PHYSICS 114 PRACTICE FINAL EXAM
VERSION A

Last Name (Print): _____ First Name (Print): _____

Honor Pledge: *All work presented here is my own.*

Signature: _____ Student ID: _____

READ THIS ENTIRE PAGE NOW
Do <u>not</u> open the exam until told to do so.
You will have <u>110 minutes</u> to complete the examination.
<u>NO</u> CELL PHONES, TEXT MSG, etc. ALLOWED AT ANY TIME.

Before the exam begins:

- Print and sign your name, and write your student ID number in the spaces above.

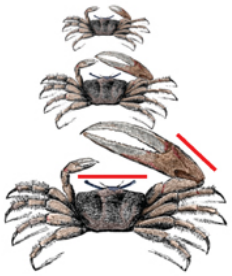
During the exam

- If you are confused about a question, raise your hand and ask for an explanation.
- If you cannot do one part of a problem, move on to the next part.
- This is a closed book examination. All equations and constants are provided.
- You may use a calculator, but not a computer, or other internet connected devices (smart-phones, iPads, etc.).
- Clearly circle your answer choice. Make no stray marks. If you must erase, erase completely.

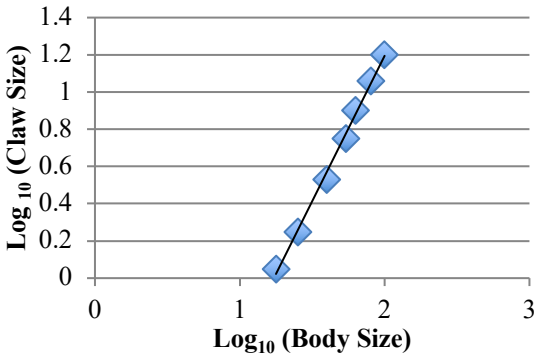
End of exam:

- Out of respect to other students, please remain seated for the last 20 minutes of the exam. At the end of the exam, please remain seated until all exams have been collected.

1. [6 pts] The graph and table below show how the claw size (c) varies with body size (b) in a growing male fiddler crab. Which of the equations below best represents the relationship between these two quantities?



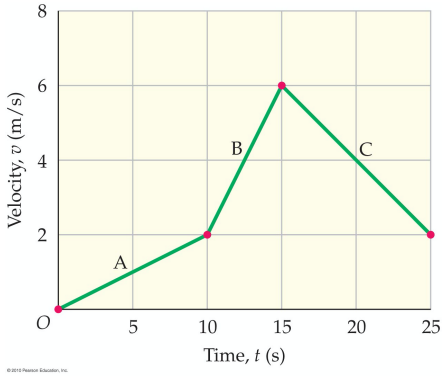
A) $c = 0.01b^{1.5}$	B) $c = 0.2b^{1.3}$	C) $c = 2b^{2.1}$
D) $c = 0.1b^{1.5}$	E) $c = 0.3b^{1.9}$	



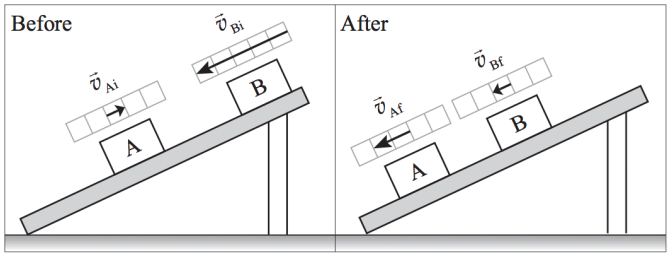
Body Size (mm)	Claw Size (mm)
17.8	1.1
25.1	1.8
39.8	3.4
54.0	5.6
63.1	8.0
80.0	11.5
100.0	15.8

2. [6 pts] A cyclist moves according to the velocity-versus-time graph shown at right. If the cyclist is at a position of $x = 10$ m at $t = 0$ s, at what time is the cyclist at $x = 65$ m?

A) 5 s
B) 10 s
C) 15 s
D) 20 s
E) 25 s



Two blocks, A and B, collide on a frictionless ramp. The instantaneous velocity vectors of the two blocks are shown on the diagrams at right for instants before and after the collision.



