Answers and LOs

Physics 206 – Exam II

Spring 2020 (all UP sections) March 16, 2020

This is the main template for the 8 different flavours generated for and distributed to the class. The questions and answer options of each of the flavours are identical, however the order of the questions and answer options are randomized in each flavour. Shown here are the correct answers and which LOs are achieved for a given answer; sometimes incorrect answer still achieve part of the total list of LOs for a given problem.
You should be able to translate your particular version by comparing to this version. This is why it is important that you keep your copy of the exam as well as any notes on scratch paper as you wrote it.

Rules of the exam:

1) You have **90 minutes** (1.5 hrs) to complete the exam.
2) You will answer using the **Grading Sheet** provided. **Make sure you have one before the exam starts**. Be sure to fill out the bubbles of the Grading sheet **completely** with a #2 pencil so as not to lose marks. If necessary (e.g. you cannot adequately erase a mistake), the proctor has extra Grading Sheets.
3) Formulae are provided to you with the exam on a separate sheet. **Make sure you have one before the exam starts**. You may *not* use any other formula sheet.
4) Cell phone use during the exam is **strictly prohibited**. Please turn off all ringers as calls during an exam can be quite distracting.
5) Check to see that there are **10 numbered pages** (5 double-sided sheets) in your exam.
6) You are **not** required to show any work, and only submit the Grading Sheet at the end of the exam. You may use the blank spaces on the exam to work out problems and/or use the extra sheets that came with your exam. If you run out of room, your proctor should have extra scratch paper you may use.
7) Calculators of any type are **not allowed**. In the case of questions with numerical values, the math should be simple enough you will not need a calculator.
8) Unless otherwise stated, assume the magnitude of the acceleration due to gravity is $g = 10\ \mathrm{m/s^2}$, and that air resistance can be considered **negligible**.
9) There is only one correct answer of the options given, but incorrect answers may yield some of the total LOs tested, a type of partial credit.
    - **Multiple answers are not allowed**. If two or more bubbles are filled for a given question, you will receive a zero for that question – even if one is correct.
    - There is **no penalty** for incorrect answers. So there is no harm in guessing if you can't solve the problem and/or run out of time.
10) Have your **TAMU ID ready when submitting your Grading Sheet** to the proctor. You may keep the exam, any blank sheets you used to work out problems, and/or formula sheet following submitting your grading sheet. Alternatively, your proctor can recycle any material you don't want to keep.

1. A box of mass $m = 1$ kg is pressed up against a spring with a force constant $k = 3500$ N/m on a ramp that makes an angle $\theta = 30^\circ$ to the horizontal as shown in the figure below. When the spring is compressed by 0.10 m, the box is $d = 1.0$ m from the top of the ramp. When the box is released from rest, the spring returns to its equilibrium length and shoots the box up the frictionless ramp. When the box reaches the top of the incline, its speed is closest to:

   (A) the box doesn't make it to the top of the ramp

   (B) 4 m/s

   (C) 5 m/s

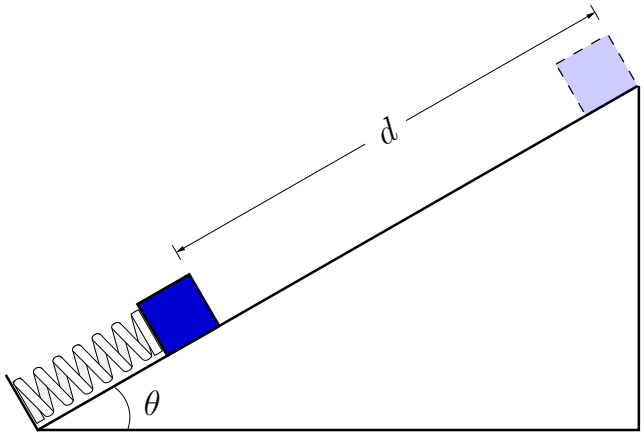
   (D) 6 m/s

   (E) 3 m/s

   (F) None of the above

Answer LOs:

A:
B:
C: 3,34,38,40
D:
E:
F:



Mass being shot by a spring up an incline, Problem 1.

