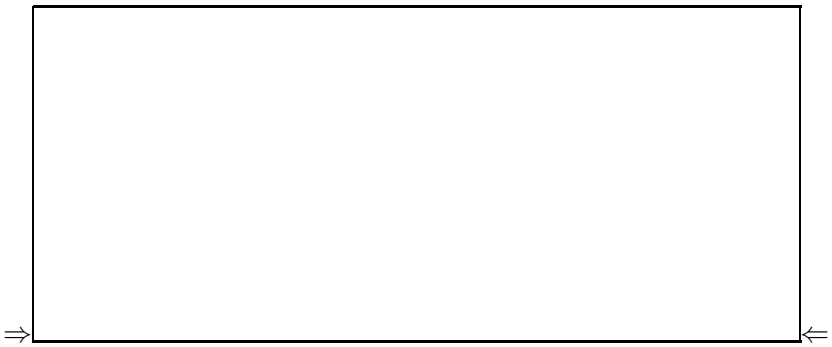
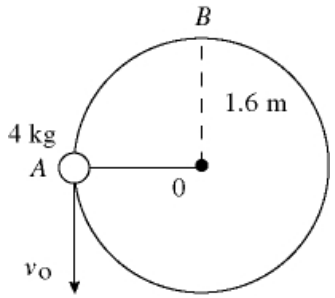
Physics 123 - Analytical Physics
FINAL EXAM
Friday, December 18, 2009 4:00 - 7:00 PM
Professor R.A. Bartynski



Your name sticker with **exam code. SIGN HERE:**

1. Use a #2 pencil to make entries on the answer sheet. Enter the following ID information now, before the exam starts..
2. In the section labeled NAME (Last, First, M.I.) enter your last name, then fill in the empty circle for a blank, then enter your first name, another blank, and finally your middle initial.
3. Under STUDENT # enter your 9-digit RUID Number.
4. Enter 123 under COURSE, and your section number (see label above) under SEC.
5. Under CODE enter the exam code given above.
6. During the exam, you may use pencils, a calculator, and two 8.5 x 11 inch sheet (both sides) with formulas and notes.
7. There are 30 multiple-choice questions on the exam. For each question, mark only one answer on the answer sheet. There is no deduction of points for an incorrect answer, so even if you cannot work out the answer to a question, you should make an educated guess. **At the end of the exam, hand in the answer sheet and the cover page.** Retain this question paper for future reference and study.
8. When you are asked to open the exam, make sure that your copy contains all 30 questions. Raise your hand if this is not the case, and a proctor will help you. Also raise your hand during the exam if you have a question.
9. Please SIGN the cover sheet under your name sticker and have your student ID ready to show to the proctor during the exam.
10. If needed, the acceleration due to gravity on earth may be take as g = 9.81 m/s^2.

1. In the figure, a 4.0-kg ball is on the end of a 1.6-m rope which is fixed at 0. The ball is held at A, with the rope horizontal, is given an initial downward velocity and returns to point A in a circular motion. When the ball moves through three quarters of the circle and arrives at B, the rope is barely under tension. The initial velocity (in m/s) of the ball, at A, is closest to(Hint: use conservation of total mechanical energy)



a) 4.0
b) 7.9
c) *6.9
d) 6.3
e) 5.6

2. Two objects, one of mass m and the other of mass 2m, are dropped from the top of a building. When they hit the ground:

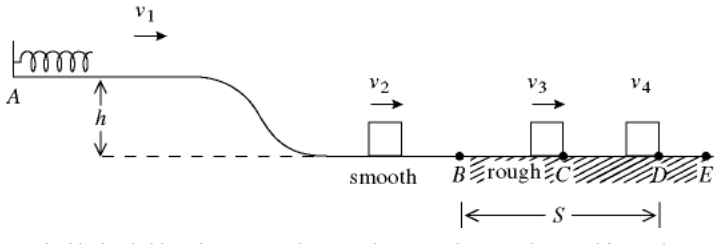
a) The heavier one will have one-fourth the kinetic energy of the lighter one.
b) *The heavier one will have twice the kinetic energy of the lighter one.
c) Both will have the same kinetic energy.
d) The heavier one will have four times the kinetic energy of the lighter one.
e) The heavier one will have half the kinetic energy of the lighter one.

