KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELLOR OF SCIENCE IN FORENSIC SCIENCE

SBC 133: PHYSICS I

DATE: Wednesday 28th March, 2012 **TIME:** 2.00 p.m. – 4.00 p.m.

INSTRUCTIONS

WRITE ALL YOUR ANSWERS IN THE EXAMINATION ANSWER BOOKLET

ANSWER QUESTION ONE AND ANY OTHER TWO

Use the following constants where necessary

Specific heat capacity of water c = 4200 J/kg K

Specific heat capacity of copper c = 0.420 J/kg K

acceleration due to gravity g = 9.8 m/s^2

Universal gravitational constant G = 6.67 x $10^{-11} N.m^2/kg^2$

mass of the earth= 5.98 x 10^{24} kg

radius of the earth= 6.38 x 10^6 m

Universal gas constant R = 8.3145 J/(mol.K)

Q1.(a) (i) Write down the S.I units of acceleration, force, work and momentum

(2marks)

(ii) Convert the 100km/hr into m/s (2 marks)

(b) A car travels due east, from A to B a distance of 275 m. The car then travel due north, from B to C, a distance of 125 m. Calculate the resultant displacement vector of the car relative to its starting point. (3 marks)

(c) What is magnitude of the gravitational force that acts between two particles of masses 1500kg and 50kg when separated by 0.3 m ? (3 marks)

(d) A particle is sitting 12cm from the axis of a disc rotating at 33 1/3 rpm. Calculate the particle's acceleration expressed in meters per second squared (3 marks)

e) A car of mass 1200 kg moving at 22 m/s is brought to rest over a distance of 50m. Find the breaking force and the time required to stop. (4 marks)

f). A displacement vector has a magnitude of 325 m and points at an angle of 50^o relative to the x-axis. Find the x-and y-components of this vector. (2 marks)

g). Write the equation of S.H.M. if

(i) Initial phase angle is zero and (2 mark)
(ii) Initial phase angle is $\pi/2$ (1 mark)

The amplitude is 5 cm and period 8 s.

h). A 30 gm bullet initially travelling 500m/s penetrates 12cm into a wooden block. What average force does it exert? (3 marks)

i). (i) State the equation of state of an ideal gas (1 mark)

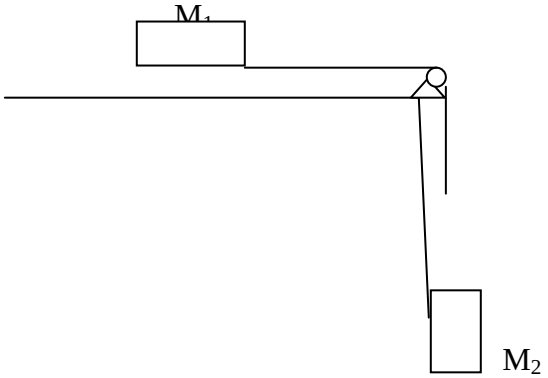
(ii) Calculate the volume of 5 moles of oxygen at STP.(treat oxygen as an ideal gas

(2 marks)

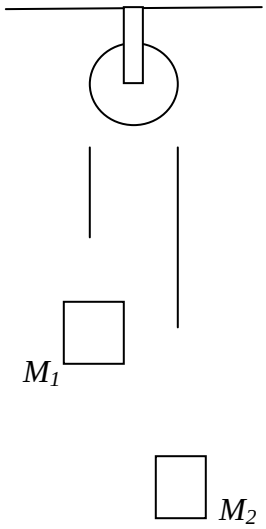
j). (i) Define impulse (1 mark)

(ii) State the impulse –momentum theorem (1 mark)

Q.2 a). An inextensible string connecting blocks $m_1 = 10kg$ and $m_2 = 5kg$ passes over a light pulley as shown. M_1 moves on a frictionless surface while m_2 moves vertically. Calculate the acceleration a of the system and the tension T in the string. *(7 marks)*



b). An inextensible string connecting blocks $m_1 = 1kg$ and $m_2 = 2kg$ passes over a light pulley as shown. Calculate the tension T in the string and the acceleration of the masses. *(7 marks)*



c). A 16kg block rests on a horizontal surface. A force of 5N is required to cause the block to break away and start moving, a force of 3N is sufficient to keep the block sliding at a constant speed once it is set in motion. Calculate the kinetic and static coefficients of friction.

(6 marks)

Q.3 a). The equation of motion of an oscillating body is $x = 6 \cos(3\pi t + \pi/3)\ m$. What is the

(i) period (2 marks)

(ii) frequency and (1 mark)

(iii)Phase constant of the motion. (1 mark)

(iv)Calculate the displacement, velocity and acceleration at time t= 2s. (6 marks)

b).(i) A mass of 250 gm hangs from a vertical spring of elastic constant 2 N/m. Calculate the frequency of small vertical oscillations, assuming that the damping is small. (3 marks)

(ii) A spring is hung vertically and loaded with a mass of 400 gm and made to oscillate. Calculate the time-period and frequency of oscillation. When the spring is loaded with 100 gm, it extends by 5 cm. (5 marks)

c). A coast guard sees a distress rocket burst in the sky and 5s later he hears the bang. If the speed of sound is 330 m/s, how far is the exploding rocket from the coast guard. (2 marks)

Q.4 a). A constant force of 5N acts for ten seconds on a body whose mass is 2 kg. The body was initially at rest. Calculate

(i) the work done by the force (3 marks)

(ii) the final kinetic energy and (2 marks)

(iii) the average power of the force. (3 marks)

b). Show with the help of work energy theorem that the minimum stopping distance for a car of mass m moving with speed v along a level load is $v^2/2\mu_s g$, where is the coefficient of static friction between the tyres and road. (4 marks)

c). A body of mass 5 kg moves down from state of rest on an inclined plane of length 5 meters having inclination of 60^o with the horizontal.

(i) If the coefficient of kinetic friction is 0.2 find the speed of the body at the bottom. (4marks)

(ii) How far shall it slide on the rough horizontal surface having same coefficient of kinetic friction as the inclined plane. (4 marks)

Q.5 a). Explain the terms: specific heat capacity, specific latent heat and internal energy. (3 marks)

b). An energetic athlete dissipates all the energy in a diet of 1.6744×10^7 J per day. If he were to release this heat at a steady state, how would his heat output compare with the energy out of a 100 watt bulb? (4 marks)

c). A system gains 1500J of heat energy, while the internal energy of the system increases by 4500J and the volume decreases by 0.010 m^3. Assume the pressure is constant and finds its value. (6 marks)

d). A 0.25 kg coffee mug is made from a material that has a specific heat capacity of 950 J/(kgC^o) and contains 0.30 kg of water. The cup and the water are at 25 ^oC. To make a cup of coffee, a small electric heater is immersed in the water and brings it to boil in two minutes. Assume that the cup and the water always have the same temperature and determine the minimum number of watts at which the heater is rated. (7 marks)

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