← Physics 205 Spring 2023 TTH, section 44832, Spring 2023

Physics 205 Homework 8 (Homework)

INSTRUCTOR
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Sierra College, CA

Current Score

QUESTION	1	2	3	4	5	6	7	8	9	
POINTS	1.25/1.25 ✓	1.25/1.25 ✓	1.25/1.25 ✓	1.25/1.25 ✓	1.25/1.25 ✓	0.93/1.25	1.25/1.25 ✓	1.25/1.25 ✓	1.25/1.25 ✓	1.2

TOTAL SCORE

13.46/21 64.1%

SUBMISSIONS USED

40/100

Due Date

TUE, MAR 21, 2023
11:59 PM PDT

Request Extension

Assignment Submission & Scoring

Assignment Submission

For this assignment, you submit the entire assignment.

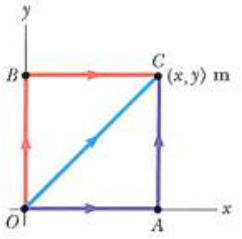
Assignment Scoring

Your last submission is used for your score.

1. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 7.P.041.SOLN.**

MY NOTES ASK YOUR TEACHER

A force acting on a particle moving in the *xy* plane is given by $\vec{F} = (2y\,\hat{i} + x^2\,\hat{j})$ N, where *x* and *y* are in meters. The particle moves from the origin to a final position having coordinates *x* = 4.50 m and *y* = 4.50 m, as in the figure below.



(a) Calculate the work done by $\vec{F}$ on the particle moved along *OAC*.

91.125 ✔ J

(b) Calculate the work done by $\vec{F}$ on the particle moved along *OBC*.

40.5 ✔ J

(c) Calculate the work done by $\vec{F}$ on the particle moved along *OC*

50.625 ✔ J

(d) Is $\vec{F}$ conservative or nonconservative?

- ○ conservative
- ◉ nonconservative ✔

Explain your answer.

Forces acting in opposite directions have different values, therefore the force is not conservative.

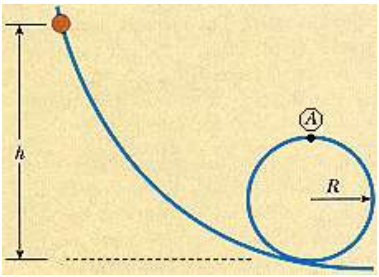
Score: 0.25 out of 0.25

Comment:

2. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.003.SOLN.**

MY NOTES ASK YOUR TEACHER

A bead slides without friction around a loop-the-loop as shown in the figure below. The bead is released from a height $h = 3.10R$.



(a) What is the bead's speed (V) at point A? Answer in terms of R and g, the acceleration of gravity.

$v_A =$

$\sqrt{2.2gR}$

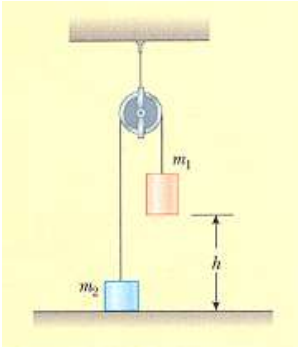
(b) How large is the normal force on the bead if its mass is 5.20 g?

.061 N (downward)

3. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.007.SOLN.**

MY NOTES ASK YOUR TEACHER

Two objects, $m_1 = 4.50$ kg and $m_2 = 3.00$ kg, are connected by a light string passing over a light frictionless pulley as shown in the figure below. The object of mass 4.50 kg is released from rest, $h = 5.50$ m above the ground.



(a) Using the isolated system model, determine the speed of the 3.00 kg object just as the 4.50 kg object hits the ground.

4.64 m/s

(b) Find the maximum height to which the 3.00 kg object rises.

6.59 m

4. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE9 8.P.011.**

MY NOTES ASK YOUR TEACHER

The system shown in the figure below consists of a light, inextensible cord, light, frictionless pulleys, and blocks of equal mass. Notice that block B is attached to one of the pulleys. The system is initially held at rest so that the blocks are at the same height above the ground. The blocks are then released. Find the speed of block A at the moment the vertical separation of the blocks is *h*. (Use any variable or symbol stated above along with the following as necessary: *g*.)

v_A =

$\sqrt{8gh15}$

5. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.010.**

MY NOTES ASK YOUR TEACHER

A 16.0 kg cannonball is fired from a cannon with a muzzle speed of 1000 m/s at an angle of 36.0° with the horizontal. A second ball is fired at an angle of 90.0°.