3. The force constant of a spring is 800 N/m and the unstretched length is 0.76 m. A 1.9-kg block is suspended from the spring. An external force slowly pulls the block down, until the spring has been stretched to a length of 0.91 m. In this situation, the external force (in N) on the block is closest to:

a) *103 b) 559 c) 255 d) 711 e) 407

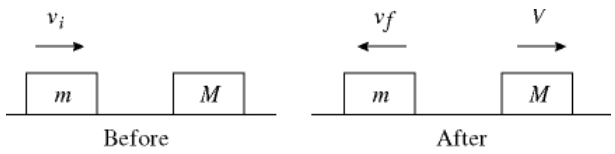
4. In the figure, a 1.52-kg block is held in place against the spring by a 70-N horizontal external force. The external force is removed, and the block is projected with a velocity $v_1 = 1.2$ m/s upon separation from the spring. The block descends a ramp and has a velocity $v_2 = 1.9$ m/s at the bottom. The track is frictionless between points A and B. The block enters a rough section at B, extending to E. The coefficient of kinetic friction is 0.34. The velocity of the block is $v_3 = 1.4$ m/s at C. The block moves on to D, where it stops. The height of the ramp h, in cm, is closest to:

a) 15 cm
b) 17 cm
c) 18 cm
d) *11 cm
e) 7.3 cm



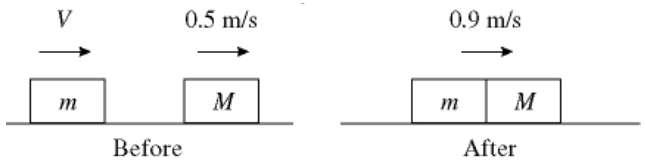
5. In the figure, a block of mass $m = 4.2$ kg, moving on a frictionless surface with a speed $v_i = 2.9$ m/s makes a perfectly elastic collision with a block of mass M at rest. After the collision, the 4.2 kg block recoils with a speed of $v_f = 1.5$ m/s. The kinetic energy of the mass M after the collisions is closest to

a) 4.7 J
b) *13 J
c) 18 J
d) 22 J
e) 5.9 J



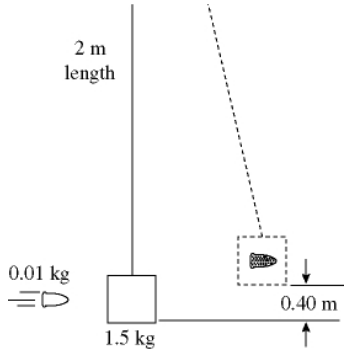
6. A block of mass $m = 25$ kg has a speed V and is behind a block of mass $M = 64$ kg that has a speed of 0.50 m/s The surface is frictionless. The blocks collide and couple. After the collision, the blocks have a common speed of 0.90 m/s. In the figure, the loss of kinetic energy of the blocks due to the collision is closest to:

a) 2.8 J
b) *18 J
c) 13 J
d) 28 J
e) 74 J



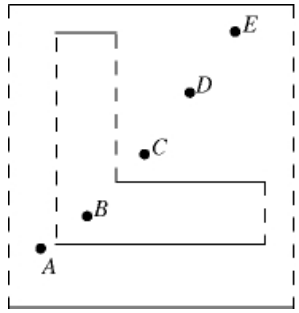
7. In the figure, a bullet of mass 0.01 kg moving horizontally strikes a block of wood of mass 1.5 kg which is suspended as a pendulum. The bullet lodges in the wood, and together they swing upward a distance of 0.40 m. What was the velocity of the bullet just before it struck the wooden block? The length of the string is 2 meters.

a) 646 m/s
b) 250 m/s
c) 366 m/s
d) *423 m/s
e) 66.7 m/s



8. In the figure, an L-shaped piece is cut from a uniform sheet of metal. Which of the points indicated is closest to the center of mass of the L-shaped object?

