KENYA METHODIST UNIVERSITY

END OF 2ND TRIMESTER 2010 EXAMINATIONS

NYERI CAMPUS

SCHOOL   :   SCIENCE & TECHNOLOGY
DEPARTMENT   :   COMPUTER SCIENCE AND BUSINESS INFORMATION
UNIT CODE   :   PHYS 100
UNIT TITLE   :   BASIC MECHANICS
TIME   :   2 HOURS

Instructions
- Answer question 1 and any other two questions.
- Marks will be awarded to clearly and concisely explained points.

Question 1
a. A motorcycle, starting from rest, has an acceleration of 2.6 m/s^2. After the motor cycle has travelled 120 m in a straight line, it slows down at a rate of 1.5m/s^2 until its velocity is 12 m/s.
  i.   What is the maximum velocity of the motor cycle?
  ii. What is the total time that the motorcycle travels? (7Mks)
b. Water flows along a horizontal pipe of cross sectional area of 48 cm^2 which has a constiction of cross section area 12 cm^2 at one place.
  i.   If the speed of water at the constriction is 4m/s, calculate the speed in the wider section.
  ii. If the pressure in the wider section is 1.0 x 10^5, calculate the pressure at the constriction. (Take density of water = 1000kg/m^3) (8Mks)
c. State the Newton's laws of motion. (6Mks)
d. A pitcher throws a ball at an angle of 37° with the horizontal and observes that the ball stays in the air for 2.5 s before hitting the ground. Neglecting air friction and the height of the pitcher, find
  i. The initial speed of the ball.
  ii. Maximum height reached by the ball.
  iii. How fast would the pitcher have to run (at constant speed) to catch his own ball? (9Mks)

Question 2
a. A certain gun is fired while pointing vertically upward and the bullet is observed to reach a maximum height of 700 m. Neglecting air friction,(12Mks)
  i. Find the maximum height of the bullet if, instead, the same gun were fired at an angle of 35° with the horizontal.
  ii. How long would the bullet stay in the air for this second case (part a)?
b. State the principle of conservation of momentum. (3Mks)

c. A Ferris-wheel carries its riders in a vertical circle with a radius of 8.0 m. The Ferris2-wheel makes one revolution every 9.0 s. Find the apparent weight of a 70 kg person when he is at the lowest point of the circle. (5Mks)

Question 3
a. A stone of mass 4kg moves round a circle of radius 6m with constant speed of 12m/s. calculate
    i. Angular velocity
    ii. Force towards the centre (6Mks)
b. A jetliner lands on a runway at 70 m/s, reverses its engines to provide braking, and comes to a halt 29 s later. (8Mks)
    i. What is the acceleration of the jet?
    ii. What is the minimum length of runway that the jet would need to safely come to a stop
c. State the laws of solid friction (6Mks).

Question 4
a. A gorilla walks 20 m due north and then walks 30 m due west. At the same time his trainer walks 75 m at 65° S of E. (6Mks)
    i. Make a careful vector diagram showing the displacements of the gorilla and the trainer.
    ii. In what direction and how far away does the gorilla look to see his trainer? Use vector components to solve this problem.
b. A motorist is speeding down the highway at 35 m/s when he spots a highway patrol officer 100 m behind him traveling at 40 m/s. The motorist immediately begins slowing down at $4m/s^2$ while the officer continues moving at constant speed. (8Mks)
    i. How long will it take for the highway patrol officer to catch the motorist?
    ii. How fast will the motorist be going when the officer passes him?
c.
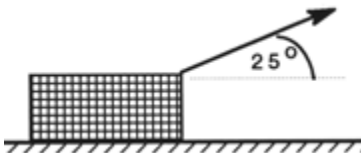
A 24 kg box is pulled with a rope along a horizontal floor as shown. The coefficient of sliding friction is 0.35 and the breaking force of the rope is 520 N. What is the shortest amount of time that the box can be pulled a distance of 20 m across the floor? (6Mks)