3. [6 pts] If the initial velocity of block A is 1 m/s, what is the change in velocity for block A and for block B? Assume up the ramp is the positive direction.

   A) Block A: -1 m/s Block B: 6 m/s

   B) Block A: -1 m/s Block B: 4 m/s

   C) Block A: -3 m/s Block B: -6 m/s

   D) Block A: -3 m/s Block B: 4 m/s

   E) Block A: 3 m/s Block B: 6 m/s

4. [6 pts] Romeo is chucking pebbles gently up to Juliet's window, and he wants the pebbles to hit the window with only a horizontal component of velocity. He is standing at the edge of a rose garden 8.0 m below her window and 9.0 m from the base of the wall. How fast are the pebbles going when they hit her window?

A) 4.6 m/s	B) 5.2 m/s	C) 5.9 m/s	D) 6.4 m/s	E) 7.0 m/s

5. [6 pts] A soccer ball is kicked with an initial speed of 10.2 m/s in a direction 25.0° above the horizontal. Find the direction of the ball's velocity 0.500 s after being kicked.

   A) 5.10° above the horizontal

   B) 2.45° above the horizontal

   C) 3.65° below the horizontal

   D) 10.6° below the horizontal

   E) 16.5° below the horizontal

6. [6 pts] What average net force is required to stop an 1100-kg car in 8.0 s if it is traveling at 90 km/hr?

A) 2.9 kN	B) 3.4 kN	C) 4.1 kN	D) 5.9 kN	E) 6.3 kN

7. [6 pts] As part of a physics experiment, you stand on a bathroom scale in an elevator. Though your normal weight is 610 N, the scale at the moment reads 730 N. Calculate the magnitude of the elevator's acceleration?

A) 1.05 m/s^2	B) 9.81 m/s^2	C) 2.87 m/s^2	D) 1.93 m/s^2	E) 2.18 m/s^2

8. [6 pts] A person pushes a 14.5-kg lawnmower at a constant acceleration of 0.600 m/s^2. The person applies an 88.0 N force directed down along the handle, which is at an angle of 45.0° to the horizontal. What is the magnitude of the friction force on the lawnmower?

A) 53.5 N

B) 55.6 N

C) 59.2 N

D) 60.8 N

E) 63.7 N

9. [7 pts] In downhill speed skiing a skier is retarded by both the air drag force on the body and the kinetic frictional force on the skis. Suppose the slope is $\theta = 40.0°$, the snow is dry snow with a coefficient of kinetic friction $\mu_k = 0.0400$, the mass of the skier and equipment is m = 85.0 kg, the cross-sectional area of the skier is A = 1.30 m^2, the drag coefficient is C = 0.170, and the air density is 1.20 kg/m^3. What is the terminal speed of the skier?

A) 38.2 m/s	B) 47.8 m/s	C) 55.9 m/s	D) 62.0 m/s	E) 68.1 m/s

10. [6 pts] A 0.40-kg ball, attached to the end of a horizontal cord, is rotated in a circle of radius 1.3 m on a frictionless horizontal surface. If the cord will break when the tension in it exceeds 60.0 N, what is the maximum linear speed the ball can have?

A) 11 m/s	B) 14 m/s	C) 16 m/s	D) 19 m/s	E) 23 m/s

11. [7 pts] A 40-cm-diameter wheel accelerates uniformly from 240 rpm to 360 rpm in 6.5 s. How far will a point on the edge of the wheel have traveled in this time?

A) 35 m	B) 38 m	C) 41 m	D) 48 m	E) 59 m

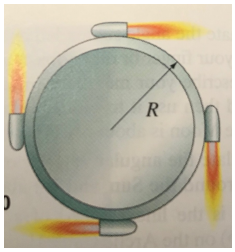
12. [6 pts] You are holding a shopping basket at the grocery store with two 0.56-kg cartons of cereal at the left end of the basket. The basket is 0.71 m long. Where should you place a 1.8-kg half gallon of milk, relative to the left end of the basket, so that the center of mass of your groceries is at the center of the basket?

