EACH QUESTION CARRIES 25 MARKS
	MARKS FOR EACH SECTION ARE IN THE RIGHT HAND MARGIN
	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) Given the vectors $\vec{A}$ and $\vec{B}$, $\vec{A} = -2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}$ and $\vec{B} = 2\hat{\imath} + 4\hat{\jmath} - 3\hat{k}$, use the dot product to find the angle between the two vectors. **(7 marks)**

(b) A body with an initial velocity of 3 m/s is accelerated at 2 m/s^2 for 4 s. It then moves at constant velocity for 3 s, after which it is accelerated at -3 m/s^2 for 4 s. Sketch the

(i) acceleration-time **(5 marks)**

(ii) velocity-time, and **(6 marks)**

(iii) displacement-time graphs for this motion. **(7 marks)**

QUESTION 2

(a) Consider Figure 1 below. Let the coefficient of static friction between the block of mass $m = 60$ kg and the surface inclined at 45° be $\mu = 0.6$.

(i) Make a resolved force diagram for the mass m, taking the direction down the inclined plane to be the positive x-direction. **(4 marks)**

(ii) Write down the equations of motion for the mass. **(4 marks)**

(iii) Find the acceleration of the mass down the inclined plane. **(4 marks)**

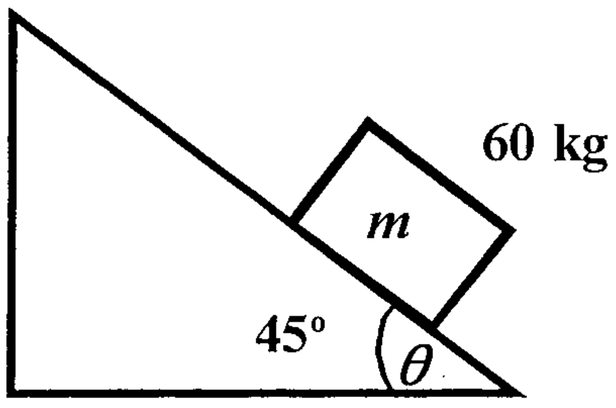

Figure 1.

(b) The system shown in Figure 2 is in equilibrium. The beam is uniform, 12 m long, weighs 2400 N, and is attached to the beam on the end furthest from the wall at an angle of 35° with the horizontal. The box of supplies of mass $m = 120$ kg is positioned 3 m from the pivot on the wall. Determine the

(i) the tension in the cable, **(9 marks)**

(ii) the x- and y-components of the reaction force by the wall. **(4 marks)**

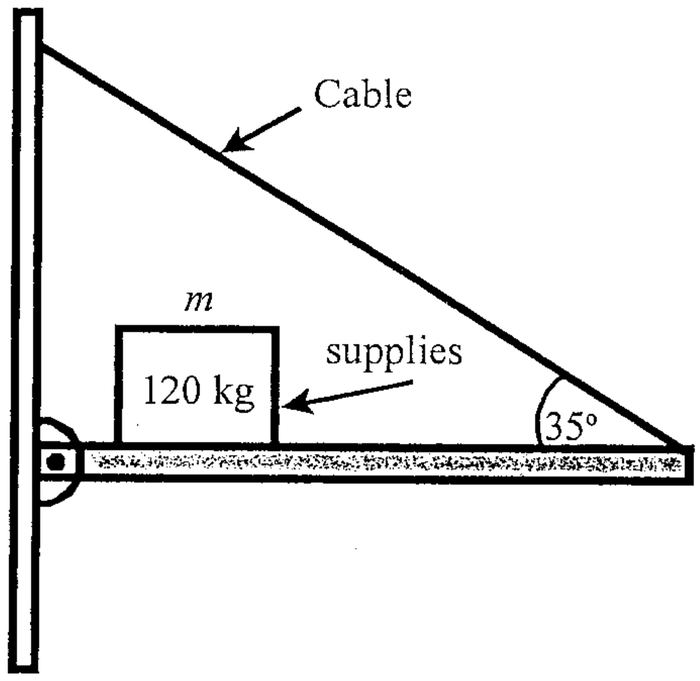

Figure 2.

QUESTION 3

(a) A student lifts 10 bags of cement each of mass 50 kg over a height of 1.50 m.

(i) How much gravitational potential energy in joules is gained by the 10 bags of cement? **(3 marks)**

(ii) What is the energy found in (i) in the unit of calorie? **(2 marks)**

(iii) What is the energy found in (i) in the unit of food calorie? **(2 marks)**

(b) A bullet of mass $m = 250$ g moving with an initial speed $v_0 = 450$ m/s strikes a stationary block of mass $M = 6$ kg. The block acquires a velocity $V' = 10.0$ m/s after the impact.

(i) What is the final velocity of the bullet v_f? **(8 marks)**

(ii) Comment on the motion of the bullet and block after the impact. **(3 marks)**

(c) A flywheel is accelerated from $\omega_0 = 800$ rpm to $\omega = 4000$ rpm in 5 s. What is the angular acceleration of the wheel? **(7 marks)**

QUESTION 4

(a) A wire of length $l_0 = 2.00$ m with a cross-sectional area of $A = 1.25 \times 10^{-5}$ m^2 is used to suspend a mass $m = 15.0$ kg. The wire stretches by $\Delta l = 0.250$ mm under this load. Determine the

(i) the stress on the wire, **(3 marks)**

(ii) the strain on the wire, and **(2 marks)**

(iii) the Young's Y modulus for this wire. **(2 marks)**

(b) Consider a metal rod the size of a normal pencil of cross-sectional area *A* and needle of the same material and cross-sectional area *a*. If the two objects supported vertically on a flat surface and a downward vertical force *F* applied to each, discuss with the aid of equations which object will provide more stress. **(5 marks)**

