Last Name: _____First Name _____ ID_____

Discussion Section:_____Discussion TA Name:_____

Instructions—Turn off your cell phone and put it away.
Calculators cannot be shared. Please keep yours on your own desk.

This is a closed book exam. You have 90 minutes to complete it.
This is a multiple choice exam. Use the bubble sheet to record your answers.

1. Use a #2 pencil; do **not** use a mechanical pencil or a pen. Fill in completely (until there is no white space visible) the circle for each intended input – both on the identification side of your answer sheet and on the side on which you mark your answers. If you decide to change an answer, erase vigorously; the scanner sometimes registers incompletely erased marks as intended answers; this can adversely affect your grade. Light marks or marks extending outside the circle may be read improperly by the scanner.

2. Print your last name in the **YOUR LAST NAME** boxes on your answer sheet and print the first letter of your first name in the **FIRST NAME INI** box. Mark (as described above) the corresponding circle below each of these letters.

3. Print your NetID in the **NETWORK ID** boxes, and then mark the corresponding circle below each of the letters or numerals. Note that there are different circles for the letter "I" and the numeral "1" and for the letter "O" and the numeral "0". **Do not** mark the hyphen circle at the bottom of any of these columns.

4. You may find the version of **this Exam Booklet at the top of page 2**. Mark the version circle in the **TEST FORM** box in the bottom right on the front side of your answer sheet. **DO THIS NOW!**

5. Stop **now** and double-check that you have bubbled-in all the information requested in 2 through 4 above and that your marks meet the criteria in 1 above. Check that you do not have more than one circle marked in any of the columns.

6. Print your UIN# in the **STUDENT NUMBER** designated spaces and mark the corresponding circles. You need not write in or mark the circles in the SECTION box.

7. Write in your course on the **COURSE LINE** and on the **SECTION** *line*, print your **DISCUSSION SECTION**. (You need not fill in the INSTRUCTOR line.)

8. Sign **(DO NOT PRINT)** your name on the **STUDENT SIGNATURE** *line*.

Before starting work, check to make sure that your test booklet is complete. After these instructions, you should have **9** numbered pages plus 2 Formula Sheets.

On the test booklet:
Write your **NAME**, your **Discussion TA's NAME**, your **DISCUSSION SECTION** and your **NETWORK-ID**. Also, write your **EXAM ROOM** and **SEAT NUMBER**.

When you are finished, you must <u>hand in BOTH the exam booklet AND the answer sheet</u>. Your exam will not be graded unless both are present.
<u>Academic Integrity</u>—Giving assistance to or receiving assistance from another student or using unauthorized materials during a University Examination can be grounds for disciplinary action, up to and including expulsion.

This Exam Booklet is Version A. Mark the **A** circle in the **TEST FORM** box in the bottom right on the front side of your answer sheet. **DO THIS NOW!**

Exam Format & Instructions:

This exam is a mixture of
* Two-Answer Multiple Choice   (2 points each)
* Three-Answer Multiple Choice   (3 points each)
* Five-Answer Multiple Choice   (6 points each)

There are 24 problems for a maximum possible raw score of 110 points.

Instructions for Two-Answer Multiple Choice Problems:
Indicate on the answer sheet the correct answer to the question (*a* or *b*).
Each question is worth 2 points. If you mark the wrong answer, or mark more than one answer, you receive 0 points.

Instructions for Three-Answer Multiple Choice Problems:
Indicate on the answer sheet the correct answer to the question (*a, b* or *c*).
Each question is worth 3 points. If you mark the wrong answer, or mark more than one answer, you receive 0 points.

Instructions for Five-Answer Multiple Choice Problems:
Indicate on the answer sheet the correct answer to each question (*a, b, c, d* or *e*).
Credit is awarded in the following way:
- If you mark one answer and it is correct, you will receive 6 points;
- If you mark two answers, and one of them is correct, you will receive 3 points;
- If you mark three answers and one of them is correct, you will receive 2 points.
- If you mark no answer or more than three answers, you will receive 0 points.

The next three questions pertain to the situation described below.

A car is traveling at *7 m/s*. At time *t = 0*, it accelerates with a constant acceleration of *0.49 m/s²*.

1) How fast is the car going after it has travelled *50 meters* from the point where it started accelerating?

a. *8.57 m/s*
b. *7.48 m/s*
c. *10 m/s*
(d.) *9.9 m/s*
e. *56 m/s*

$$v^2 = v_0^2 + 2a\,\Delta x$$
$$v = \sqrt{(7\,m/s)^2 + 2 \times 0.49\,m/s^2 \times 50\,m}$$
$$= 9.9\,m/s$$

2) How long does it take for the car to speed up to *20 m/s*?