A) 0.58 m	B) 0.65 m	C) 0.19 m	D) 0.27 m	E) 0.35 m

13. [6 pts] A softball player swings a bat, accelerating it from rest to 18.8 rad/s in a time of 0.200 s. Approximate the bat as a 2.2-kg uniform rod of length 0.950-m rotating about one of its ends, and compute the torque the player applies to one end of it. $I_{rod} = \frac{1}{3}mL^2$ (Assume the player applies the net torque to the bat.)

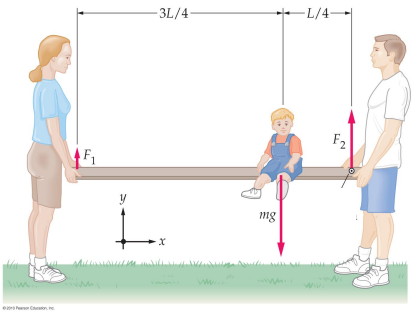
A) 53.1 Nm	B) 62.2 Nm	C) 78.1 Nm	D) 89.3 Nm	E) 97.3 Nm

14. [7 pts] In order to get a flat uniform cylindrical satellite spinning at constant rate, engineers fit four tangential rockets as shown. If the satellite has a mass of 2600 kg and a radius of 3.0 m, what is the required steady force of each rocket if the satellite is to reach 30 rpm in 5.0 min? $I_{solid\ disk} = \frac{1}{2}mR^2$



A) 7.2 N	B) 8.1 N	C) 9.4 N	D) 10 N	E) 13 N

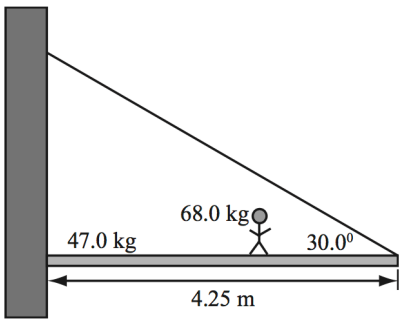
15. [6 pts] A child of mass m is supported on a plank by his parents, who exert forces F_1 and F_2 as indicated. The plank also has a mass m, and is in static equilibrium. Find the value of F_1 in terms of m and g. Briefly show your work.



A) $\frac{1}{4}mg$ B) $\frac{1}{3}mg$ C) $\frac{2}{5}mg$

D) $\frac{3}{5}mg$ E) $\frac{3}{4}mg$

16. [7 pts] A 47.0-kg uniform rod 4.25 m long is attached to a wall with a hinge at one end. The rod is held in a horizontal position by a wire attached to its other end. The wire makes an angle of 30.0° with the horizontal, and is bolted to the wall directly above the hinge. If the wire can withstand a maximum tension of 1450 N before breaking, how far from the wall can a 68.0-kg person sit without breaking the wire



A) 3.47 m

B) 2.85 m

C) 3.15 m

D) 3.23 m

E) 3.92 m

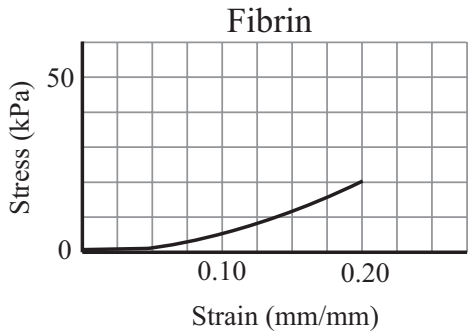
17. [6 pts] An small jeep is parked on a steep banked curve that is 32.0° above the horizontal. What is the maximum center of gravity height the jeep can have such that it will not topple over? The jeep has a width of 1.90 meters.

A) 1.27 m	B) 1.35 m	C) 1.52 m	D) 1.74 m	E) 1.86 m

18. [6 pts] A 3.50 kg block is held on a compressed vertical spring that has a spring constant of 800 N/m. The spring is initially compressed a distance of 8.00 cm from its equilibrium position. Determine the acceleration of the block at the moment the block is released.

A) 8.48 m/s^2	B) 9.17 m/s^2	C) 9.81 m/s^2	D) 14.9 m/s^2	E) 18.3 m/s^2

19. [6 pts] The graph at right shows the result of an experiment conducted in 2004 by scientists at Georgia Tech, in which they stretched a sample of fibrin until it broke (the point at where the curve ends). If the sample was originally 38 mm long before the stress was aplied, what was the final length of the sample?



