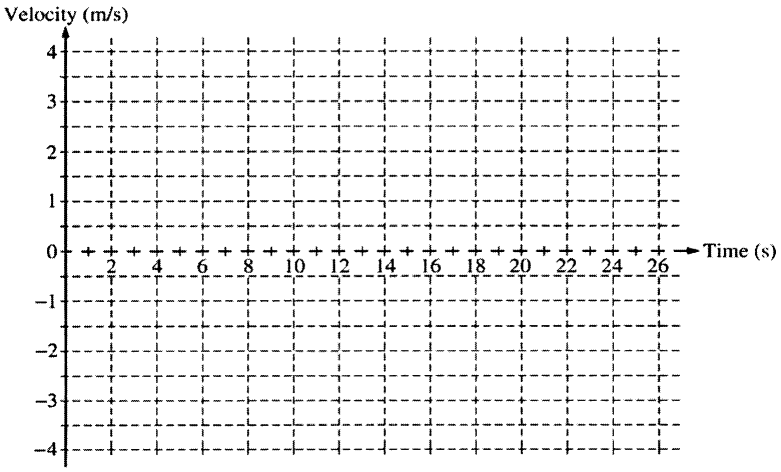
AP C – Practice FRQ pack II

(Solutions can be found online – these are AP B questions, the year is included with each)

1)

2005B1 (10 points) The vertical position of an elevator as a function of time is shown above.

a. On the grid below, graph the velocity of the elevator as a function of time.

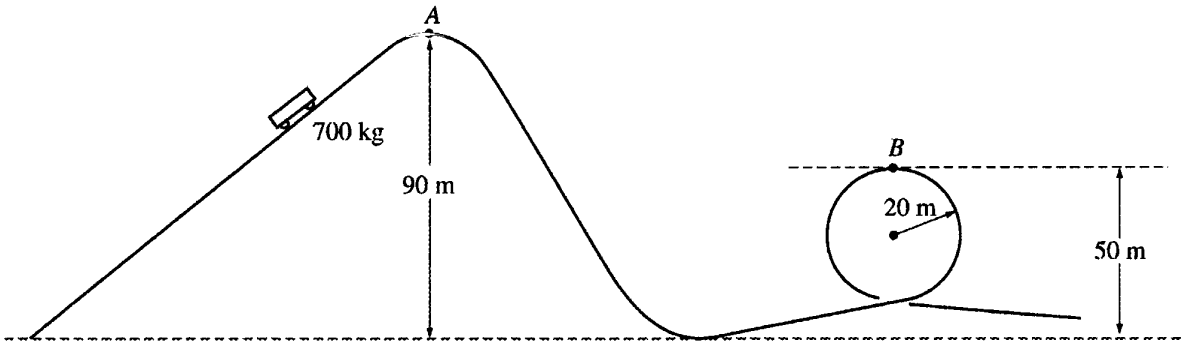


b. i. Calculate the average acceleration for the time period t = 8 s to t = 10 s.

ii. On the box below that represents the elevator, draw a vector to represent the direction of this average acceleration.

c. Suppose that there is a passenger of mass 70 kg in the elevator. Calculate the apparent weight of the passenger at time t = 4 s.

2)



2004B1. (15 points) A roller coaster ride at an amusement park lifts a car of mass 700 kg to point *A* at a height of 90 m above the lowest point on the track, as shown above. The car starts from rest at point *A*, rolls with negligible friction down the incline and follows the track around a loop of radius 20 m. Point *B*, the highest point on the loop, is at a height of 50 m above the lowest point on the track.

(a)

i. Indicate on the figure the point *P* at which the maximum speed of the car is attained.

ii. Calculate the value v_{max}. of this maximum speed.

(b) Calculate the speed v_B of the car at point *B*.

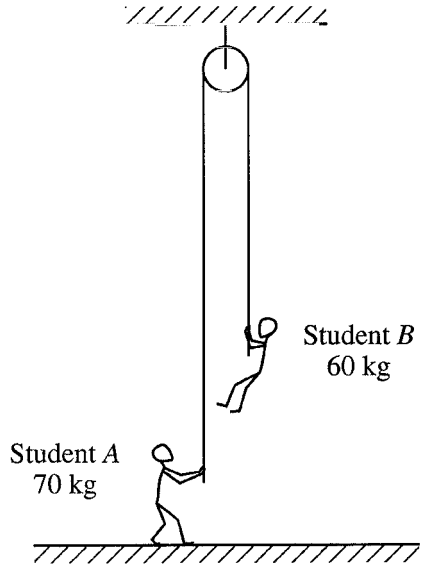
(c)

i. On the figure of the car below, draw and label vectors to represent the forces acting on the car when it is upside down at point *B*.

ii. Calculate the magnitude of all the forces identified in (c)i.

(d) Now suppose that friction is not negligible. How could the loop be modified to maintain the same speed at the top of the loop as found in (b)? Justify your answer.

3)



2003B1 (15 points) A rope of negligible mass passes over a pulley of negligible mass attached to the ceiling, as shown above. One end of the rope is held by Student A of mass 70 kg, who is at rest on the floor. The opposite end of the rope is held by Student B of mass 60 kg, who is suspended at rest above the floor.

a. On the dots below that represent the students, draw and label free-body diagrams showing the forces on Student A and on Student B.