(a) Use the isolated system model to find the maximum height reached by each ball.

17627.1 m (first ball)

51020.4 m (second ball)

(b) What is the total mechanical energy of the ball-Earth system at the maximum height for each ball? Let $y = 0$ at the cannon.

8E6 J (first ball)

8E6 J (second ball)

6. **[0.93/1.25 Points]** DETAILS PREVIOUS ANSWERS **SB5 8.P.26.**

MY NOTES ASK YOUR TEACHER

After its release at the top of the first rise, a roller-coaster car moves freely with negligible friction. The roller coaster shown in Figure P8.26 has a circular loop of radius 20.8 m. The car barely makes it around the loop. At the top of the loop, the riders are upside down and feel weightless.

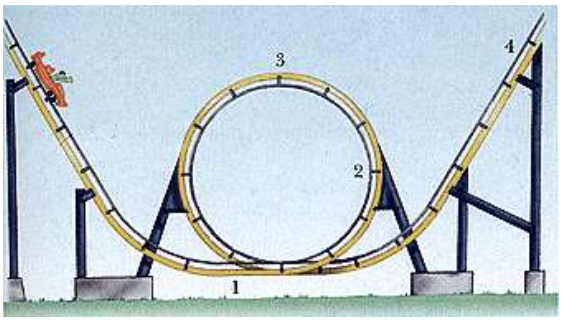


Figure P8.26

(a) Find the speed of the roller coaster car at the top of the loop (position 3).

14.1393 ✓ m/s

(b) Find the speed of the roller coaster car at position 1.

31.6165 ✓ m/s

(c) Find the speed of the roller coaster car at position 2.

24.49 ✓ m/s

(d) Find the difference in height between positions 1 and 4 if the speed at position 4 is 10.4 m/s.

45.48 ✗ m

7. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.018.**

MY NOTES ASK YOUR TEACHER

At time t_i, the kinetic energy of a particle is 29.0 J and the potential energy of the system to which it belongs is 11.0 J. At some later time t_f, the kinetic energy of the particle is 21.0 J.

(a) If only conservative forces act on the particle, what are the potential energy and the total energy at time t_f?

19 ✓ J (potential energy)

40 ✓ J (total energy)

(b) If the potential energy of the system at time t_f is 14.0 J, are there any nonconservative forces acting on the particle?

- ○ Yes. The loss in potential energy and the gain in kinetic energy of the system are not equal.
- ○ No. The loss in potential energy and the gain in kinetic energy of the system are equal.
- ◉ Yes. The gain in potential energy and the loss in kinetic energy of the system are not equal.
- ○ No. The gain in potential energy and the loss in kinetic energy of the system are equal.

✓

8. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.XP.010.**

MY NOTES ASK YOUR TEACHER

A 62.0 kg diver steps off a 13.0 m tower and drops straight down into the water. If he comes to rest 6.50 m beneath the surface of the water, determine the average resistance force exerted by the water on the diver.

1822.8 ✔ N

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9. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.XP.014.**

MY NOTES ASK YOUR TEACHER

A block of mass m = 2.50 kg situated on a rough incline at an angle of θ = 37.0° is connected to a spring of negligible mass having a spring constant of 100 N/m (Fig. P8.54). The pulley is frictionelss. The block is released from rest when the spring is unstretched. The block moves 12.5 cm down the incline before coming to rest. Find the coefficient of kinetic friction between block and incline.

.432 ✔

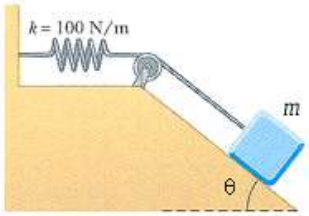

Figure P8.54

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10. **[1.25/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.023.**

MY NOTES ASK YOUR TEACHER

A toy cannon uses a spring to project a 5.31 g soft rubber ball. The spring is originally compressed by 5.08 cm and has a force constant of 8.02 N/m. When the cannon is fired, the ball moves 14.1 cm through the horizontal barrel of the cannon, and there is a constant frictional force of 0.0324 N between the barrel and the ball.

(a) With what speed does the projectile leave the barrel of the cannon?

1.479 ✔ m/s

(b) At what point does the ball have maximum speed?