A) 8 mm

B) 46 mm

C) 0.2 mm

D) 38.2 mm

E) 80 mm

20. [6 pts] A 0.285-kg ball falls vertically downward, hitting the floor with a speed of 2.50 m/s and rebounding upward with a speed of 2.0 m/s. Determine the magnitude of the impulse delivered to the ball by the floor?

A) 1.46 kgm/s	B) 0.854 kgm/s	C) 1.28 kgm/s	D) 0.143 kgm/s	E) 1.15 kgm/s

21. [6 pts] Force A has a magnitude F and acts for a time Δt, force B has a magnitude $2F$ and acts for a time $\Delta t/3$, and force C has a magnitude $5F$ and acts for a time $\Delta t/10$. Rank these forces in terms of impulse delivered by each force.

A) C > B > A

B) A> B > C

C) B > A > C

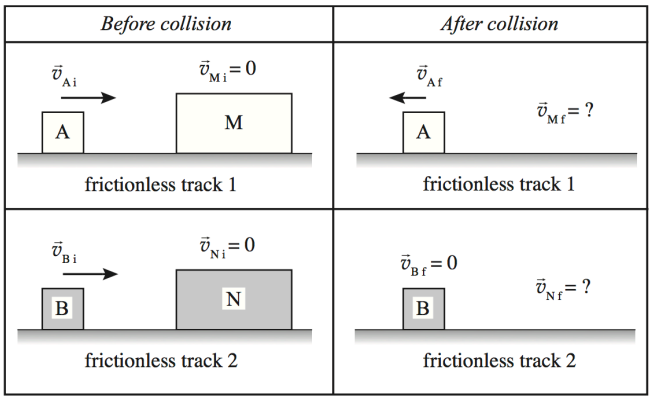
D) A = B > C

E) A = C > B

22. [7 pts] A bullet with a mass of 4.00 g and a speed of 550.0 m/s is fired at a block of wood with a mass of 3.20 kg. The block rests on a frictionless surface, and the bullet becomes embedded in the block. What is the final speed of the block?

A) 0.549 m/s	B) 0.592 m/s	C) 0.687 m/s	D) 0.749 m/s	E) 0.828 m/s

Four blocks are arranged on two level, frictionless tracks as shown. Blocks A and B are launched with the *same initial velocity* toward the stationary blocks M and N, respectively. After the collisions, block A has reversed direction and block B is at rest



The masses of block A and B are equal, as are the masses of blocks M and N. The mass of block M is five times that of block A.

Note: Blocks A and M are made of different materials than block B and N.

$m_A = m_B$
$m_M = m_N$
$m_M = 5m_A$

23. [6 pts] After the collisions, is the speed of block M *greater than, less than,* or *equal to* the speed of block N? If the speed of either block is zero, state so explicitly

    A) Greater than

    B) Less than

    C) Equal to

    D) Not enough information to answer.

24. [6 pts] Consider system X, which consists of block B and block N. Is the final kinetic energy of system X *greater than, less than* or *equal to* the initial kinetic energy of system X? Explain

    A) Greater than

    B) Less than

    C) Equal to

    D) Not enough information to answer.

25. [7 pts] A block of mass m and speed v collides with a spring, compressing it a distance Δx. What is the compression of the spring if the force constant of the spring is increased by a factor of four?

    A) $4\Delta x$

    B) $0.5\Delta x$

    C) $2\Delta x$

    D) $0.25\Delta x$

    E) $0.0625\Delta x$

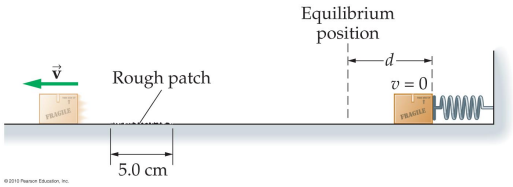
26. [6 pts] A 51-kg packing crate is pulled with constant speed across a rough floor with a rope that is at an angle of 33.5° above the horizontal. If the tension in the rope is 115 N, how much work is done on the crate by the tension force, if the crate moves 8.0 m? Show your work.