(a.) *26.5 s*
b. *40.8 s*
c. *7.14 s*
d. *2.5 s*
e. *14.3 s*

$$v = v_0 + at$$
$$t = \frac{1}{a}(v - v_0) = \frac{1}{0.49\,m/s^2} \times (20 - 7)\,m/s$$
$$= 26.5\,s$$

3) How far does the car travel in 10 s?
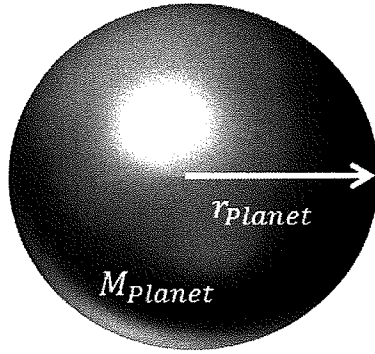
a. *70 m*
b. *119 m*
c. *72.4 m*
(d.) *94.5 m*
e. *24.5 m*

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$
$$\Delta x = 7\,m/s \times 10s + \frac{1}{2}\,0.49\,m/s^2 \times (10s)^2$$
$$= 94.5\,m$$

**The next three questions pertain to the situation described below.**

NOT ON EXAM 1

The *weight, W,* of an object on a planet can be calculated using: $W = G\,M_{planet}m/r^2_{planet}$. You travel from Earth to a new planet where M_{planet} is the mass of the planet and r_{planet} is its radius.

4) Which of the following do you need to know to calculate your *weight* on the new planet?

    a. M_{planet} only.
    b. r_{planet} only.
    c. M_{planet} and r_{planet}.

5) If the mass of the new planet is $3.2M_{Earth}$, but the radius is $r_{planet} = r_{Earth}$, how does your *weight* change compared to on Earth?

    a. It gets smaller by 3.2 times.
    b. It gets larger by 3.2 times.
    c. It stays the same.

6) If the radius of the new planet is $7.7r_{Earth}$, but the mass is $M_{planet} = M_{Earth}$, how does your *weight* change compared to on Earth?

    a. It stays the same.
    b. It gets smaller by 7.7 times.
    c. It gets smaller by 7.7^2 times.
    d. It gets larger by 7.7 times.
   e. It gets larger by 7.7^2 times.

The next two questions pertain to the situation described below.
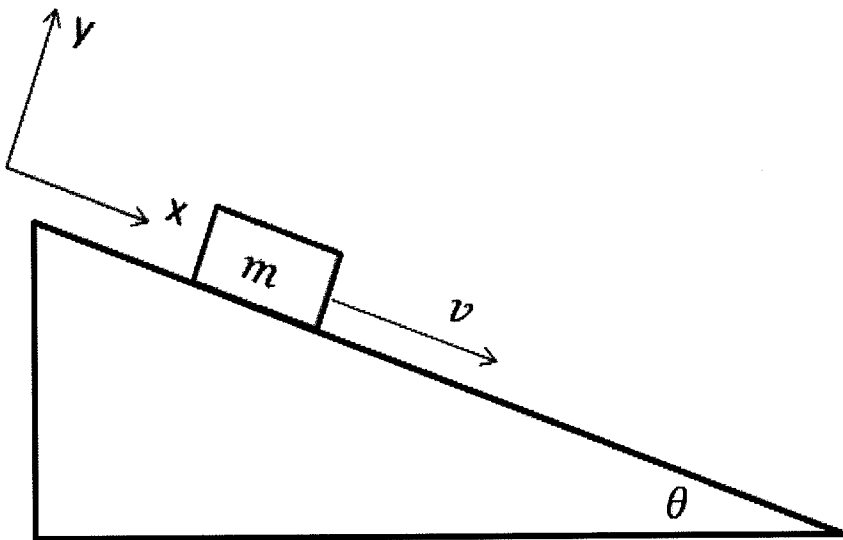
A block of mass $m = 7\ kg$ is sliding down an inclined plane. The coefficient of kinetic friction is $\mu_k = 0.36$. The angle θ of the inclined plane with respect to the horizontal is adjusted such that the block slides at a constant speed of $19.8\ cm/s$.

$$N = mg\,\cos\theta$$

7) Calculate the angle of inclination of the plane.

