Center for Academic Resources in Engineering (CARE)
Peer Exam Review Session

Phys 100 — Thinking About Physics

Midterm Worksheet

The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive. In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.

Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Session 1: Nov 1, 4-6pm Alex and Cindy Session 2: Nov 3, 4-6pm Jason and Yvonne

Can't make it to a session? Here's our schedule by course:

https://care.engineering.illinois.edu/tutoring-resources/tutoring-schedule-by-course/

Solutions will be available on our website after the last review session that we host, as well as posted in the zoom chat 30 minutes prior to the end of the session

Step-by-step login for exam review session:

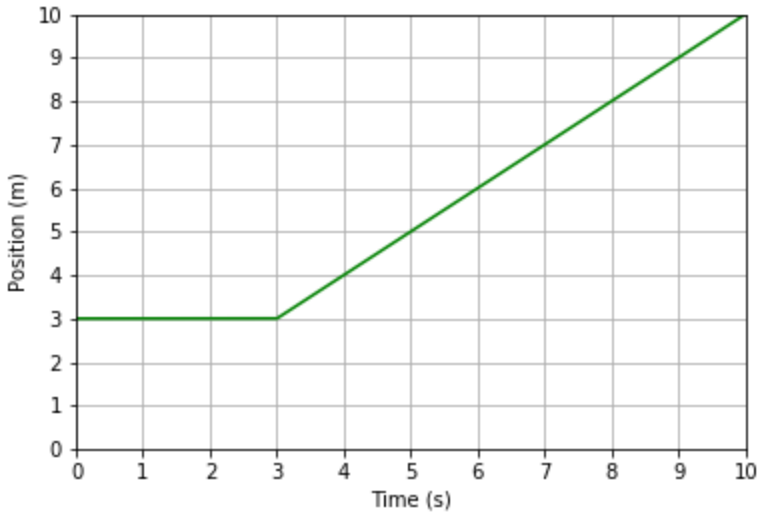
1. Log into Queue @ Illinois
2. Click "New Question"
3. Add your NetID and Name
4. Press "Add to Queue"
5. Join the zoom link in the staff message

Please do not log into the zoom call without adding yourself to the queue

Good luck with your exam!

1. The following two parts refer to their respective plots and are mutually exclusive.

(a) Below is a graph position versus time and its equation of an object traveling along some path described by: $s(x) = \begin{cases} 3 & t < 3 \\ x & t > 3 \end{cases}$

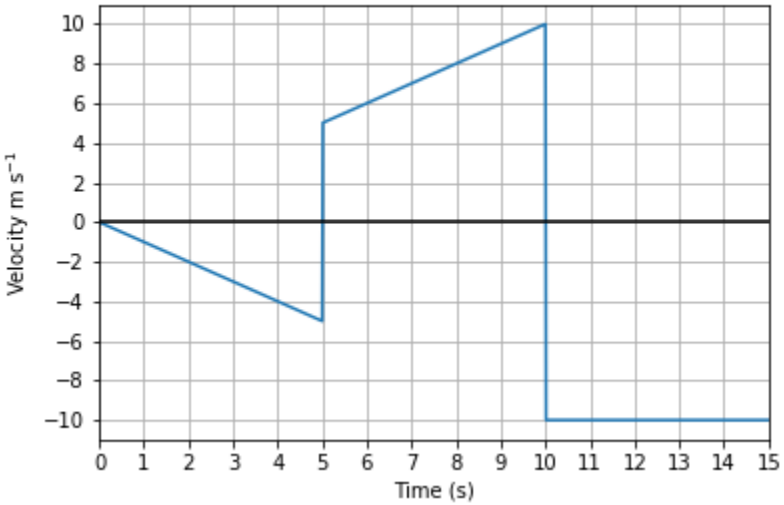


i) What is the object's velocity at time t = 2 s?

ii) What is the object's velocity at time t = 5 s?

iii) When is the object accelerating?

