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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
First Year – Semester I Examination – April / May 2016

PHY 1201 –GENERAL PHYSICS / GENERAL AND THERMAL PHYSICS

AnswerAll Questions. Time allowed: **2 hours**

Gravitational field intensity, $\mathbf{g = 9.8\ N\ kg^{-1}}$

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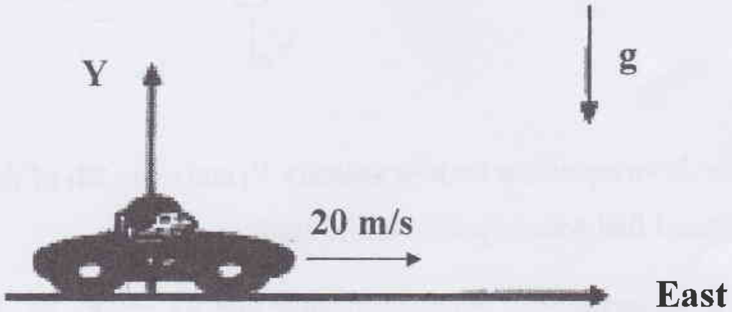
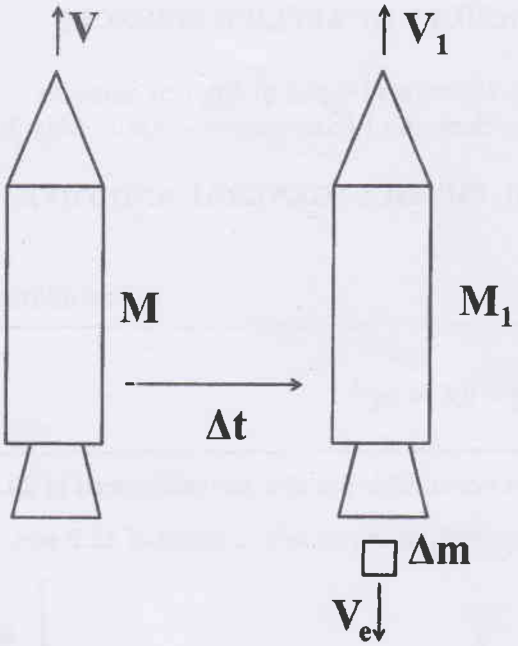
1. You are driving in an open convertible car at a canstant speed of **20.0 m/s** to the east and throwing a ball straights up relative to you with a speed of **15.0 m/s**.



   a. Make sketches of the trajectory of the ball relaitive to you and the trajectory of the ball relative to an observer standing on the ground.
   b. How high above the ground will the ball reach before falling back down? (Use the coordinate system of the given figure and assume the ball was thrown from an initial vetical height above the ground of **1.00 m**.)
   c. How far does the car move while the ball is in the air? Assume the ball is caught at the same level that the ball was thrown.
   d. What is the velocity (direction and magnitude) of the ball as seen by an observer on the ground two seconds after leaving your hand?

(25 Marks)

2. A rocket has an initial mass of **M** and velocity of **V**as shown in the following figure. After time **Δt**, mass **Δm** amount of fuel has ejected from the rocket with a velocity of $\mathbf{V_e}$ relative to the rocket in opposite direction and the velocity of the rocket has increased by **ΔV**.



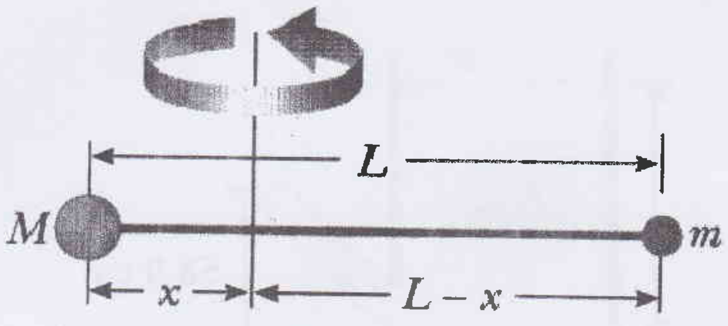
   a. Write down equations for new velocity $\mathbf{V_1}$ and mass $\mathbf{M_1}$ of the rocket and velocity of ejected fuel with respected to the earth.

   b. Using conservation of momentum show that $V_f - V_i = V_e \ln \frac{M_i}{M_f}$, where $\mathbf{V_f}$ and $\mathbf{V_i}$ represent the final and initial velocities and $\mathbf{M_i}$ and $\mathbf{M_f}$ represent the initial and final masses of the rocket respectively.

   c. A rocket moving in free space has a speed of 3.0×10^3 **m/s** relative to the earth. Its engines are turned on, and fuel is ejected in a direction opposite the rocket's motion at a speed of 5.0×10^3 **m/s** relative to the rocket. What is the speed of the rocket relative to the earth once the rocket's mass is reduced to one-third of its initial mass?

(25 Marks)

3. Two masses **M** and **m** are connected by a rigid rod of length **L** and of negligible mass, as shown in the figure.



a. Write down an equation for the moment of inertia of the system.

b. Show that system has the minimum moment of inertia when, $X = \frac{mL}{M+m}$

c. Show that the minimum moment of inertia of the system, $I = \frac{Mm}{M+m}L^2$

The combination of an applied force and a frictional force produces a constant total torque of **36.0 N m** on above system. The applied force acts **6.00 s**, during this time the angular speed of the wheel increase from **0** to **10.0 rad/s**. The applied force is then removed, and the system comes to rest in **60.0 s**.

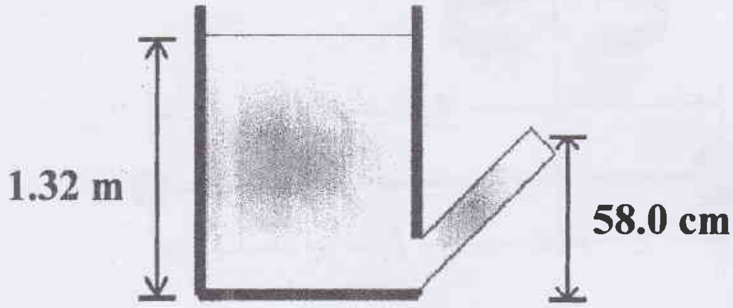
d. the moment of inertia of the wheel

e. the magnitude of the frictional torque

(Hint: Moment of Inertia, $I = \sum_i M_i R_i^2$)

(25 Marks)

4. A tank **1.50 m** in height is filled with water to a level of **1.32 m**. At the bottom of the tank a hose is attached. The hose goes up at an angle of **55.0°** with respect to the ground. The end of the hose at a height of **58.0 cm** above the bottom of the tank. Atmospheric pressure is **1.00 atm**.



a. Find the velocity of the water coming out of the hose.
b. Find the velocity of the water **inside the hose** at the bottom end of the hose (next to the tank).
c. Find the pressure of the water **inside the hose** at the bottom end of the hose (next to the tank).
d. Is the pressure you found in part **(c)** the same as the pressure at the bottom of the tank (not inside the hose)?

(25 Marks)