BBMerlion

# Physics A Level

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# QUIZ 1

Meausurement, Kinematics, Dynamics, Forces, Energy, Motion in Circle, Gravitational Field, Oscillation

# Question 1

A. A rock is dropped from rest into a well. The sound of the splash is actually heard 2.40 s after the rock is released from rest. How far below the top of the well is the surface of the water? The speed of sound in air (at the ambient temperature) is 336 m/s.

# Question 1

B. A test rocket is fired vertically upward from a well. A catapult gives it an initial speed of 80.0 m/s at ground level. Its engines then fire and the rocket accelerates upward at 4.00 $m/s^2$ until it reaches an altitude of 1000m. At that point its engines fail and the rocket goes into free fall, with an acceleration of 9.80 $m/s^2$.

(i) How long is the rocket in motion above the ground?

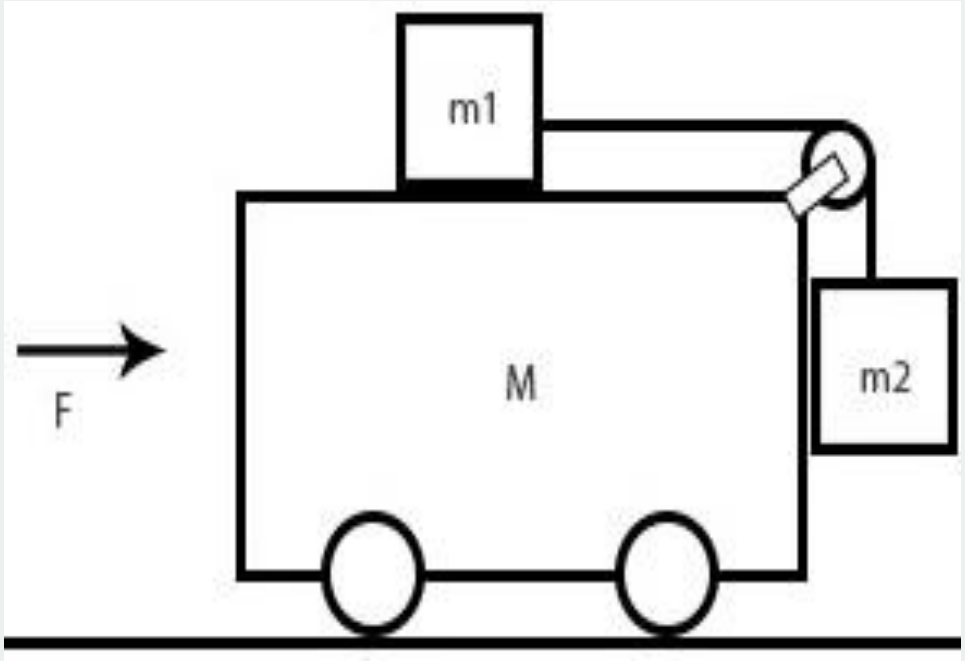
(ii) What is its maximum altitude?

(iii) What is its velocity just before it collides with the Earth? (You will need to consider the motion while the engine is operating separate from the free-fall motion.)

# Question 1

c. One gallon of paint ($Volume = 3.78 \times 10^{-3} m^3$) covers an area of 25.0 $m^2$. What is the thickness of the fresh paint on the wall?