● *B*

● *A*

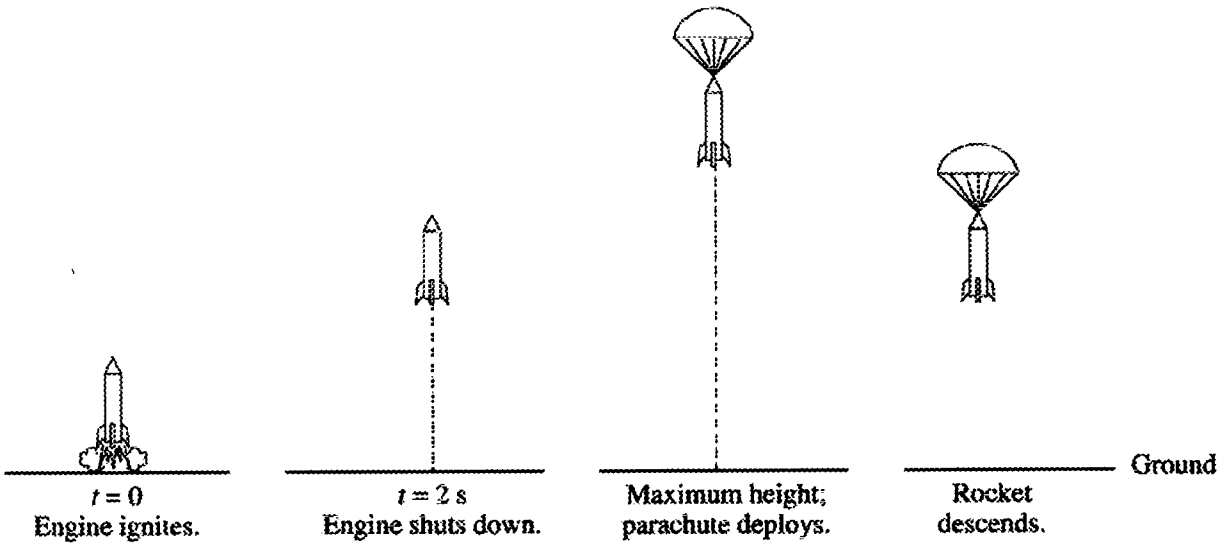
b. Calculate the magnitude of the force exerted by the floor on Student A. Student B now climbs up the rope at a constant acceleration of 0.25 m/s^2 with respect to the floor.

c. Calculate the tension in the rope while Student B is accelerating.

d. As Student B is accelerating, is Student A pulled upward off the floor? Justify your answer.

e. With what minimum acceleration must Student B climb up the rope to lift Student A upward off the floor?

4)



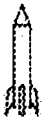
Note: Figures not drawn to scale.

2002B1. A model rocket of mass 0.250 kg is launched vertically with an engine that is ignited at time t = 0, as shown above. The engine provides an impulse of 20.0 N•s by firing for 2.0 s. Upon reaching its maximum height, the rocket deploys a parachute, and then descends vertically to the ground.

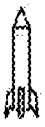
(a) On the figures below, draw and label a free-body diagram for the rocket during each of the following intervals.

i. While the engine is firing

ii. After the engine stops, but before the parachute is deployed



iii. After the parachute is deployed

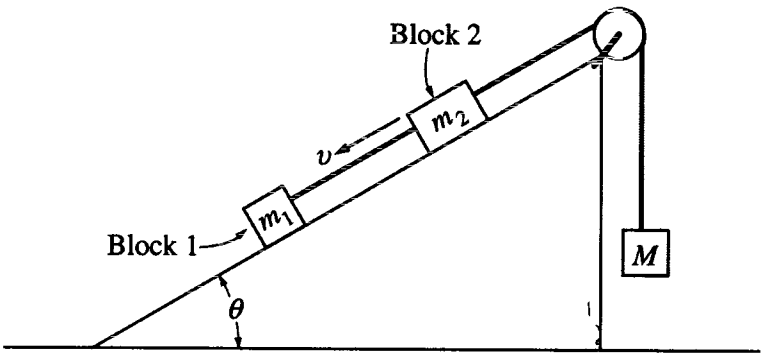


(b) Determine the magnitude of the average acceleration of the rocket during the 2 s firing of the engine.

(c) What maximum height will the rocket reach?

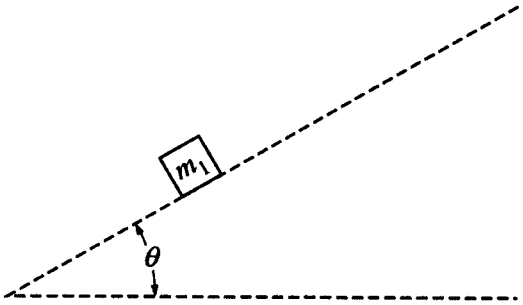
(d) At what time after t = 0 will the maximum height be reached?

5)



2000B2. Blocks 1 and 2 of masses m_1 and m_2, respectively, are connected by a light string, as shown above. These blocks are further connected to a block of mass M by another light string that passes over a pulley of negligible mass and friction. Blocks l and 2 move with a constant velocity v down the inclined plane, which makes an angle θ with the horizontal. The kinetic frictional force on block 1 is f and that on block 2 is 2f.

a. On the figure below, draw and label all the forces on block m_1.



Express your answers to each of the following in terms of m_1, m_2, g, θ, and f.

b. Determine the coefficient of kinetic friction between the inclined plane and block 1.

c. Determine the value of the suspended mass M that allows blocks 1 and 2 to move with constant velocity down the plane.

d. The string between blocks 1 and 2 is now cut. Determine the acceleration of block 1 while it is on the inclined plane.