KABARAK   **UNIVERSITY**

SUPPLEMENTARY/SPECIAL EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: PHYS 111

COURSE TITLE: **MECHANICS**

STREAM: **SESSION II & III**

DAY: **WEDNESDAY**

TIME: **2.00 – 4.00 P.M**

DATE: 08/04/2009

INSTRUCTIONS
1. Answer Question ONE and **any** other TWO questions.
2. Question ONE carries 40 marks and the rest 15 marks each.
3. Assume $\pi = 3.14$, Gravitational Constant $= 6.67 \times 10^{-11}$ N m^2 kg^{-2} and g = 9.8 m/s^2

PLEASE TURN OVER

QUESTION ONE

a) The position of a runner as a function of time is plotted as moving along the x-axis of a coordinate system. During a 3 seconds time interval, the runner's position changes from $x_1 = 30.5$m to $x_2 = 50$m. What is the runner's average velocity?

(3 marks)

b) Briefly describe the triangle method of addition of vectors.

(6 marks)

c) How long does it take a car to travel 30m if it accelerates uniformly from rest at a rate of 2 m/s^2?

(4 marks)

d) Does a car speedometer measure speed, velocity or both?

(2 marks)

e) A boat starts to cross a 120m wide river at a constant velocity of 20 km/hr. If the speed of the water downstream is 12 km/hr, how far from the point directly opposite the starting point of the boat will the boat land on the opposite side of the river?

(4 marks)

f) A rock is thrown horizontally from a 100m high cliff. It strikes the ground 90m from the base of the cliff. Assuming the ground is level with the base of the cliff, at what velocity was the ball thrown?

(5 marks)

g) Differentiate between static and kinetic friction.

(4 marks)

h) Write down the equation that gives the distance travelled by free-falling objects, neglecting air-resistance.

(2 marks)

i) The centres of two 10 kg spheres are separated by 0.1m. Calculate:
   i. Their gravitational attraction
   ii. The ratio of this attraction to the weight of one of the spheres

(6 marks)

j) How long will it take a 1500W motor to lift a 100 kg bag of maize to a surface 20m above?

(4 marks)

QUESTION TWO

a) State the three Keppler's laws of planetary motion.

(6 marks)

b) A child throws a 3.2 kg package horizontally from a boat with a speed of 10 m/s. Calculate the resulting velocity of the boat, assuming it was initially at rest. The mass of the child is 20 kg and that of the boat is 60 kg.   (6 marks)

c) A force $\dddot{F} = 7$N acts on a block at an angle $\theta = 30°$ to the horizontal as shown in the figure below. Find the x- and y-components of the force $\dddot{F}$
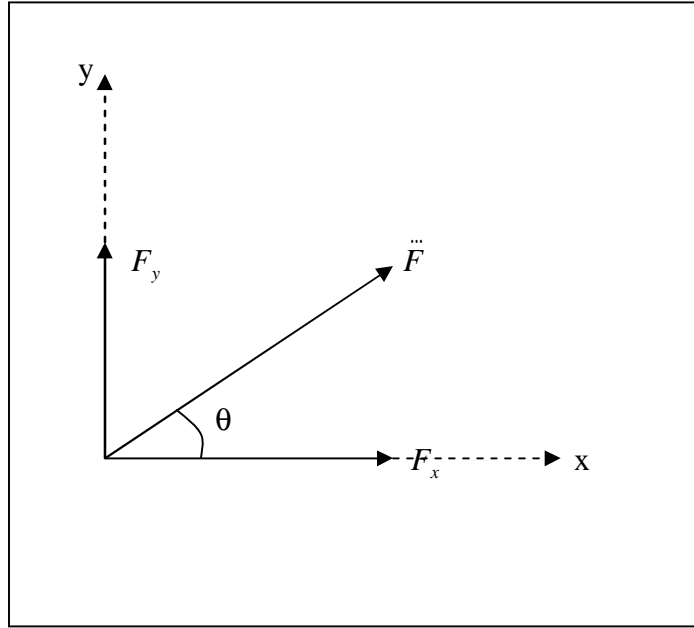
(3 marks)

QUESTION THREE

a) A 10-gram bullet moving horizontally at a velocity of 400m/s penetrates a 3 kg wooden block resting on a frictionless horizontal surface and emerges from the other side of the wooden block. If the bullet slows down to a velocity of 300m/s after emerging from the block, what will be the velocity of the block immediately after the bullet emerges?

(5 marks)

b) What is the linear velocity of a point on the edge of a CD rotating at a constant speed of 30 rpm (revolutions per minute) if the radius of the CD is 5 cm?

(5 marks)

c) A force of 400N is required to start a 40 kg box moving across a concrete floor. What is the coefficient of static friction between the box and the concrete floor?

(3 marks)

d) Give two examples of non-contact forces.

(2 marks)

QUESTION FOUR

a) Determine the kinetic energy of a train having 10 coaches, each of mass 50,000 kg and an engine of mass 100,000kg, if the train is moving at a velocity of 72 km/hr.

(5 marks)

b) From what height must water fall to strike a turbine wheel with a vertical downward velocity of 29.4 m/s?

(4 marks)

c) Differentiate between the three types of equilibrium that objects can assume.

(6 marks)