a. 29.7^o

b. 9.9^o

c. 13.2^o

(d.) 19.8^o

e. 39.6^o
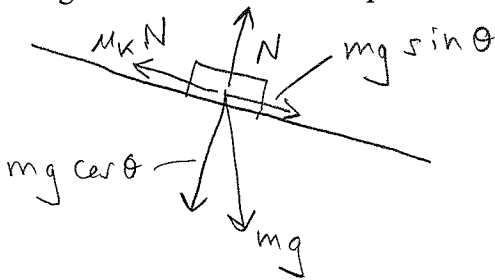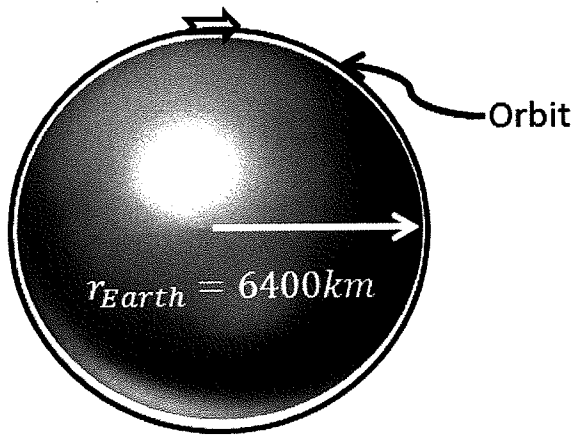
$$mg\sin\theta - \mu_k N = ma = 0$$

$$\cancel{m}g\sin\theta - \mu_k \cancel{m}g\cos\theta = 0$$

$$\mu_k = \tan\theta$$

$$\theta = \tan^{-1}\mu_k = \tan^{-1}0.36$$

$$= 19.8^o$$

8) If the angle of inclination is decreased slightly while the block is moving, the block will
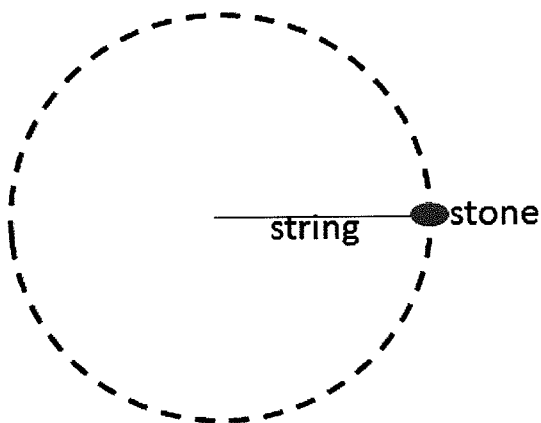
(a.) gradually come to rest.

b. speed up to a new constant speed.

c. slow down to a new constant speed.

9) An object is launched with a velocity v such that it begins to orbit around the earth with a radius R. If the object could orbit the Earth just at its surface, how fast would it have to travel? (R_{Earth} =6400 km)

NOT ON EXAM !

a. $v = 16\ km/s$
b. $v = 250\ km/s$
c. $v = 120\ km/s$
d. $v = 7.9\ km/s$
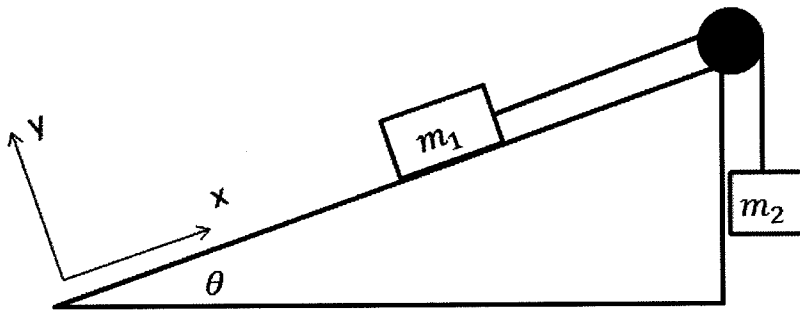e. $v = 6.3 \times 10^4\ km/s$

10) A boy uses a string to swing a *2.2 kg* stone around his head. The string is *1.5 m* long, and can bear a maximum tension of *1012 N*. What is the maximum speed at which the boy can swing the stone without breaking the string?

$$T = ma = m\frac{v^2}{R}$$

a. $v = 394\ m/s$
b. $v = 690\ m/s$
ⓒ $v = 26.3\ m/s$

$$v = \sqrt{\frac{TR}{m}} = \sqrt{\frac{1012\ N \times 1.5\ m}{2.2\ kg}} = 26.3\ m/s$$

The next two questions pertain to the situation described below.