a) A
b) B
c) *C
d) D
e) E



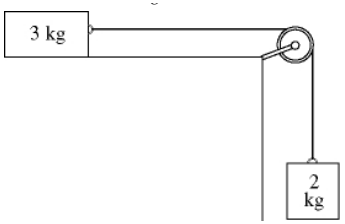
9. At time $t = 0$ s, a wheel has an angular displacement of zero radians and an angular velocity of +26 rad/s. The wheel has a constant acceleration of -50 rad/s^2. In this situation, the maximum value of the angular displacement, in rad, is closest to:

a) +135.2
b) *+67.6
c) +11.83
d) +101.4
e) +84.5

10. A turbine blade rotates with angular velocity $\omega(t) = 2.0 - (0.60)t^2$. What is the angular acceleration of the blade at $t = 9.30$ s?

a) -24.9 rad/s^2
b) -5.58 rad/s^2
c) *-11.2 rad/s^2
d) -49.9 rad/s^2
e) -9.16 rad/s^2

11. In the figure, two blocks, of masses 2 kg and 3 kg, are connected by a light string that passes over a pulley of negligible mass and radius 0.37 m. The table top is very smooth. The blocks are released from rest. After the 3 kg block has moved 0.65 m, the speed of the 2 kg block is closest to:

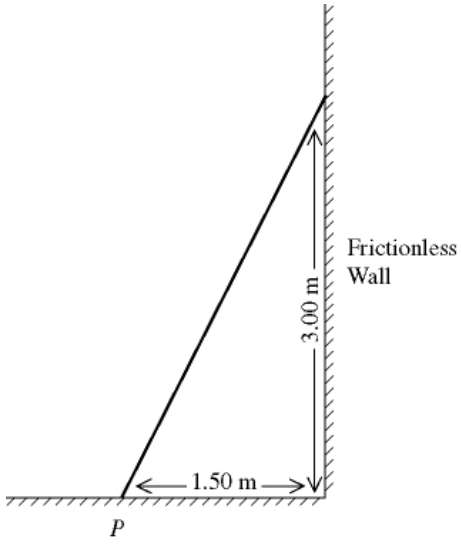


a) 7.8 m/s
b) 11.2 m/s
c) 9.8 m/s
d) 5.6 m/s
e) *2.3 m/s

12. A string with negligible mass is wrapped around a cylinder of radius 0.10 m and moment of inertia 2.0 kg·m^2 which can spin freely about an axis through its center. The string is pulled with a constant force of 5.0 N. The angular acceleration (in rad/s^2) of the cylinder is closest to:

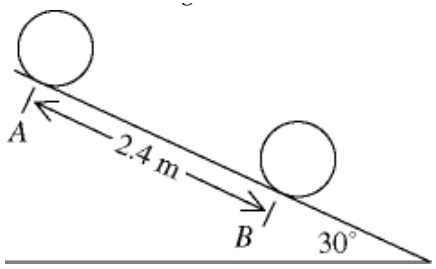
a) 1.0 b) 100 c) *0.25 d) 0.50 e) 20

13. A ladder leans against a *perfectly frictionless* wall, as shown in the figure. You determine that the magnitude of the force that the wall exerts on the ladder is 100.0 N. The torque that this force exerts about the foot of the ladder (point P) is closest to:



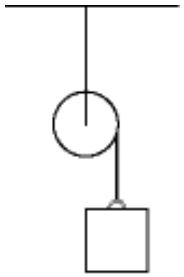
a) 2940 Nm
b) 150 Nm
c) 1470 Nm
d) *300 Nm
e) 335 Nm

14. A wheel has a mass $M = 3.0$ kg and a radius $R = 0.060$ m. Its moment of inertia is given by $I = MR^2$. The wheel is released from rest at point A on a 30° incline. The rolls without slipping and moves 2.4 m to point B as shown in the figure. The speed of the center of mass of the wheel is closest to:



a) 5.0 m/s
b) 24 m/s
c) 8.0 m/s
d) *3.4 m/s
e) 48 m/s

15. In the figure, a mass of 47.5 kg is attached to a light string, which is wrapped around a cylindrical spool of radius 0.15 m and moment of inertia 1.85 kg·m^2. The spool can rotate freely around its axis. The spool is suspended from the ceiling as shown, and the mass is then released from rest. After the mass is released, the tension in the string attached to it is closest to (recall $\alpha = \frac{a}{R}$):