(c) State Pascal's law and give one example with explanation on how it is used in every day life. **(6 marks)**

(d) How much heat is released when steam of mass $m = 5$ kg at a temperature of 120°C is cooled to water at 20°C? **(7 marks)**

QUESTION 5

(a) An isotropic sound source produces 1.50 W of acoustic power. At what distance from the source is the sound level 75 dB? **(6 marks)**

(b) A light ray is incident from water towards the water-air interface at an angle of incidence of 70°. Find the angle of refraction of the light ray and comment on the result obtained. **(4 marks)**

(c) The near point of a person is 6 m. What should be the focal length of the spectacle lenses for the person to read a newspaper at 25 cm? **(4 marks)**

(d) Consider the network shown in Figure 3.

(i) Find the effective resistance between points *a* and *b*. **(3 marks)**
(ii) Find the effective resistance between points *b* and *c*. **(4 marks)**
(iii) Find the effective resistance of the network. **(2 marks)**
(iv) What is the total current through the network? **(2 marks)**

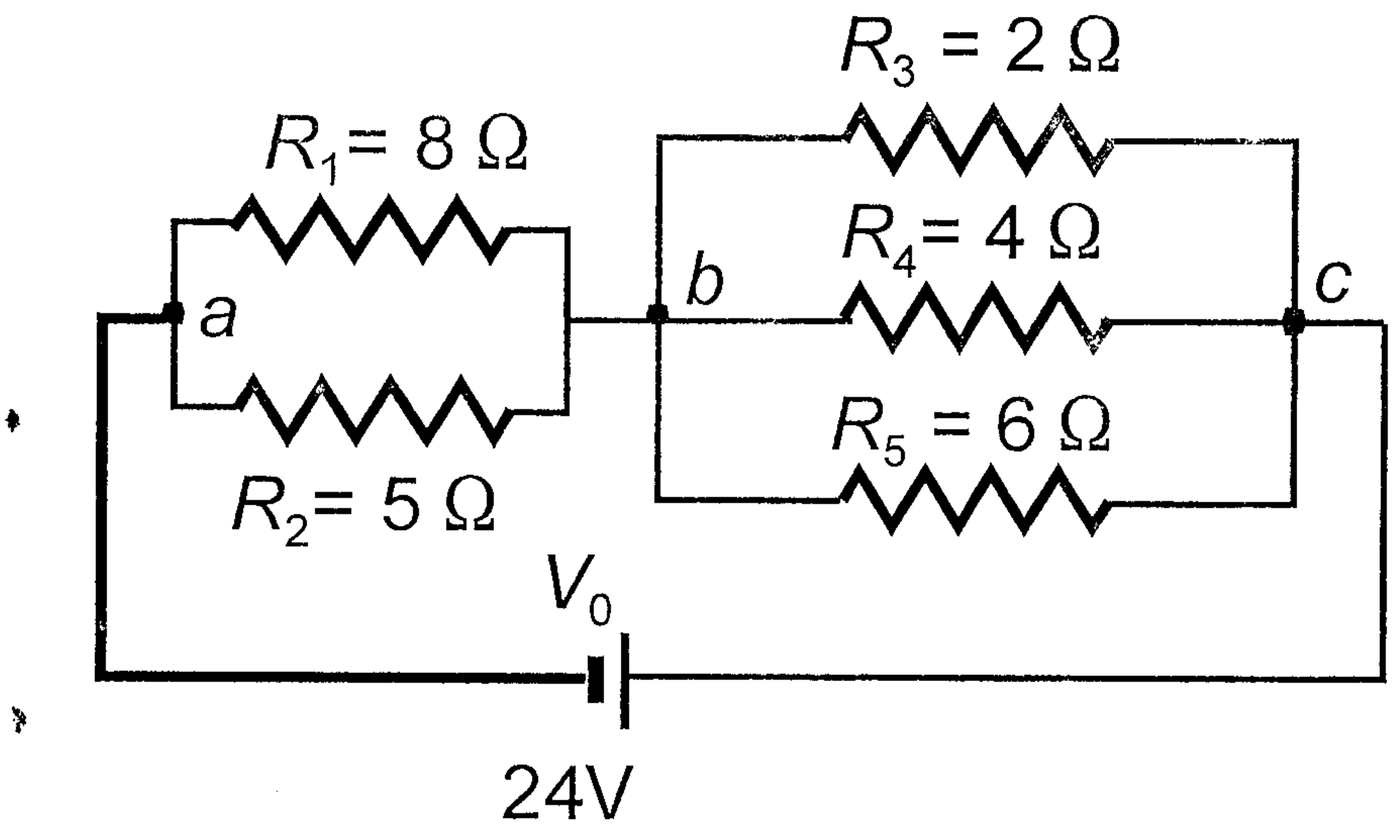

Figure 3.

GENERAL DATA SHEET

Avogadro's number $N_A = 6.022 \times 10^{23}$ mol^{-1}
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)
Threshold of hearing $I_0 = 10^{-12}$ W/m^2
1 calorie = 1 ca = 4.186 J
1 food calorie = 1 Calorie = 1Ca = 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)
$L_{f\text{-}ice} = 3.33 \times 10^5$ J/kg $L_{v\text{-}water} = 2.260 \times 10^6$ J/kg

Refractive index of water $n_{water} = 1.333$
$k_e = 8.9875 \times 109\ N{\cdot}m^2/C^2$
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