INSTRUCTIONS:

This exam contains 20 multiple-choice questions plus 1 extra credit question, each worth 3 points. Choose one answer only for each question. Choose the best answer to each question. Answer all questions.

Allowed material: Before turning over this page, put away all materials except for pens, pencils, erasers, rulers and your calculator. There is a formula sheet attached at the end of the exam. Other copies of the formula sheet are not allowed.

Calculator: In general, any calculator, including calculators that perform graphing, is permitted. Electronic devices that can store large amounts of text, data or equations (like laptops, e-book readers, smart phones) are NOT permitted. Devices (including calculators and smart watches) with WiFi technology are NOT permitted. If you are unsure if your calculator is allowed for the exam, ask your TA.

How to fill in the bubble sheet:

 Use a number 2 pencil. Do NOT use ink. If you did not bring a pencil, ask for one.
 You will continue to use the same bubble sheet you already used for Exam 1.
 Bubble answers 22-42 on the bubble sheet for this exam.

If you did not take the first exam, write and fill in the bubbles corresponding to:
- Your last name, middle initial, and first name.
- ★★ Your ID number (the middle 9 digits on your ISU card) ★★
- Special codes K to L are your recitation section. Always use two digits (e.g. 01, 09, 11, 13).

Please turn over your bubble sheet when you are not writing on it.

If you need to change any entry, you must completely erase your previous entry. Also, circle your answers on this exam. Before handing in your exam, be sure that your answers on your bubble sheet are what you intend them to be. You may also copy down your answers on a piece of paper to take with you and compare with the posted answers. You may use the table at the end of the exam for this.

When you are finished with the exam, place all exam materials, including the bubble sheet, and the exam itself, in your folder and return the folder to your recitation instructor.

No cell phone calls allowed. Either turn off your cell phone or leave it at home. Anyone answering a cell phone must hand in their work; their exam is over.

Best of luck,

Dr. Soeren Prell
22. In the figure, block A has a mass of 3.00 kg. It rests on a smooth horizontal table and is connected by a very light horizontal string over an ideal pulley to block B, which has a mass of 2.00 kg. When block B is gently released from rest, how long does it take block B to travel 80.0 cm?

A) 0.639 s  
B) 0.404 s  
C) 0.494 s  
D) 0.785 s  
E) 0.935 s

23. A 10-kg sign is held by two ropes as shown in the figure. What is the tension on rope A?

A) 69 N  
B) 98 N  
C) 72 N  
D) 44 N  
E) 88 N

24. Person X pushes twice as hard against a stationary brick wall as person Y. Which one of the following statements is correct?

A) Both do zero work.  
B) Both do the same amount of positive work.  
C) Both do positive work, but person X does one-half the work of person Y.  
D) Both do positive work, but person X does four times the work of person Y.  
E) Both do positive work, but person X does twice the work of person Y.
25. A truck has four times the mass of a car and is moving with twice the speed of the car. If $KE_t$ and $KE_c$ refer to the kinetic energies of truck and car respectively, it is correct to say that

A) $KE_t = \frac{1}{2} KE_c$
B) $KE_t = KE_c$
C) $KE_t = 2 KE_c$
D) $KE_t = 4 KE_c$
E) $KE_t = 16 KE_c$

26. You slam on the brakes of your car in a panic, and skid a certain distance on a straight level road. If you had been traveling twice as fast, what distance would the car have skidded, under the same conditions?

A) It would have skidded twice as far.
B) It would have skidded 1.4 times farther.
C) It would have skidded one half as far.
D) It would have skidded 4 times farther.
E) It is impossible to tell without knowing the mass of the car.

27. Which requires more work, increasing a car's speed from 0 mph to 30 mph or from 50 mph to 60 mph?

A) 50 mph to 60 mph
B) 0 mph to 30 mph
C) Need to know the mass of the car to answer the question.
D) Need to know the forces acting on the car to answer the question.
E) It is the same in both cases.
28. Two cyclists who weigh the same and have identical bicycles ride up the same mountain, both starting at the same time. Joe rides straight up the mountain, and Bob rides up the longer road that has a lower grade. Joe gets to the top before Bob. Ignoring friction and wind resistance, which one of the following statements is true?

A) The average power exerted by Bob and Joe was the same, but Joe exerted more work in getting there.
B) The amount of work done by Joe is greater than the amount of work done by Bob, and the average power exerted by Joe is greater than that of Bob.
C) Bob and Joe exerted the same amount of work, and the average power of each cyclist was also the same.
D) The amount of work done by Joe is equal to the amount of work done by Bob, but the average power exerted by Joe is greater than that of Bob.
E) The amount of work done by Bob is greater than the amount of work done by Joe, but the average power exerted by Bob and Joe was the same.