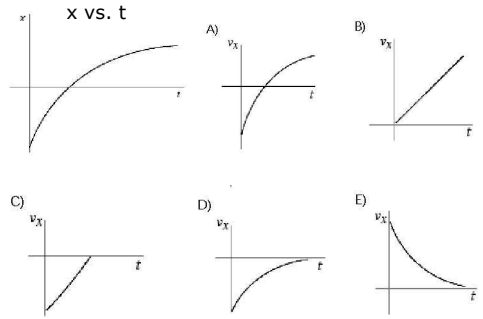


a) 18.1 N
b) *294 N
c) 803 N
d) 465 N
e) 12.3 N

16. A train starts from rest and accelerates uniformly, until it has traveled 5.4 km and acquired a velocity of 31 m/s The train then moves at a constant velocity of 31 m/s for 400 s. The train then decelerates uniformly at 0.065 m/s^2 until it is brought to a halt. The distance traveled by the train during deceleration is closest to:

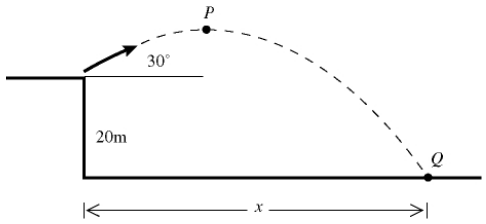
a) 6.7 km b) *7.4 km c) 7.0 km d) 6.0 km
e) 6.3 km

17. Figure "x vs. t" shows the graph of the position x as a function of time for an object moving in the straight line (the x-axis). Which of the graphs(A - E) best describes the x-component of the velocity, v_x, as a function of time for this object?



a) A
b) B
c) C
d) D
e) *E

18. A projectile is fired from the edge (at y = 0 m) of the top of the physics building as shown in the figure. The initial velocity components are $v_{0x} = 104$ m/s and $v_{0y} = 60.0$ m/s. The projectile reaches maximum height at point P, then it falls and strikes the ground at point Q. In the figure, the magnitude of acceleration at point P is closest to:



a) 0 m/s^2
b) 4.90 m/s^2
c) *9.81 m/s^2
d) 60.0 m/s^2
e) 120 m/s^2

19. An object moves in a circle of radius R at constant speed with a period T. If you want to change only the period in order to cut the object's acceleration in half, the new period should be:

a) $T/\sqrt{2}$ b) $*T\sqrt{2}$ c) $4T$ d) $T/2$ e) $T/4$

20. A force of 1 N will cause a mass of 1 kg to have an acceleration of 1 m/s^2. Thus it follows that a force of 2 N applied to a mass of 2 kg will cause it to acquire an acceleration(in m/s^2) of:

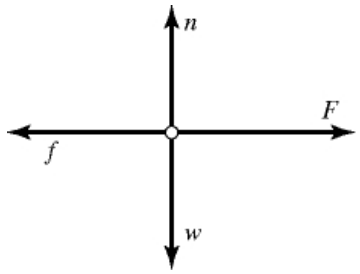
a) *1 b) 4 c) 2 d) 0.50 e) 3

21. A force F of 150 N is applied vertically upward to lift a 5.0 kg block in the physics lecture hall. The magnitude of acceleration of the block is closest to:

