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School, #_:_____
Date:_____

Hovercraft Captains Exchange -- Taken in 25 minutes for 2, w/ Binder, no sigfigs

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History (8)

1) Who designed the Luftkissengleitboot? (1)

2) List 3 United Kingdom shipbuilding firms invested in r&d for hovercraft. (3)

3) What is the name of the classified vehicle created by Charles Fletcher? (1)

4) How did Christopher Cockerell come across the momentum curtain? (2)

5) What is the name of the vehicle created in 1998 and used by the US Postal Service? (1)

Kinematics (10)

1. Give the horizontal range equation. (1)

2. A projectile is launched from a cannon on a flat plane.
    a. If the projectile was launched such that the angle was optimized for range, what would the angle be? (1)

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b. In what range would the optimal angle be if air resistance is taken into account?
    a)58-67 degrees
    b)40-45 degrees
    c)88-90 degrees
    d)68-74 degrees

(1)

3. A ferry boat is sailing at 12 km/h 30◦ W of N with respect to a river that is flowing at 6.0 km/h E As observed from the shore, the ferry boat is sailing (2)

4. A cannon shoots a ball at an angle of 45 degrees from the horizontal with an initial velocity of 30m/s. The cannon is also pointing 20 degrees east of north in an aerial perspective. (hint: 3 dimensions)
    a. What is the range of the cannon? (1)

    b. What are the coordinates of the point of impact of the projectile? (2)

5. Two vectors lie with their tails at the same point. When the angle between them is increased by 20 degrees, their scalar product has the same magnitude but changes from positive to negative. The original angle (in degrees) between them was (2)

Every Other Topic (18)

1. A dart with mass 2 kg is launched at an angle of 30 degrees above the horizontal with an initial speed of 10 m/s. As it reaches its apex, it hits a block of mass 10 kg suspended on a massless string 1.2 m below the pivot of the string.
    a. Determine the speed of the dart just before it strikes the block. (1)

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b. Calculate the horizontal distance between the initial launch and the moment it strikes the block. (1)

c. After the dart hits the block, it sticks. Calculate the speed of the block and dart just after the collision. (2)

d. The block and dart become a simple pendulum after the strike. Calculate the time it takes for the block to return to its original position after the initial strike. (2)

2. A basketball with mass = .624 kg and .243 m in diameter is held fully under water.
   a. Calculate the buoyant force and weight. (2)

   b. When released, does the ball sink to the bottom or float to the surface? (1)

   c. If it floats, what percentage of it is sticking out of the water? If it sinks, what is the normal force, F_N with which it sits on the bottom of the pool? (2)

3. The density of an oil is 850 kg/m3. Find its relative density and kinematic viscosity if the dynamic viscosity is 5e-3 kg/ms. (2)

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4. What will be the the gauge pressure and the absolute pressure of water at depth 12m below the surface? Roh water = 1000 kg/m3, and p atmosphere = 101 kN/m2 .
    a. (1)

    b. (1)

5. A block of mass m is projected up from the bottom of an inclined ramp with an initial velocity of magnitude v0 . The ramp has negligible friction and makes an angle omega with the horizontal. A motion sensor aimed down the ramp is mounted at the top of the incline so that the positive direction is down the ramp. The block starts a distance D from the motion sensor, as shown above. The block slides up the ramp, stops before reaching the sensor, and then slides back down.
    a. Consider the motion of the block at some time t after it has been projected up the ramp. Express your answers in terms of m, D, v0, t, omega and physical constants, as appropriate.
        i. Determine the acceleration a of the block. (1)

        ii. Determine an expression for the velocity v of the block. (1)

        iii. Determine an expression for the position x of the block. (1)

    b. Derive an expression for the position min x of the block when it is closest to the motion sensor. Express your answer in terms of m, D, v0, omega, and physical constants, as appropriate. (2)