Physics 5A - Winter 2021 Midterm 4

ZOE GLEASON

TOTAL POINTS

100 / 100

QUESTION 1

1 1 **5 / 5**

✓ **- 0 pts Correct**

- 5 pts Incorrect

QUESTION 2

2 2 **5 / 5**

✓ **- 0 pts Correct**

- 5 pts Incorrect

QUESTION 3

3 3 **5 / 5**

✓ **- 0 pts Correct**

- 5 pts Incorrect

QUESTION 4

4 4 **5 / 5**

✓ **- 0 pts Correct**

- 5 pts Incorrect

QUESTION 5

5 5 **40 / 40**

✓ **- 0 pts Correct**

- 10 pts Incorrect final answer

- 5 pts Incorrect steps for speed

- 5 pts Incorrect minimum speed required

- 10 pts Incorrect energy equation established

- 5 pts Incorrect value plug in

- 5 pts Missing inertia part

QUESTION 6

6 **40 / 40**

✓ **+ 40 pts Correct: $$L = \frac{v_0^2}{2g(\sin\alpha + \mu_k\cos\alpha)}$$**

+ 5 pts Partial Credit: $$h = L\sin\alpha$$

+ 7 pts Partial Credit: Energy not conserved because of friction

+ 7 pts Partial Credit: $$\Delta K + \Delta U = W_{friction}$$

+ 8 pts Partial Credit: $$W_{friction} = -\mu_k mgL\cos\alpha$$

+ 8 pts Partial Credit: $$\Delta K = -1/2 mv_0^2$$, $$\Delta U = mgL\sin\alpha$$

+ 0 pts No Points

gradescope

Midterm 4

Physics 5A, Winter 2021

Full Name (Printed) Zoe Gleason

Full Name (Signature) Zoe Glea

Student ID Number 405308281

There is only one correct answer for each multiple-choice question. Clearly circle your multiple choice answers.

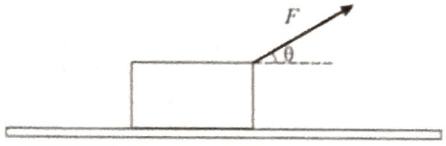
On free-answer questions, it is not sufficient to just present the final answer on any given problem. You need to show all of your work in your solution to justify your steps so that another person can understand how you arrived at the final answer. **All work must be your own and do not communicate with anyone about the exam.** Be prepared to defend anything you write down in a potential follow-up oral examination.

Your submitted exam on Gradescope must contain the same number of pages in the same order as the original exam packet, and your solutions must be clearly written in the spaces below each question with your final answer clearly boxed or circled. (You may want to work on the problems on scratch paper, and when you are happy with your solution, write down your final solution in the space provided on the exam packet. But, do not turn in scratch paper on Gradescope – we will only grade what is written in the proper sections on the exam packet.)

Have fun! Good luck!

Multiple-choice Section – Each question only has one correct answer.

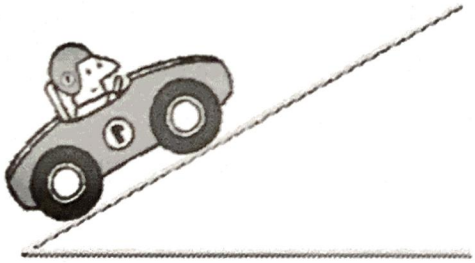
1. A man pulls a sled along a rough horizontal surface by applying a constant force $\vec{F}$ at an angle θ above the horizontal. In pulling the sled a horizontal distance d, the work done by the man is:



a. Fd
b. $Fd \cos \theta$
c. $Fd \sin \theta$
d. $Fd/\cos \theta$
e. $Fd/\sin \theta$

B

2. A car drives up a hill with constant speed. Which statement best describes the total work done on the car by all forces as it moves up the hill with a constant speed?



a. Positive
b. Zero
c. Negative

B

3. A golf ball is struck from ground by a golf club and falls on a green eight feet above the ground. The potential energy of the Earth-ball system is greatest (relative to ground level):

   a. just before the ball is struck
   b. just after the ball is struck
   c. just after the ball lands on the green
   d. when the ball comes to rest on the green
   (e.) when the ball reaches the highest point in its flight

E

4. Two particles, one having twice the mass of the other, are released from rest from the same height. Just before hitting the ground, the kinetic energies of the particles are K_1 and K_2 respectively. How do K_1 and K_2 compare?

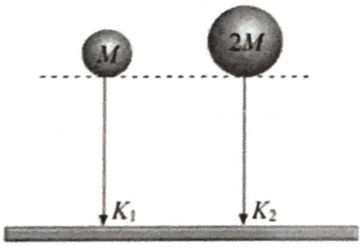
   [Hint: You can ignore air resistance.]

