

Physics 2A (Fall 2024)
Review Problems for the Final Celebration

From new material:

1) A boy holds a cube of wood under water by exerting a downward force F on it. The volume of the cube is $8.0 \times 10^{-3} \text{ m}^3$, the density of the wood is 400 kg/m^3 , and the density of water is 1000 kg/m^3 . What is the force F ?

(Answer: 47 N)

2) A 0.050 kg mass is attached to a horizontal spring ($k = 75.0 \text{ N/m}$) on a frictionless surface. The mass is released from rest a distance of 20.00 cm from the equilibrium position of the spring. (a) What is the speed of the mass when it is at $x = 10.0 \text{ cm}$. (b) What is the maximum speed of the mass? (c) At what position is the speed of the mass $10.00 \text{ feet per second}$?

(Answer: (a) 6.71 m/s; (b) 7.75 m/s; (c) 18.5 cm)

3) Two trains with 124 Hz horns approach one another. The slower of the two trains has a speed of 22 m/s . What is the speed of the fast train if an observer standing near the tracks between the trains hears a beat frequency of 4.4 Hz ?

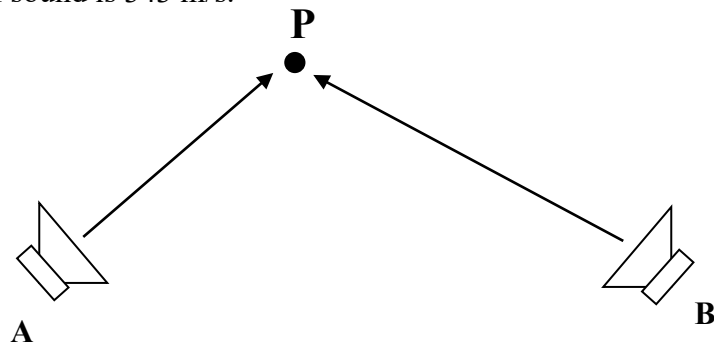
(Answer: 32 m/s)

4) What mass of steam at 100.0°C must be mixed with 150.0 g of ice at its melting point, in a thermally isolated container, to produce liquid water at 50.0°C ? **(Answer: 0.033 kg)**

5) A balloon contains 2.0 liters of nitrogen gas at a temperature of 77 K and a pressure of 101 kPa . If the temperature of the gas is allowed to increase to 23°C and the pressure remains constant, what volume will the gas occupy? ($1 \text{ liter} = 10^3 \text{ cm}^3$)

(Answer: $7.7 \times 10^3 \text{ cm}^3$)

6) A person is standing at point P, which is 4.50 m away from speaker A and 7.00 m away from speaker B as shown below. Both speakers vibrate in phase and play sound of the same frequency. Assume that the speed of sound is 343 m/s .



a) What are the two largest wavelength sound waves that the speaker can play so that the person at point P hears constructive interference? **(Answer: 2.50 m and 1.25 m)**

b) What are the two smallest frequency sound waves that the speakers can play so that a person at point P hears no sound? **(Answer: 68.6 Hz and 205.8 Hz)**

From old material:

7) A 10.5 kg object is traveling at 6.50 m/s to the right and collides with a 6.50 kg object traveling at 4.50 m/s to the left. If the two objects stick together after the collision, how much energy is lost during the collision? Where did the energy go? (**Answer: KE lost = 243 J; heat**)

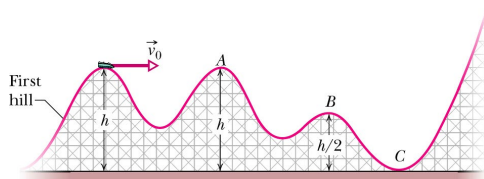
8) A 2.0 kg ball is launched at 40.0 m/s at an angle of 35.0° above the horizontal.

a) How far from its launch point does the ball land? (**Answer: 153 m**)

b) When is the ball's speed equal to 35.0 m/s? (**Answer: t = 1.1 s and t = 3.6 s**)

c) What is the magnitude and direction of the ball's velocity at t = 3.0 s? (**Answer: 33.5 m/s at $\theta = 349^\circ$**)

9) A frictionless roller coaster passes over the first hill of height $h = 75.0$ m with a speed $v_0 = 12.50$ m/s as shown in the figure below.



a) What is the speed of the roller coaster at point B? (**Answer: 29.9 m/s**)

b) What is the speed of the roller coaster at point C? (**Answer: 40.3 m/s**)

c) How high will the roller coaster go on the last hill (beyond point C), which is too high for it to cross? (**Answer: 83.0 m**)

10) A 100.0 N block slides up a ramp at an angle of 20.0°. The coefficient of friction between the block and ramp is $\mu_k = 0.50$. What is the magnitude of the acceleration of the crate? (**Answer: 8.0 m/s²**)

11) A car drives at a constant speed of 35.0 **mi/hr** at 30.0° east of north for 2 minutes, then at a constant speed of 20.0 m/s at 25° south of west for 45 s, and finally at a constant speed of 25.0 m/s at 60° south of east for 5 minutes.

a) What is the magnitude and direction of the average velocity of the car during this trip? (**Answer: 14.0 m/s at 306°**)

b) What is the average speed of the car during this trip? (**Answer: 22.1 m/s**)

12) A falling stone takes 0.30 s to travel past a window 2.2 m tall (see the figure to the right). From what height above the top of the window did the stone fall (assuming it was released from rest)? (**Answer: 1.75 m**)