4.6 ✔ cm (from its original position)

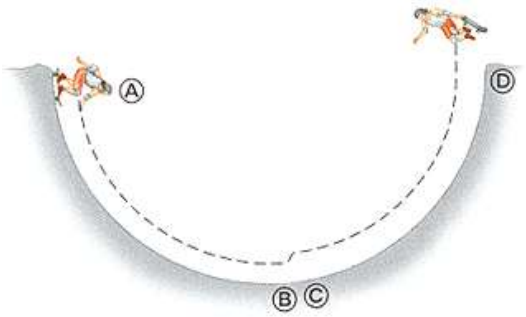
(c) What is this maximum speed?

1.82 ✔ m/s

11. **[1.28/2.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.037.**

MY NOTES ASK YOUR TEACHER

A skateboarder with his board can be modeled as a particle of mass 80.0 kg, located at his center of mass (which we will study in a later chapter). As shown in the figure below, the skateboarder starts from rest in a crouching position at one lip of a half-pipe (point A). The half-pipe is a dry water channel, forming one half of a cylinder of radius 6.70 m with its axis horizontal. On his descent, the skateboarder moves without friction so that his center of mass moves through one quarter of a circle of radius 6.20 m.



(a) Find his speed at the bottom of the half-pipe (point B).

11.02 ✔ m/s

(b) Find his centripetal acceleration.

19.6 ✔ m/s^2

(c) Find the normal force n_B acting on the skateboarder at point B.

2352 ✔ N

Immediately after passing point B, he stands up and raises his arms, lifting his center of mass from 0.500 m to 0.920 m above the concrete (point C). To account for the conversion of chemical into mechanical energy, model his legs as doing work by pushing him vertically up, with a constant force equal to the normal force *nB*, over a distance of 0.420 m. (You will be able to solve this problem with a more accurate model described in a later chapter.)

(d) What is the work done on the skateboarder's body in this process?

987.84 ✔ J

Next, the skateboarder glides upward with his center of mass moving in a quarter circle of radius 5.78 m. His body is horizontal when he passes point D, the far lip of the half-pipe.

(e) Find his speed at this location.

✘

Your response differs from the correct answer by more than 10%. Double check your calculations. m/s

(f) At last he goes ballistic, twisting around while his center of mass moves vertically. How high above point D does he rise?

✘ m

(g) Over what time interval is he airborne before he touches down, 2.26 m below the level of point D?

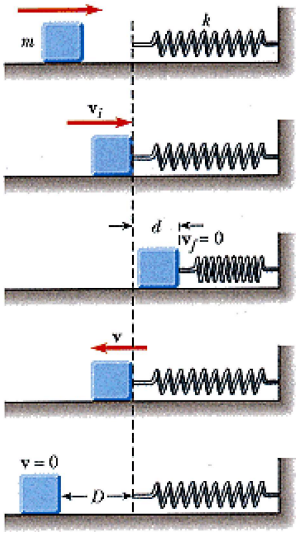
✘ s

(*Caution*: Do not try this yourself without the required skill and protective equipment or in a drainage channel to which you do not have legal access.)

12. [0/1.25 Points] DETAILS PREVIOUS ANSWERS SERPSE7 8.P.054.

MY NOTES ASK YOUR TEACHER

A 1.40 kg mass slides to the right on a surface having a coefficient of kinetic friction 0.250. The object has a speed of v_i = 3.00 m/s when it makes contact with a light spring that has a force constant of 50.0 N/m. The object comes to rest after the spring has been compressed a distance *d*. The object is then forced toward the left by the spring and continues to move in that direction beyond the spring's unstretched position. Finally, the object comes to rest a distance *D* to the left of the unstretched spring.



(a) Find the distance of compression *d*.

[ ] ✖ m

(b) Find the speed *v* at the unstretched position when the object is moving to the left.

[ ] ✖ m/s

(c) Find the distance *D* where the object comes to rest.

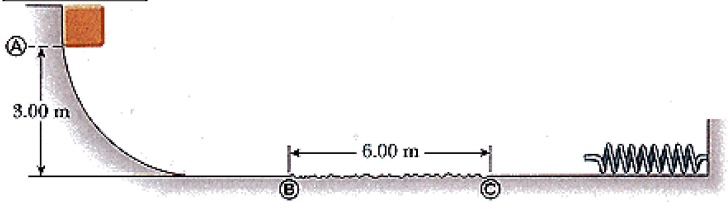
[ ] ✖ m

13. [0/1.25 Points] DETAILS PREVIOUS ANSWERS SERPSE7 8.P.055.SOLN.