A block of mass $m_1 = 3$ kg is on an inclined plane at an angle of $\theta = 31°$. A second block of mass m_2 is connected to m_1 by a string passing over a small frictionless pulley as shown. The coefficients of friction between m_1 and the inclined plane are: static friction is $\mu_s = 0.4$ and kinetic friction is $\mu_k = 0.2$.

11) What is the maximum value that m_2 may have, m_2^{max}, for the system of masses to remain at rest?

a. $m_2^{max} = 38.5$ kg

(b.) $m_2^{max} = 2.57$ kg

c. $m_2^{max} = 206$ kg

d. $m_2^{max} = 1.03$ kg

e. $m_2^{max} = 0.517$ kg

$N = m_1 g \cos\theta$

$T - m_1 g \sin\theta - \mu_s N = 0$

$T - m_1 g \sin\theta - \mu_s m_1 g \cos\theta = 0$

$T = m_2 g$

$m_2 g - m_1 g \sin\theta - \mu_s m_1 g \cos\theta = 0$

$m_2 = m_1 (\sin\theta + \mu_s \cos\theta)$

$= 3 \, kg \, (\sin 31 + 0.4 \cos 31)$

$= 2.57 \, kg$

12) If the value of m_2 is 3 kg and it is sufficient to overcome static friction, what is the magnitude of the acceleration, a, of the system of masses?

a. $a = 32.3$ m/s^2

b. $a = 0.697$ m/s^2

c. $a = 3.22$ m/s^2

(d.) $a = 1.54$ m/s^2

e. $a = 5.75$ m/s^2

$N = m_1 g \cos\theta$

$T - m_1 g \sin\theta - \mu_k N = m_1 a$
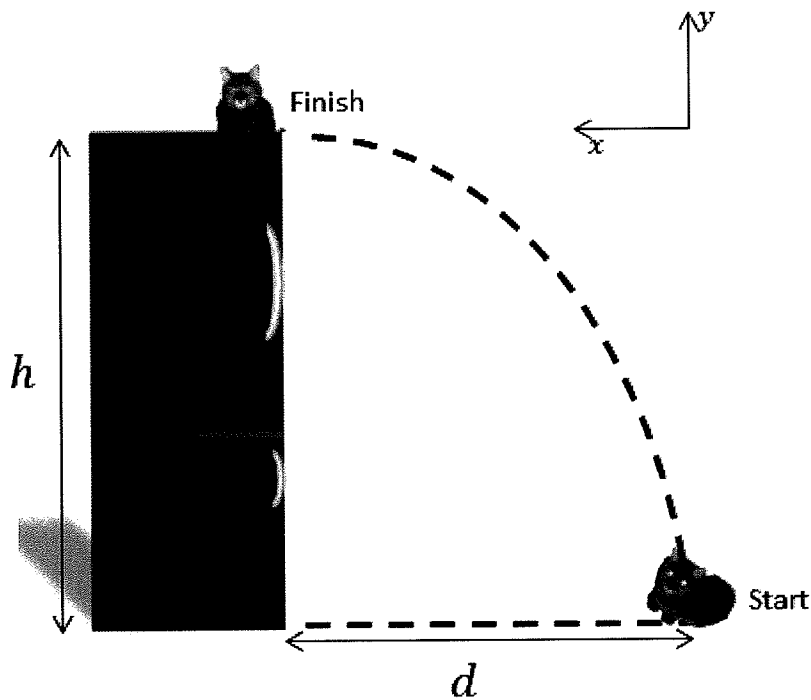
$T - m_2 g = -m_2 a \Rightarrow T = m_2 (g - a)$

$m_2 (g - a) - m_1 g \sin\theta - \mu_k m_1 g \cos\theta = m_1 a$

$m_2 g - m_1 g \sin\theta - \mu_k m_1 g \cos\theta = a(m_1 + m_2)$

$9.8 \, m/s^2 \times (3 \, kg - 3 \, kg \sin 31 - 0.2 \times 3 \, kg \times \cos 31) = a(3 + 3) \, kg$

$\Rightarrow a = 1.54 \, m/s^2$

The next two questions pertain to the situation described below.

Finish

Start

h

d

A cat wants to sit on top of a refrigerator. The refrigerator is $h = 1.1$ m tall.