a) 9.8 m/s^2
b) 40 m/s^2
c) 30 m/s^2
d) *20 m/s^2
e) 0 m/s^2

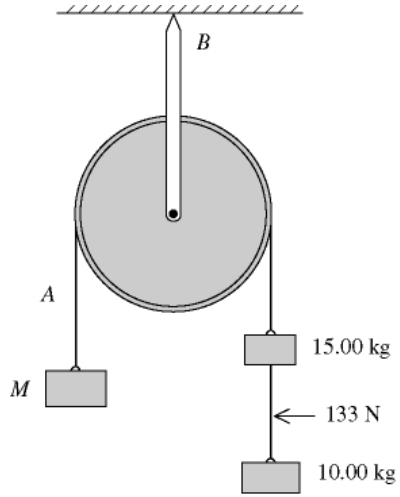
22. A box with weight 32 N is on a rough horizontal surface. An external force F is applied horizontally to the box. A normal force and a friction force are also present, denoted by n and f. A force diagram, showing the four forces that act on the box, is shown in the figure. When force F equals 8.6 N, the box is in motion at constant velocity. The box decelerates when force F is removed. The magnitude of the acceleration of the box is closest to:

a) 2.0 m/s^2
b) 1.3 m/s^2
c) 0.67 m/s^2
d) *2.6 m/s^2
e) zero m/s^2



23. Three objects are connected by massless wires over a massless frictionless pulley as shown in the figure. The tension in the wire connecting the 10.0-kg and 15.0-kg objects is measured to be 133 N. The acceleration(upward is +) of the 10.0 kg mass is closest to:

a) The mass M has to be known to answer.
b) -3.49 m/s^2
c) *$+3.49$ m/s^2
d) $+13.3$ m/s^2
e) -13.3 m/s^2



24. A packing crate is at rest on a horizontal surface. It is acted on by three horizontal forces: 600 N to the left, 200 N to the right, and friction. The weight of the crate is 400 N. If the 600-N force is removed, the net force acting on the block is:

a) *zero
b) 200 N to the right
c) 400 N to the left
d) 200 N to the left
e) impossible to determine from the information given

25. A girl throws a stone from a bridge. Consider the following ways she might throw the stone. The speed of the stone as it leaves her hand is the same in each case. Case A: Thrown straight up.Case B: Thrown straight down.Case C: Thrown out at an angle of 45° above horizontal.Case D: Thrown straight out horizontally. In which case will the speed of the stone be greatest when it hits the water below?

a) Case D
b) Case A
c) Case B
d) Case C
e) *The speed will the same in all cases.

26. A 13.5-kg box slides over a rough patch 1.75 m long on a horizontal floor. Just before entering the rough patch, the speed of the box was 2.25 m/s, and just after leaving it, the speed of the box was 1.20 m/s. The magnitude of the average force that friction on the rough patch exerts on the box is closest to:

a) 19.5 N
b) 5.55 N
c) *14.0 N
d) 13.7 N
e) It is impossible to know since we are not given the coefficient of friction.

27. A certain car traveling 32.0 miles per hour skids to a stop in 35 m from the point where the brakes were applied. In approximately what distance(in m) would the car stop had it been going 89.6 miles per hour?

a) 59 b) *274 c) 35 d) 164 e) 98

28. Two vectors are given as follows: $\vec{A} = +4\hat{\mathbf{i}} - 2\hat{\mathbf{j}} - 2\hat{\mathbf{k}}$,
$\vec{C} = -2\hat{\mathbf{i}} - 2\hat{\mathbf{j}} - 3\hat{\mathbf{k}}$.
The magnitude of $|\vec{A} - \vec{C}|$ is closest to:

a) 8 b) 5 c) 9 d) *6 e) 7

29. A man pushes against a rigid, immovable wall. Which of the following is the most accurate statement concerning this situation?

a) Since the wall cannot move, it cannot exert any force on the man.
b) The friction force on the man's feet is directed to the left.
c) *If the man pushes on the wall with a force of 200 N, we can be sure that the wall is pushing back with a force of exactly 200 N on him.
d) The man can never exert a force on the wall that exceeds his weight.
e) The man cannot be in equilibrium since he is exerting a net force on the wall.

30. A 60-kg person drops from rest a distance of 1.20 m to a platform of negligible mass supported by a stiff spring. The platform drops 6 cm before the person comes to rest. What is the spring constant of the spring?

a) 1.03×10^5 N/m
b) *4.12×10^5 N/m
c) 8.83×10^4 N/m
d) 2.56×10^5 N/m
e) 5.45×10^4 N/m