A) 510 J	B) 640 J	C) 770 J	D) 840 J	E) 920 J

27. [6 pts] A sled slides without friction down a small, ice-covered hill. If the sled starts from rest at the top of the hill, its speed at the bottom is 7.50 m/s. On a second run, the sled starts with a speed of 1.50 m/s at the top. Find the speed of the sled at the bottom of the hill after the second run.

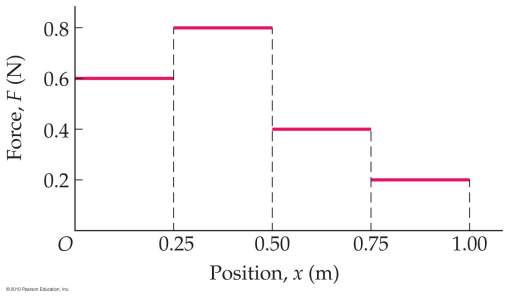
A) 10.0 m/s	B) 9.00 m/s	C) 7.65 m/s	D) 8.75 m/s	E) 5.63 m/s

28. [7 pts] A 1.20-kg block is held at rest against a spring with a force constant $k = 730.0$ N/m. Initially, the spring is compressed a distance 9.73 cm. When the block is released, it slides across a surface that is frictionless except for a rough patch of width 5.0 cm that has applies a friction force of magnitude 5.61 N. What is the speed of the block after it passes across the rough patch?



A) 1.45 m/s	B) 1.93 m/s	C) 2.30 m/s	D) 2.75 m/s	E) 3.16 m/s

29. [6 pts] The force shown in the figure at right acts on a 1.7-kg object whose initial speed is 0.44 m/s and initial position is $x = 0.27$ m. Find the speed of the object when it is located at $x = 0.73$ m.



A) 0.45 m/s

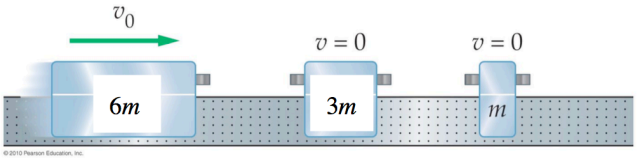
B) 0.51 m/s

C) 0.60 m/s

D) 0.25 m/s

E) 0.72 m/s

30. [7 pts] The three air carts shown below have masses, reading from left to right, of $6m$, $3m$, and m, respectively. The most massive cart has an initial speed of v_0; the other two carts are at rest initially. All carts are equipped with spring bumpers that give elastic collisions. Find the final kinetic energy of the m glider.



A) $K_f = 2mv_o^2$

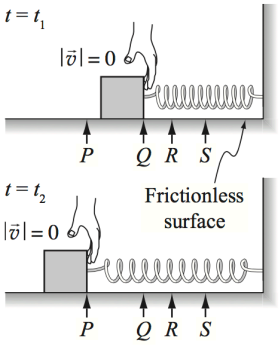
B) $K_f = \frac{8}{9}mv_o^2$

C) $K_f = \frac{8}{3}mv_o^2$

D) $K_f = \frac{1}{3}mv_o^2$

E) $K_f = 3mv_o^2$

31. [6 pts] A block on a table is connected to a spring, as shown at right. At time t_1, the block is at point Q, and the spring is at its equilibrium length. The block is pushed to the left, stretching the spring. At time t_2, the block is at point P. The block begins and ends at rest. Over the interval from t_1 to t_2, is the absolute value of the work on the block by the hand *greater than, less than,* or *equal to* the absolute value of the work on the block by the spring?



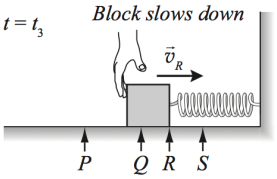
A) Greater than

B) Less than

C) Equal to

D) Not enough information to answer.

32. [6 pts] The block is now released, and it moves back toward point Q. When it passes point Q, a hand begins to push the block *to the right,* compressing the spring. The hand pushes the block, which passes point R with speed v_R at time t_3, until it reaches point S at time t_4. The block *slows down* as it moves from point R to point S. Over the interval from t_3 to t_4 *(i.e.,* as the block moves from R to S*),* does the total energy of the block-spring system *increase, decrease,* or *stay the same?*



A) Increase

B) Decrease

C) Stay the same

D) Not enough information to answer.