2. Masses $M_1 = m$ and $M_2 = 2m$ are held in place as they hang on opposite sides of a long massless rope resting on two massless, frictionless pulleys (see the figure below). The masses are released from rest. Find the magnitude of the acceleration of the masses, a, and the magnitude of the tension in the rope, T, in terms of m and the acceleration due to gravity, g.

(A) $a = g$ and $T = \frac{1}{3}mg$

(B) $a = g$ and $T = 3mg$

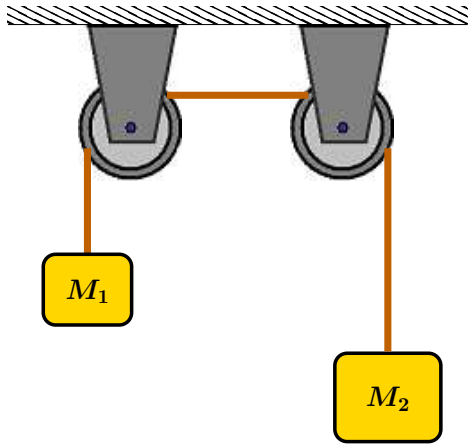
(C) $a = \frac{1}{3}g$ and $T = \frac{4}{3}mg$

(D) $a = \frac{1}{3}g$ and $T = 3mg$

(E) $a = \frac{2}{3}g$ and $T = \frac{1}{3}mg$

(F) $a = \frac{2}{3}g$ and $T = \frac{4}{3}mg$

Answer LOs:
A:
B:
C: 4,21,23,24
D:
E:
F:



Two masses and two pulleys of Problem 2.

3. A block of mass $M = 1$ kg slides up an incline from point A at the bottom to point B at the top of the incline. See the figure below. During the motion from point A to point B, which of the following statements is true regarding W_{grav}, the work done on the rock by gravity, and W_{norm}, the work done on the rock by the normal force?

(A) $W_{\text{grav}} > 0$ and $W_{\text{norm}} < 0$

(B) $W_{\text{grav}} < 0$ and $W_{\text{norm}} < 0$

(C) $W_{\text{grav}} < 0$ and $W_{\text{norm}} > 0$

(D) $W_{\text{grav}} > 0$ and $W_{\text{norm}} = 0$

(E) $W_{\text{grav}} = 0$ and $W_{\text{norm}} > 0$

(F) $W_{\text{grav}} < 0$ and $W_{\text{norm}} = 0$

(G) $W_{\text{grav}} = 0$ and $W_{\text{norm}} < 0$

(H) $W_{\text{grav}} > 0$ and $W_{\text{norm}} > 0$

Answer LOs:
A:
B: 23,32
C: 23,32
D: 26,32
E:
F: 23,26,32,32
G:
H:

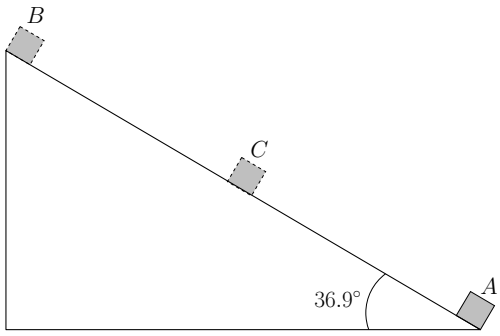


Figure for Problems 3, 4 and 5.

4. The 1-kg block from the previous problem is at point B with height $h_B = 6.0$ m and $v_B = 0$. It slides down a surface with friction to a height $h_C = 2.0$ m, where it has $v_C = 8.0$ m/s. Find the work done by friction on the block.

