King Fahd University of Petroleum and Minerals - Department of Physics

Physics 101 First Major Exam - 19 October, 1996 (PHYS101.EX1.961).

Q1. The displacement of an accelerating particle is given by $\mathbf{s} = k\,\mathbf{v}^m\,\mathbf{a}^n$
where k is a dimensionless constant, **a** is the acceleration and **v** is the velocity.

(One) Determine by dimensional analysis the values of the constants m and n in order for the equation to be dimensionally correct.

(Two) Can one get the value of k from this analysis ?

Q2. A stone is dropped from a bridge that is 940 m above the water. Another stone is thrown vertically downward form this bridge 1.0 s after the first stone is dropped. Both stones strike the water at the same time.

(a) How long will it take the first stone to strike the water ?
(b) What was the initial speed of the second stone?

Q3. An object moves along the x-coordinate according to the equation $x(t) = (3 - 4t^2 + 9t^3)$ m. Determine:

(a) the average velocity between t = 1 s and t = 2 s ?
(b) the instantaneous acceleration at t = 1 s.

Q4. A person walks 12.0 km, 20^o south of east, and then walks 15.0 km, 10^o south of west. Call these displacements **A** and **B,** respectively.

(One) Write down in unit-vector notation these two displacements **A** and **B**. Take east along the positive x-axis and north along the positive y-axis.

(b) Find the magnitude and direction of the resultant vector.

Q5. At t = 0 , a particle leaves the origin with a velocity $\mathbf{v_o}$ = 12 **j** m/s. Its acceleration is given by **a** = (**i** - 4 **j**) m/s^2. When the particle reaches its maximum y coordinate, the y component of its velocity is zero. Find

(a) the time the particle takes to reach the maximum y coordinate, and
(b) the coordinates of the particle at that time.

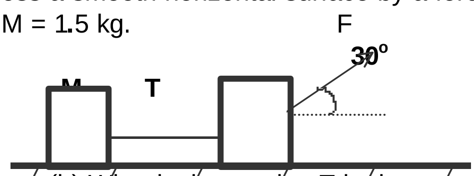
Q6. A cannon on the ground shoots out a ball at 60^o to the horizontal with an initial speed of 30 m/s. The ball strikes a target located at a horizontal distance of 70 m from the cannon and at a height H above the ground.

(a) How long is the ball in the air ? (b) What is the value of H ?

Q7. A spacecraft is circling the moon in an orbit of radius 1800 km. The spacecraft takes 19.0 h to complete one revolution about the moon.

(a) Find the speed of the spacecraft. (b) Find the centripetal acceleration of the spacecraft.

Q8. Two blocks, connected by a string, are pulled across a smooth horizontal surface by a force applied to one of the blocks, as shown in the figure. F = 20 N, M = 1.5 kg.



(a) What is the acceleration of the system ? (b) What is the tension T in the connecting string?

Q9. A block of mass M = 30 kg moves with constant velocity along an inclined plane under the action of a force F, as shown in the figure. Take $\theta = 5^o$ and $\mu_k = 0.10$. Determine the force F.