13) The cat starts her jump from the floor $d = 0.82$ m away from the refrigerator. She lands $t=0.474$ s later. What is the horizontal component of her velocity?

a. $v_x = 0.184$ m/s
b. $v_x = 8.04$ m/s
c. $v_x = 1.73$ m/s

$$V_x = \frac{d}{t} = \frac{0.82 \text{ m}}{0.474 \text{ s}} = 1.73 \text{ m/s}$$

14) She just lands at the top of the refrigerator. What is the vertical component of her initial velocity?

a. $v_{y0} = 2.32$ m/s
b. $v_{y0} = 4.65$ m/s
c. $v_{y0} = 3.28$ m/s

$$V_y'' = V_{oy} - gt$$

$$V_{oy} = gt = 9.8 \text{ m/s}^2 \times 0.474 \text{ s}$$

$$= 4.645 \text{ m/s}$$

The next four questions pertain to the situation described below.

You throw a baseball straight up with a speed of *5.2 m/s*. Neglect air resistance for all of the following questions.

15) Which of the following forces does the ball experience after leaving your hand?

    a. Only a force from you hand
    (b.) Gavity only.
    c. Gravity and a force from your hand.

16) Which of the following is true for the speed of the ball during its flight?

    (a.) It is never constant.
    b. It is always constant.
    c. It always decreases.
    d. It will increase, decrease, and be constant.
    e. It always increases.

17) How much time does it take for the ball to reach the highest point of its flight?

$$V_y \overset{\;0}{=} V_{oy} - gt$$

    a. *1.06 s*
    (b.) *0.53 s*
    c. *0.353 s*

$$t = \frac{V_{oy}}{g} = \frac{5.2 \; m/s}{9.8 \; m/s^2} = 0.53 \, s$$

18) If you catch the ball at the same height at which you threw it, what speed will it have just before you catch it?

    (a.) *5.2 m/s*
    b. *2.6 m/s*
    c. *0 m/s*
    d. *1.73 m/s*
    e. *10.4 m/s*

The next two questions pertain to the situation described below.

You are a passenger on a train travelling in a straight line at *26.5 m/s*. Each car is *51.1 m* long. You walk through the train cars at *2 m/s* in the direction of the train's motion.

19) If you can walk *2 m/s*, how much time does it take to walk through *3* train cars?
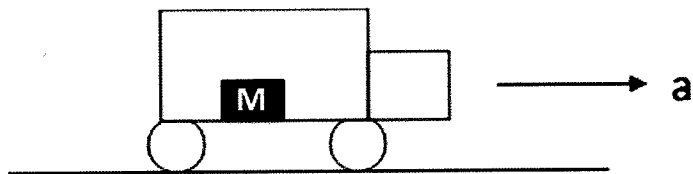
a. $t = 5.38\ s$
b. $t = 76.7\ s$
c. $t = 28.9\ s$

$$d = vt$$

$$t = \frac{d}{v} = \frac{3 \times 51.1\ m}{2\ m/s} = 76.65\ s$$

20) You walk for *24 s*. How far have you travelled with respect to the ground?

a. $d = 636\ m$
b. $d = 48\ m$
c. $d = 684\ m$

$$d = vt \qquad V_{you} + V_{train}$$

$$= (2\ m/s + 26.5\ m/s) \times 24s$$

$$= 684\ m$$

The next four questions pertain to the situation described below.

A crate of mass $M = 8\ kg$ is sitting on the floor of a large truck. The coefficient of static friction between the crate and the floor is 0.611. The truck is accelerating to the right with an acceleration $a = 3.9\ m/s^2$.

21) Does the crate slide on the floor of the truck?

$F = ma$

a. Yes

$= 8\ kg \times 3.9\ m/s^2 = 31.2\ N$

b.) No

$Max\ friction = \mu_s N = 0.611 \times 8\ kg \times 9.8\ m/s^2 = 47.9\ N$

22) What is the frictional force exerted by the floor on the crate?

a.) 31.2 N

b. 15.6 N

c. 7.8 N

d. 19.1 N

e. 48 N

23) What is the maximum acceleration of the truck such that the crate does not slide on the floor of the truck?

$F = ma$

$\mu_s N$

$\Rightarrow a = \dfrac{\mu_s N}{m} = \dfrac{\mu_s mg}{m} = \mu_s g$

a. 2.38 m/s²

b. 1.95 m/s²

c.) 5.99 m/s²

$= 0.611 \times 9.8\ m/s^2$

d. 9.81 m/s²

$= 5.99\ m/s^2$

e. 0.975 m/s²

24) What is the frictional force acting on the crate just before it begins to slide?

a) 48 N

$F = ma$

b. 19.1 N

$= 8\ kg \times 5.99\ m/s^2 = 47.9\ N$

c. 12 N

d. 24 N

e. 31.2 N