$K_1 = \frac{1}{2}mv^2$

$K_2 = \frac{1}{2} \cdot 2mv^2$

$K_2 = mv^2$

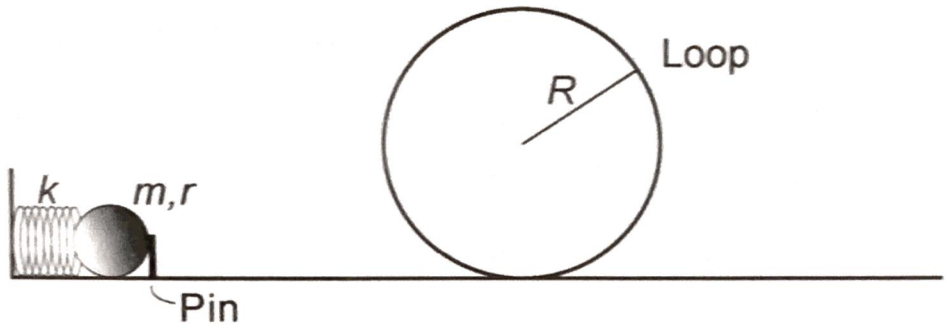
$2K_1 = K_2$



   a. $K_2 = K_1$
   (b.) $K_2 = 2K_1$
   c. $K_2 = 4K_1$

B

5. A ball of mass m and radius r is held in place by a pin against a spring compressed by distance x_o from its equilibrium length. The spring has a spring constant k. When the pin is suddenly removed, the ball is launched by the spring and rolls without slipping along a track that includes a large loop of radius R (which is much larger than r), as shown in the figure. What is the minimum initial compression of the spring, x_o, in order get the ball completely around the loop?



For full credit, solve this system from scratch and show all of your work!

[Hint: The moment of inertia of a sphere of mass m and radius r is, $I_{sphere} = \frac{2}{5}mr^2$.]

Speed of launch

PE = KE

$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$

$v = \sqrt{\frac{k}{m}} \cdot x$

On loop

KE = PE + KE

$\frac{1}{2}mv^2 = 2mgR + \frac{1}{2}mv^2 + \frac{1}{2}Iw^2$

$\frac{1}{2}m(\frac{k}{m})x^2 = 2mgR + \frac{1}{2}mv^2 + \frac{1}{2}Iw^2$

$w = v/r$

$v^2 = gR$

$\frac{1}{2}kx^2 = 2mgR + \frac{1}{2}mv^2 + \frac{1}{2}(\frac{2}{5}mr^2)(\frac{v}{r})^2$

$\frac{1}{2}kx^2 = 2mgR + \frac{1}{2}mv^2 + \frac{1}{5}mv^2$

$\frac{1}{2}kx^2 = 2mgR + \frac{7}{10}mv^2$ $\quad v^2 = gR$

$\frac{1}{2}kx^2 = 2mgR + \frac{7}{10}mgR$

$\frac{1}{2}kx^2 = 2.7mgR$

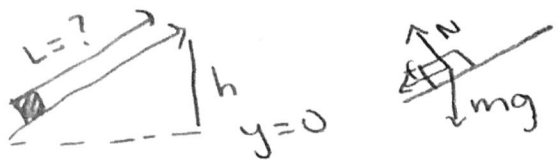
$$x = \sqrt{\frac{5.4mgR}{k}}$$

Extra space for problem 5.

Please include this page in your solutions. Even if you do not use this extra space, insert the blank page into your solutions to ensure you are uploading the same number of pages in the same order as the original exam packet.

6. A block of mass m on an inclined plane is kicked up the incline with an initial velocity v_o and slides up the incline a distance L before it stops. The inclined plane makes an angle α with the horizontal, and the friction coefficients between the box and surface are μ_s and μ_k. What is the distance L the box slides up the ramp before it stops?

   [Hint: The known quantities are the mass, the initial speed, the angle, the coefficients of friction, and the acceleration of gravity: $\{m, v_o, \alpha, \mu_s, \mu_k, g\}$. Solve for the distance L in terms of these quantities—you may or may not need to use all of these values in the final solution.]



where $N = mg\cos\alpha$

$\sin\alpha = h/L$

$h = L\sin\alpha$

$W_f = -\mu_K N_{ramp} L$

$W_f = -\mu_K mg\cos\alpha L$

$\Delta U + \Delta K = W$

$-\mu_K mg\cos\alpha L = \Delta U + \Delta K$

$= (U_f - U_i) + (K_f - K_i)$

$= U_f - K_i$

$-\mu_K mg\cos\alpha L = mgh - \frac{1}{2}mv_0^2$

$-\mu_K mg\cos\alpha L = mg(L\sin\alpha) - \frac{1}{2}mv_0^2$

$\frac{1}{2}mv_0^2 = L(mg\sin\alpha + \mu_K mg\cos\alpha)$

$L = \frac{\frac{1}{2}mv_0^2}{mg\sin\alpha + \mu_K mg\cos\alpha}$

$$\boxed{L = \frac{\frac{1}{2}v_0^2}{g\sin\alpha + \mu_K g\cos\alpha}}$$

Extra space for problem 6.

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