   (A) 8 J

   (B) -8 J

   (C) -40 J

   (D) 32 J

   (E) -32 J

   (F) 40 J

Answer LOs:
A:
B: 32,34,38,40
C: 38
D:
E:
F:

5. The block of mass $M = 1$ kg from Problem 3 is at rest at point C on the rough incline shown in that problem. The magnitudes of the normal force, F_N, and frictional force, f, are:

   (A) $F_N = 8$ N and $f = 6$ N

   (B) $F_N = 10$ N and $f = 6$ N

   (C) $F_N = 8$ N and $f = 8$ N

   (D) $F_N = 6$ N and $f = 8$ N

   (E) $F_N = 8$ N and $f = 10$ N

   (F) $F_N = 6$ N and $f = 10$ N

   (G) $F_N = 10$ N and $f = 8$ N

   (H) $F_N = 6$ N and $f = 6$ N

Answer LOs:
A: 1,6,23,26,27,29,31
B:
C: 1,26
D:
E:
F:
G:
H: 1,27,29,31

6. A skier of mass 70 kg starts from rest at the top of a frictionless ski jump (point A) and travels down the ramp, as shown in the figure below. Which value is closest to her speed at point B? (Note: the ramp is exactly horizontal at point B).

(A) 40 m/s

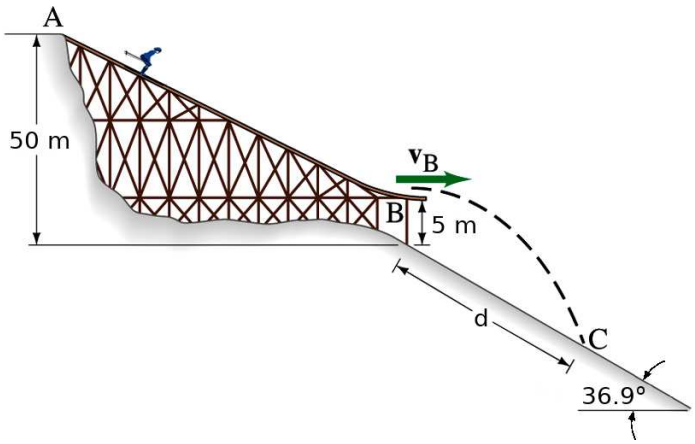
(B) 30 m/s

(C) 70 m/s

(D) 50 m/s

(E) 60 m/s

Answer LOs:
A:
B: 3,6,34,38,40
C:
D:
E:



Ski jumper and ramp for Problems 6 and 7.

7. Continuing with the previous question, the slope following the ramp makes an angle $\theta = 36.9°$ with the horizontal as shown in the figure. The skier is observed to land at point C, which is a distance $d = 85$ m from the ramp. Taking the potential energy at point A to be zero, find her potential energy at point C.

(A) $+70\,700$ J

(B) $+79\,100$ J

(C) $+67\,200$ J

(D) $+82\,600$ J

(E) $-82\,600$ J

(F) $-70\,700$ J

(G) $-67\,200$ J

(H) $-79\,100$ J

Answer LOs:
A: 1
B:
C: 1
D:
E: 38
F: 1,38
G: 1
H:

8. An object of mass $m = 4.0$ kg is moving along a horizontal, frictionless surface with a speed $v_0 = 5.0$ m/s. It then comes in contact with a spring which has a spring constant $k = 40,000$ N/m and is initially in equilibrium. What is Δx, the maximum distance the spring compresses?

(A) 0.25 cm

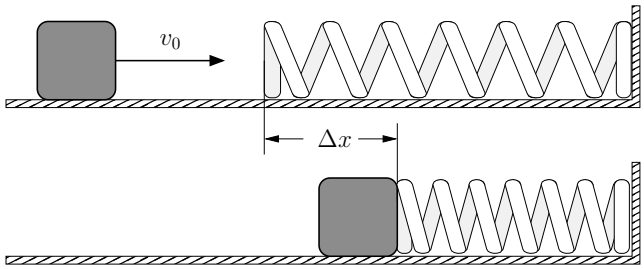
(B) 6.00 cm

(C) 5.00 cm

(D) 0.05 cm

(E) 2.25 cm

Answer LOs:
A:
B:
C: 3,34,38,40
D:
E:



Object running into and compressing a spring (Problem 8).