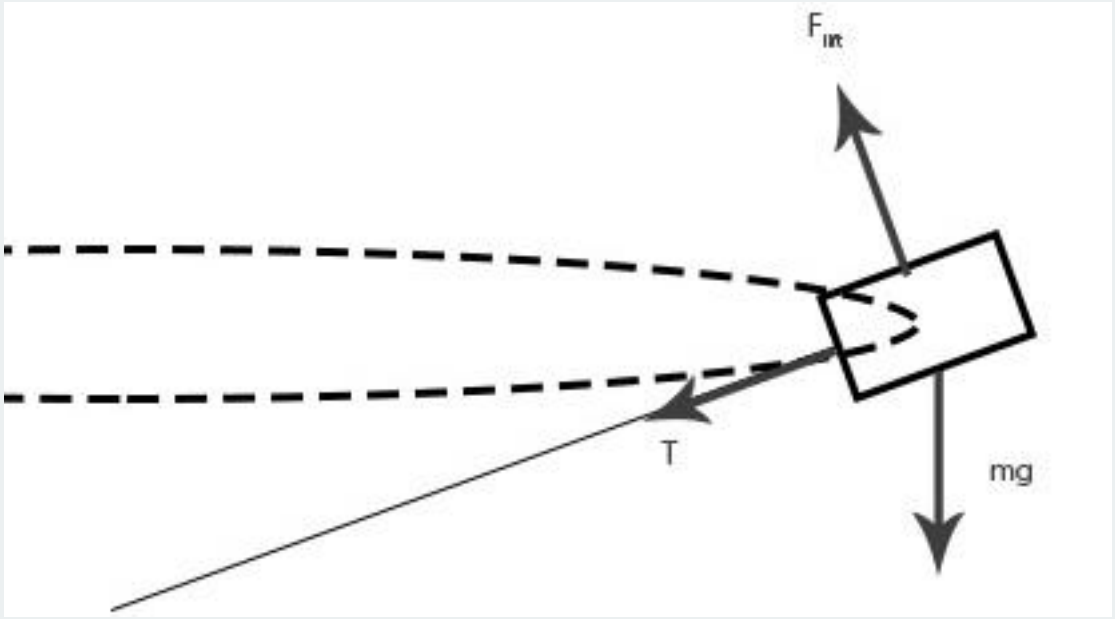
# Question 2



# Question 2

A. What horizontal force must be applied to the cart shown in figure above so that the blocks remain stationary relative to the cart? Assume all surfaces, wheels and pulley are frictionless. Notice that the force exerted by the string accelerates m1.

# Question 2



# Question 2

B. A model airplane of mass 0.750 kg flies with a speed of 35.0 m/s in a horizontal circle at the end of a 60.0-m control wire. Compute the tension in the wire, assuming it makes a constant angle of 20.0° with the horizontal. The forces exerted on the airplane are the pull of the control wire, the gravitational force, and aerodynamic lift that acts at 20.0° inward from the vertical as shown in Figure above.

# Question 3

A. A 2 100-kg pile driver is used to drive a steel I-beam into the ground. The pile driver falls 5.00 m before coming into contact with the top of the beam. Then it drives the beam 12.0 cm farther into the ground as it comes to rest. Using energy considerations, calculate the average force the beam exerts on the pile driver while the pile driver is brought to rest.

# Question 3

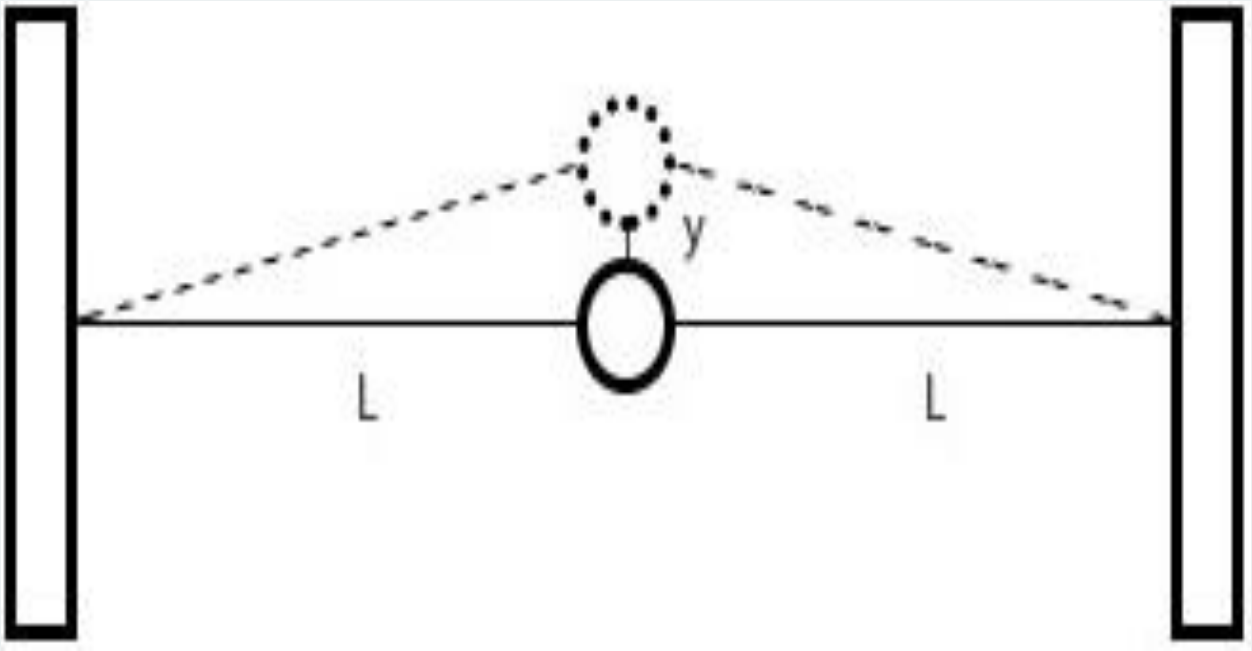
B. A loaded ore car has a mass of 950 kg and rolls on rails with negligible friction. It starts from rest and is pulled up a mineshaft by a cable connected to a winch. The shaft is inclined at 30.0° above the horizontal. The car accelerates uniformly to a speed of 2.20 m/s in 12.0 s and then continues at constant speed.