29. An ideal spring stretches by 21.0 cm when a 135-N object is hung from it. If instead you hang a fish from this spring, what is the weight of a fish that would stretch the spring by 31.0 cm?

A) 91 N
B) 199 N
C) 145 N
D) 279 N
E) 185 N

30. It takes 87 J of work to stretch an ideal spring from 1.4 m to 2.9 m from equilibrium. What is the value of the spring constant (force constant) of this spring?

A) 77 N/m
B) 27 N/m
C) 52 N/m
D) 39 N/m
E) 61 N/m
31. Three objects are moving along a straight line as shown in the figure. Taking the positive direction to be to the right, what is the total momentum of this system?

A) 0.00 kg m/s  
B) −106 kg m/s  
C) +106 kg m/s  
D) −14 kg m/s  
E) +14 kg m/s

32. A block of mass $m = 9.0$ kg and speed $v$ and is behind a block of mass $M = 27$ kg and speed of 0.50 m/s as shown in the figure. The surface is frictionless, and the blocks suddenly collide and stick together. After the collision, the blocks have a common speed of 0.90 m/s. What was the speed of the lighter block $(v)$ before the collision?

A) 1.3 m/s  
B) 1.6 m/s  
C) 1.9 m/s  
D) 2.1 m/s  
E) 2.3 m/s

33. A baseball is pitched horizontally toward home plate with a velocity of 110 km/h. In which of the following scenarios does the baseball experience the largest magnitude impulse?

A) The baseball is hit straight back to the pitcher at a speed of 110 km/h.
B) The ball is popped straight up at a speed of 110 km/h.
C) The catcher catches the ball.
D) Scenarios B and C have the same change in momentum.
E) Scenarios A, B and C have the same change in momentum.
34. A 15-kg child is sitting on a playground teeter-totter, 1.5 m from the pivot. What is the minimum distance, on the other side of the pivot, such that a 220-N force will make the child lift off the ground?

A) 9.8 m  
B) 1.0 m  
C) 2.4 m  
D) 0.1 m  
E) 1.5 m

35. A string is wound tightly around a fixed pulley having a radius of 5.0 cm. As the string is pulled, the pulley rotates without any slipping of the string. What is the angular speed of the pulley when the string is moving at 5.0 m/s?

A) 50 rad/s  
B) 25 rad/s  
C) 20 rad/s  
D) 100 rad/s  
E) 10 rad/s

36. Two uniform solid spheres have the same mass, but one has twice the radius of the other. The ratio of the larger sphere's moment of inertia about a central axis to that of the smaller sphere is

A) 8/5  
B) 1/2  
C) 4/5  
D) 2  
E) 4
37. A series of wrenches of different lengths is used on a hexagonal bolt, as shown below. Which combination of wrench length and force applies the greatest torque to the bolt?

- a. 
- b. 
- c. 
- d. 
- e.

38. A carousel—a horizontal, rotating platform—of radius \( r \) is initially at rest, and then begins to accelerate constantly until it has reached an angular velocity \( \omega \) after 2 complete revolutions. What is the angular acceleration of the carousel during this time?

A) \( \omega^2/(8\pi) \)
B) \( \omega^2/(4\pi) \)
C) \( \omega/(4\pi) \)
D) \( \omega^2/(4\pi r) \)
E) \( \omega^2/(2\pi r) \)
39. When an object experiences uniform circular motion, the direction of the acceleration is

A) in the same direction as the velocity vector.
B) in the opposite direction of the velocity vector.
C) is directed toward the center of the circular path.
D) is directed away from the center of the circular path.
E) in uniform circular motion the speed is constant and the acceleration is zero.

40. Which one of the following statement about the center of mass of an object is true:

A) The center of mass of an object must lie within the object.
B) The center of mass of an object cannot move if the net force exerted on the object is zero.
C) All the mass of an object is actually concentrated at its center of mass.
D) The center of mass of an object must lie outside the object.
E) None of the above.

41. An object is moving in a clockwise direction around a circle at constant speed. Use the diagram shown at the right. Which vector below represents the direction of the net force vector when the object is located at point A on the circle?

- e. There is no net force acting on the object.

42. Which one of the following choices is an example of a non-conservative force doing work?

A) spring force of a spring cannon shooting a toy cannon ball
B) static friction between a box sitting on an incline and the surface of the incline
C) kinetic friction between a box sliding down an incline and the surface of the incline
D) gravitational force on a falling ball
E) None of the above
Physics 111 Exam 2 - KEY

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42