(b) Below is a graph velocity versus time and its equation of an object traveling along some path described by: $v(x) = \begin{cases} -x & 0 < t \leq 5 \\ x & 5 < t \leq 10 \\ -10 & 10 < t \leq 15 \end{cases}$

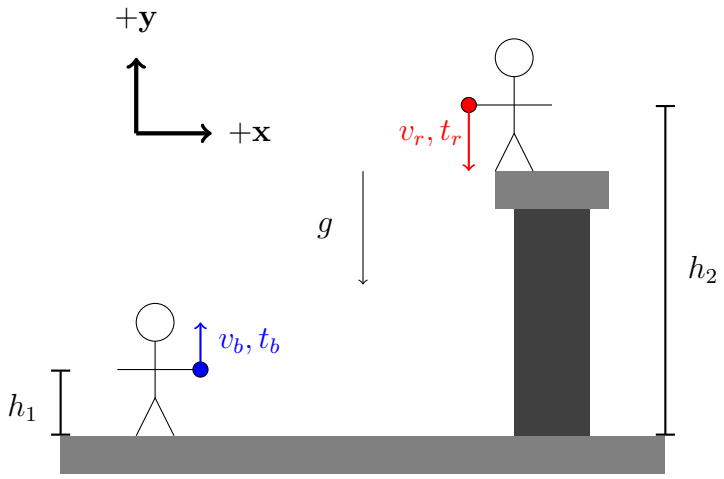


i) If the object started at initial position x = 15 m, where does it end up after the whole 15 s?

ii) On which intervals of times is the object accelerating?

iii) On which intervals of times in the object decelerating?

2. A blue ball is thrown upward with an initial speed of $v_b = 20$ m/s, from a height of $h_1 = 0.6$ meters above the ground. $t_d = 2.4$ seconds after the blue ball is thrown, a red ball is thrown down with an initial speed of $v_r = 8.7$ m/s from a height of h_2 22.8 meters above the ground. The force of gravity due to the earth results in the balls each having a constant downward acceleration of $g = 9.81$ m/s^2



(a) What is the speed of the blue ball when it reaches its maximum height?

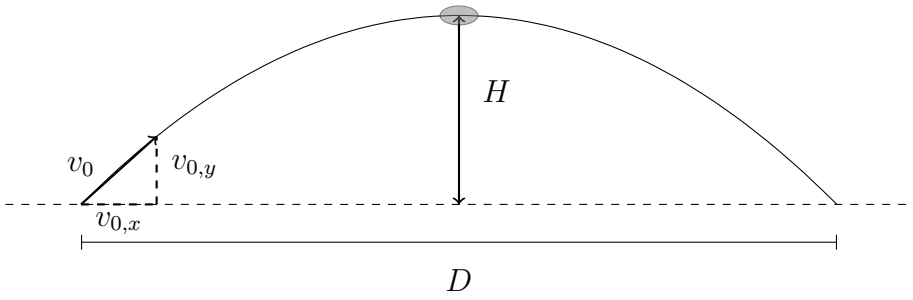
(b) How long does it take the blue ball to reach its maximum height?

(c) What is the maximum height of the blue ball?

(d) Write the position of the red ball as a function of time

(e) When are the red ball and the blue ball at the same height?

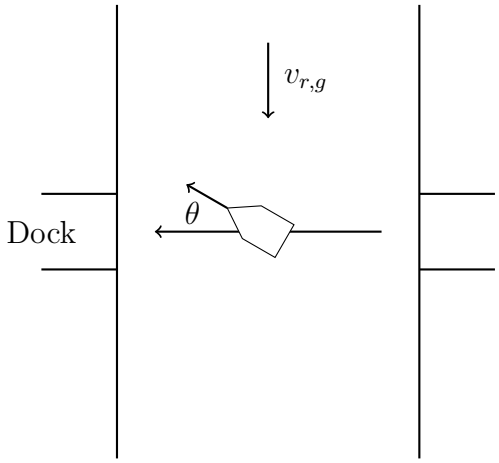
3. A quarterback throws a football toward a receiver who catches it t seconds later D meters away. Assume the ball is thrown and caught at the same height above the horizontal field and that you can ignore air resistance.



(a) If $t = 3$ seconds and $D = 60$ m, what is the horizontal component $v_{0,x}$ of the initial velocity of the ball?

(b) If $t = 3$ seconds and $D = 60$ m, what is the maximum height H reached by the ball (above its initial position)?