(i) What power must the winch motor provide when the car is moving at constant speed?

(ii) What maximum power must the winch motor provide?

(iii) What total energy has transferred out of the motor by work by the time the car moves off the end of the track, which is of length 1 250 m?

# Question 4



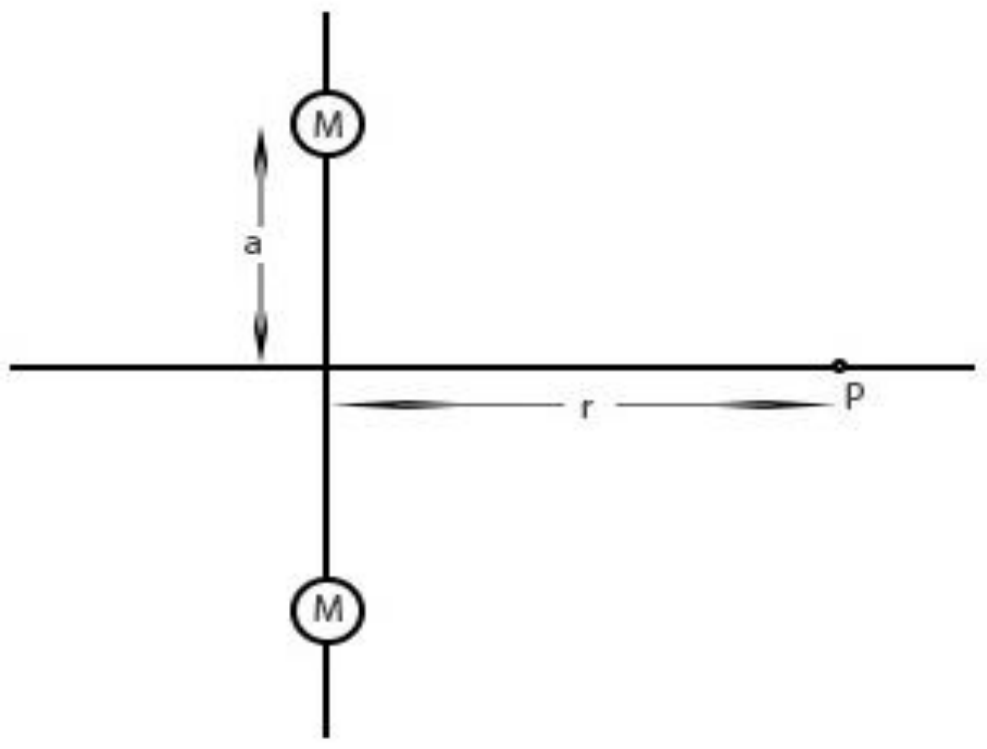
# Question 4

A. A ball of mass m is connected to two rubber bands of length L, each under tension T as shown in figure below. The ball is displaced by a small distance y perpendicular to the length of the rubber bands. Assuming the tension does not change, show that

(i) the restoring force is -(2T/L)y

(ii) the system exhibits simple harmonic motion with an angular frequency $\omega = \sqrt{\frac{2T}{mL}}$

# Question 4



# Question 4

B.

(i) Compute the vector gravitational field at a point P on the perpendicular bisector of the line joining two objects of equal mass separated by a distance 2a as shown in Figure above.

(ii) Explain mathematically why the field should approach zero as r approaches 0.

(iii) Explain mathematically why the magnitude of the field should approach $2GM/r^2$ as r approaches infinity.

# Reference

- Physics for Scientist and Engineer, 6th ed, Serway Jewett