9. A small cart of mass $m = 10$ kg is released from rest at point A at the top of a track which is a height $h = 3.8$ m above the bottom of the track. As shown in the figure below, the bottom of the track is a circular loop of radius $R = 1.00$ m. The cart moves without friction to Point B at the top of the vertical loop. Find the cart's speed at point B.

(A) $\sqrt{96}$ m/s

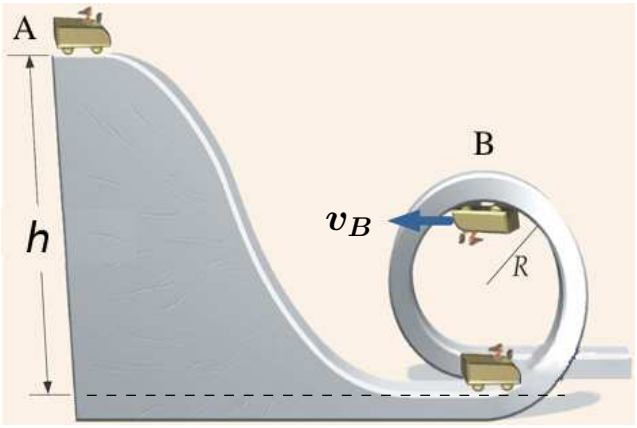
(B) $\sqrt{76}$ m/s

(C) $\sqrt{56}$ m/s

(D) $\sqrt{36}$ m/s

(E) None of the above

Answer LOs:
A:
B:
C:
D: 37
E:



Roller-coaster for Problems 9 and 10.

10. Continuing with the same track and loop as in the previous problem, find the minimum starting height h that is required so that the cart does not fall off the track at point B.

(A) 2.0 m

(B) 3.0 m

(C) 3.5 m

(D) 1.5 m

(E) 2.5 m

(F) None of the above

Answer LOs:
A:
B:
C:
D:
E: 40
F:

11. A ball of mass $m = 0.10$ kg is at the lower end of a light rope that is attached to the ceiling. The ball moves with constant speed in a horizontal circle of radius $r = 0.60$ m when the rope makes a constant angle of $\theta = 36.9°$ with the vertical. The tension force in the rope is:

(A) 1.00 N

(B) 1.67 N

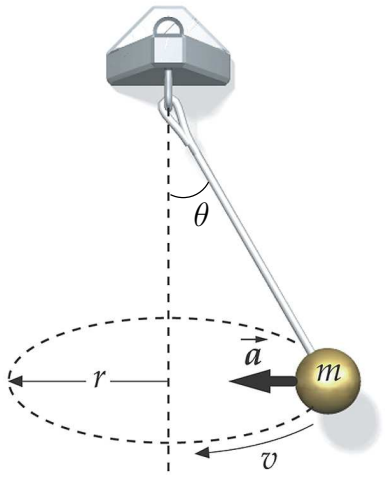
(C) 0.80 N

(D) 0.60 N

(E) 1.25 N

(F) None of the above

Answer LOs:
A:
B:
C:
D:
E: 3,18,19,21,24
F:



Pendulum in circular motion (Problem 11).

12. A piano of mass M is held using the frictionless pulley mechanism shown in the figure below. Assume that all ropes and pulleys shown in the picture are massless and all ropes are exactly vertical. What is the magnitude of the tension, F, in the rope connecting the pulley to the ceiling?

(A) $\frac{1}{2}Mg$

(B) 0

(C) Mg

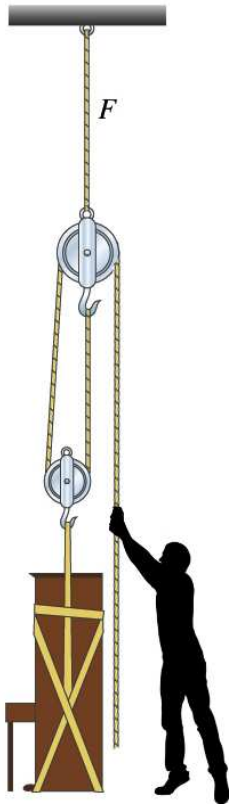
(D) $\frac{1}{3}Mg$

(E) $2Mg$

(F) $\frac{3}{2}Mg$

Answer LOs:

A:
B:
C:
D:
E:
F: 21,23,24,31



Piano being held in place using a pulley mechanism for Problem 12. A mover is holding the free end of the rope to the right of the piano so that the system is in static equilibrium.