MY NOTES ASK YOUR TEACHER

A 10.0 kg block is released from point *A* in the figure below. The track is frictionless except for the portion between points *B* and *C*, which has a length of 6.00 m. The block travels down the track, hits a spring of force constant 2100 N/m, and compresses the spring to 0.250 m from its equilibrium position before coming to rest momentarily. Determine the coefficient of kinetic friction between the block and the rough surface between *B* and C.

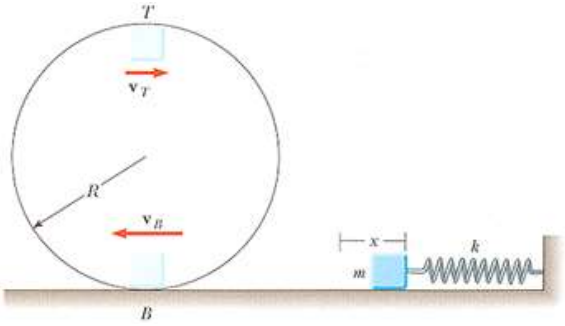
[ ] ✖



14. [0/1.25 Points] DETAILS PREVIOUS ANSWERS SERPSE7 8.P.059.SOLN.

MY NOTES ASK YOUR TEACHER

A block of mass 0.520 kg is pushed against a horizontal spring of negligible mass until the spring is compressed a distance x. The force constant of the spring is 450 N/m. When it is released, the block travels along a frictionless, horizontal surface to point B, the bottom of a vertical circular track of radius R = 1.00 m, and continues to move up the track. The speed of the block at the bottom of the track is v_B = 13.1 m/s, and the block experiences an average frictional force of 7.00 N while sliding up the track.



(a) What is x?

[ ] ✗ m

(b) What speed do you predict for the block at the top of the track?

[ ] ✗ m/s

(c) Does the block actually reach the top of the track, or does it fall off before reaching the top?

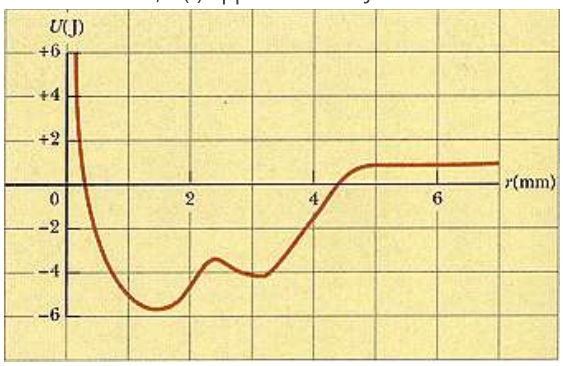
- ○ block reaches top of the track
- ○ block falls off before reaching the top

✗

15. **[0/1.25 Points]** DETAILS PREVIOUS ANSWERS **SERPSE7 8.P.024.**

MY NOTES ASK YOUR TEACHER

A particle moves along a line where its potential energy depends on its position *r*, as graphed in the figure below. In the limit as *r* increases without bound, *U*(*r*) approaches +1 J.



(a) Identify each equilibrium position for this particle. Indicate whether each is a point of stable, unstable, or neutral equilibrium.

$r \to -\infty$ ---Select---

r = 0 mm ---Select---

r = 1.5 mm ---Select---

r = 2.0 mm ---Select---

r = 2.3 mm ---Select---

r = 3.2 mm ---Select---

r = 4.0 mm ---Select---

$r \to \infty$ ---Select---

(b) The particle will be bound if the total energy of the system is in what range?

J $\leq E <$ J

Now suppose the system has energy -3 J. Determine the following.

(c) the range of positions where the particle can be found

mm $\leq r <$ mm

(d) its maximum kinetic energy

J

(e) the location where it has maximum kinetic energy

mm

(f) the *binding energy* of the system--that is, the additional energy that it would have to be given in order for the particle to move out to $r \to \infty$

J

16. [0/1.25 Points] DETAILS PREVIOUS ANSWERS SERPSE9 7.P.050.

MY NOTES ASK YOUR TEACHER

A single conservative force acting on a particle within a system varies as $\vec{\mathbf{F}} = (-Ax + Bx^3)\hat{\mathbf{i}}$ N, where A and B are constants, $\vec{\mathbf{F}}$ is in newtons, and x is in meters.

(a) Calculate the potential energy function $U(x)$ associated with this force, taking $U = 0$ at $x = 0$. (Use any variable or symbol stated above as necessary.)

$U(x) =$

(b) Find the change in potential energy and change in kinetic energy as the particle moves from $x = 1.10$ m to $x = 3.60$ m. (Use any variable or symbol stated above as necessary.)

$\Delta U =$

$\Delta K =$

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