4. A boat is traveling directly across a river (as seen by an observer standing on the shore) that flows at a uniform rate of $v_{r,g} = 10$ ft/s, as shown in the figure. To compensate for the flow of the river, the boat must head upstream as it travels. The speed of the boat is 18 ft/s with respect to the water



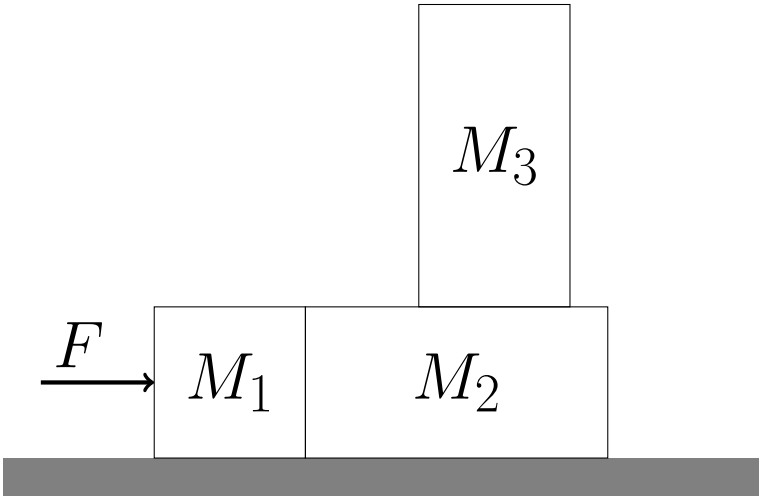
(a) What is the angle between the direction the boat points and the direction it is traveling with respect to the shore?

(b) If the river has width, $W = 500$ ft, and the angle is $\theta = 50°$:

i) How long does it take the boat to reach the other side

ii) How far upstream does the boat end up?

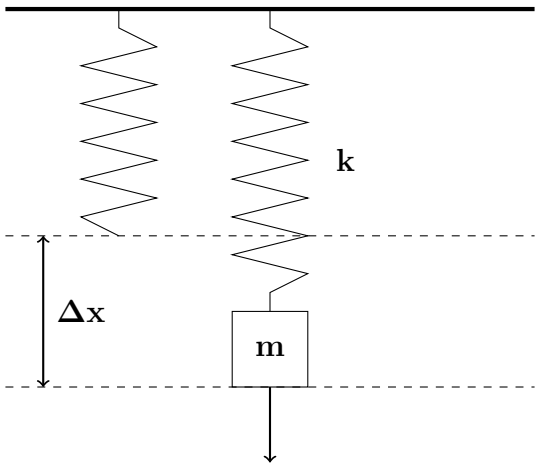
5. Three blocks are placed in contact on a horizontal frictionless surface. A constant force of magnitude $F = 30$ N is applied to the box of mass $M_1 = 8$kg. There is friction between the surfaces of blocks $M_2 = 2M_1$ and $M_3 = 3M_1$ ($\mu_s = 0.5$, $\mu_k = 0.3$) so the three blocks accelerated together to the right.



(a) What is the acceleration of the top block? Is it different than the acceleration of mass M?

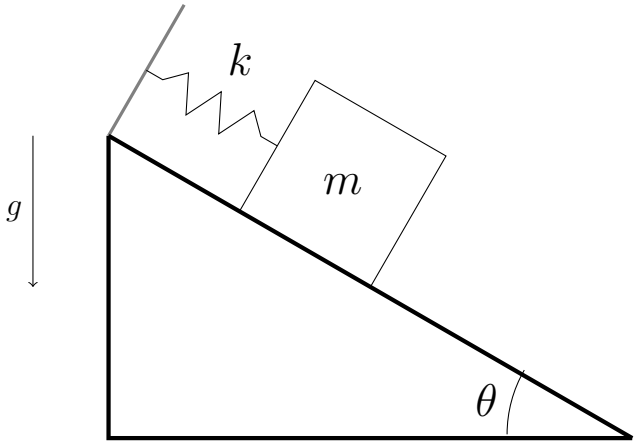
(b) What is the maximum force F that can be applied, before the 3M block slides off? (Hint: draw force diagrams for all three of the blocks)

6. Consider the following vertical spring system before and after a mass is attached:
begincenter



After the mass, m, is attached to the spring with spring constant k the spring stretches by some Δx. Find an expression for Δx in terms of k and m

7. A block of mass $m = 1.5$ kg is kept in place on a rough ramp by a spring, as shown. The ramp makes an angle $\theta = 50°$ with respect to the horizontal, and the coefficients of static and kinetic frictions are $\mu_s = 0.65$ and $\mu_k = 0.3$, respectively. The spring constant is $k = 40\text{N/m}$.



What is Δx_{min}, the minimum amount the spring must be stretched in order for the block to be at rest?