13. The potential energy, U, of a point-like particle as a function of position, x, is shown in the plot below. At which of the marked positions is the net force acting on the particle negative?

(A) C and E

(B) B and D

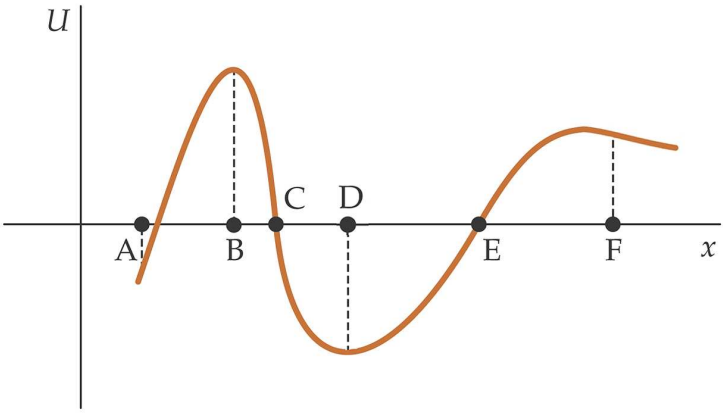
(C) A and E

(D) C and F

(E) C, E and F

(F) A, E and F

Answer LOs:
A:
B:
C: 37,41,44
D:
E:
F:



Potential energy as a function of position for Problems 13, 14 and 15.

14. Referring to the same potential energy versus position curve of Problem 13, at which of the marked positions is the net force acting on the particle positive?

(A) A, E and F

(B) C and E

(C) C and F

(D) B and D

(E) A and E

(F) C, E and F

Answer LOs:
A:
B:
C: 37,41,44
D:
E:
F:

15. Referring to the same potential energy versus position curve of Problem 13, at which of the marked position(s) is the net force acting on the particle zero?

(A) CE

(B) CF

(C) BD

(D) AE

(E) AEF

(F) CEF

Answer LOs:

A:
B:
C: 37,41,44
D:
E:
F:

16. A rock with mass M swings on the end of string of length L like a simple pendulum . As the rock passes its lowest point and the string is vertical, the tension in the string is T. At this point the speed of the rock is:

(A) $\frac{T}{Mg}$

(B) $\sqrt{g/L}$

(C) $\left(T - Mg\frac{L}{M}\right)^2$

(D) $\sqrt{(T - Mg)\frac{L}{M}}$

(E) $\sqrt{(T + Mg)\frac{L}{M}}$

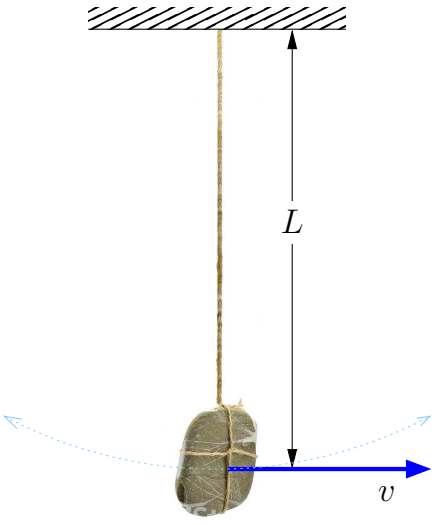
(F) $\frac{Mg}{T}$

(G) $\sqrt{\frac{TM}{L}}$

(H) $\sqrt{TL/M}$

Answer LOs:

A:
B:
C: 23,24
D: 3,16,18,21,23,24
E: 18,23
F:
G:
H: 18,24



Rock on a string passing through vertical for for Problem 16.