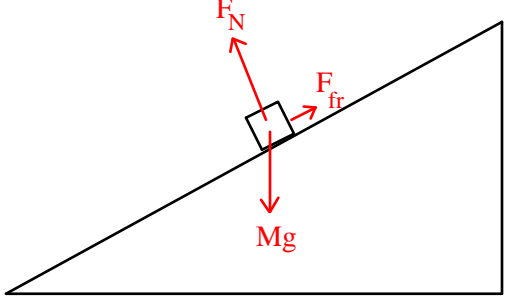


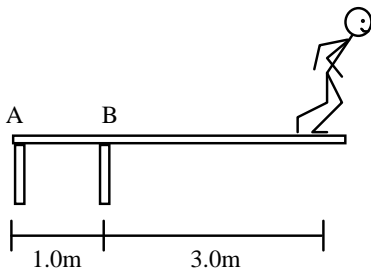
1st Semester Final Exam Study Sheet

Sample Multiple Choice Questions:

- A 6.4 kg crate is pushed up a rough 25° incline. The coefficient of friction = 0.35.
 - What minimum work is necessary to push the crate a distance of 10m up along the surface? (463.02 J)
 - What minimum work would be necessary if the surface were frictionless? (265.07 J)
 - Show a free body diagram of all forces acting on the crate.
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- What work is done in pulling a 30 kg wagon at an angle of 37° with a force of 25 N for a horizontal distance of 12 m? (239.6J) What normal force acts on the wagon? (279N)
 - A rock is thrown horizontally off the top of a cliff 120 m high, landing 25 m from the base.
 - How much time passed before the ball hit the ground? (5.0 s)
 - What is the initial velocity of the ball in the x and y directions? (5.0 m/s)
 - What was the initial and final horizontal acceleration of the ball after the throw? (0.0 m/s²)
 - A person dives off a cliff, landing in a reservoir 25 meters from the base 1.5 seconds later.
 - How high is the cliff? (11.0m)
 - What was the velocity of the diver just before (s)he hit the water? ($v_t = 16.7$ m/s; $v_f = 22.2$ m/s)
 - Find the tension on the rope if a 45 kg child accelerates down it at a rate of 2.3 m/s². (337.5N)
 - Find the tension on a rope being climbed by a 34 kg monkey at a rate of 1.2m/s² (374N)
 - A 65N junior on a skateboard pushes off an 87kg senior (who remains standing) with a force of 15 N. What force does the senior experience, and what force does the junior experience? (15N)
 - How much force is necessary to throw a 0.14 kg baseball at an initial speed of 40 m/s if it is accelerated over a distance of 1.3m? (86.2N)
 - What is the coefficient of static friction between the surface and a crate sliding down a 27° ramp at a constant 5.7m/s? (0.51)
 - What value can be determined from the slope of a displacement vs. time graph?
 - velocity
 - acceleration
 - gravity
 - total distance
 - displacement
 - A 1200 kg car accelerates from rest to 28 m/s in 35 seconds. What net force acts on the car? (960N)
 - An object moves with a constant speed of 15 m/s on a circular track of radius 25 m. What is the acceleration of the object? (9m/s²)
 - Two objects collide and bounce off each other. Kinetic energy
 - is definitely conserved
 - is definitely not conserved
 - is conserved only if the collision is elastic
 - is conserved only if there was no friction
 - Two objects collide and stick together. Kinetic energy
 - is definitely conserved
 - is definitely not conserved
 - is conserved only if the collision is elastic
 - is conserved only if there was no friction

15. When a cannon fires a cannonball, the cannon will recoil backward because the:
- energy of the cannonball and cannon is conserved
 - momentum of the cannonball and cannon is conserved**
 - energy of the cannon is greater than the energy of the cannonball
 - momentum of the cannon is greater than the energy of the cannonball.
16. A constant 6.0 N net force acts for 4.0 seconds on a 12 kg object. What is the object's change in velocity?
- 2.0 m/s**
 - 12 m/s
 - 18 m/s
 - 288 m/s
17. A 63.4 kg man runs up a flight of stairs a vertical height of 12 meters, in 10 seconds. What was his power output?
- 746 Watts**
 - 1.0 hp**
 - 7456 Watts
 - two of these answers are correct**
 - none of these
18. What energy is stored when a 15 gram dart is placed in a dart gun and the spring ($k = 25 \text{ N/m}$) is compressed by 4cm?
- 0.03 J
 - 1.40 J
 - 0.02 J**
 - 0.47 J
19. A car travels 50 kilometers in 90 minutes due East, and then 25 kilometers in 1 hour due West. What is its average velocity? **(6.21 m/s)**
20. A 0.5 kg ball is swung vertically at a constant 8 m/s at the end of a 1 meter string.
- What is the tension on the string at the top of the swing? **(27.1N)**
 - What is the tension on the string at the bottom of the swing? **(36.9N)**
21. A 2.5 kg rifle shoots a 0.05 kilogram bullet with an initial velocity of 325 m/s. What was the recoil velocity of the rifle? **(6.5m/s)**

22.

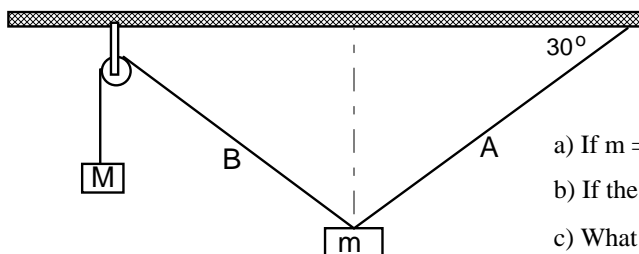


If the diver weighs 540 N, and the uniform diving board weighs 50N, find the force on each support.

(F at A = -1670 N)

(F at B = 2260 N)

23. A 2500 kg open box car is traveling 9.2 m/s. If a 250 kg weight is suddenly dropped into it, what will be the final velocity of the box car? **(8.36 m/s)**
24. Shown below, mass M is supported over a frictionless pulley by strings B and A and mass m. The system is in equilibrium.



a) If $m = 10 \text{ N}$, what is the tension in string A? **(10 N)**

b) If the two horizontal angles are equal, what is the tension in string B? **(10 N)**

c) What is the weight of the mass, M? **(10 N)**

25. A wheel spins through 50 revolutions. Through how many radians did it move? **(100π or 314.2 radians)**

26. If the radius of the wheel is 0.25 meters, what linear distance did it move? **(78.5 m)**

27. A wheel accelerates from 50 revolutions per minute to 250 revolutions per minute in 10 seconds.
- What is the initial angular speed of the wheel? (5.24 rad/s)
 - What is the final angular speed of the wheel? (26.18 rad/s)
 - What is the angular acceleration? (2.09 rad/s²)
28. Who wrote each of the following books:
- the Honors Physics text book? (Douglas Giancoli)
 - the Honors Physics lab book? (Vandermeer and Ziegler)
 - the Principia? (Isaac Newton)

1st Semester Final Exam Rapid-Fire Review Questions

29. What does the slope of a displacement vs. time graph tell you? (velocity)
30. What is meant if the graph is a straight diagonal line going up? (It is moving at constant velocity; it is not accelerating)
31. How long does it take a 6 kg bowling ball to fall 20 meters? (2.02 s)
32. What are the common units for acceleration? (m/s²)
33. What are the common units for torque? (Newton meters or meter Newtons)
34. What does a displacement versus time graph look like if the velocity is constant? (a straight diagonal line)
35. What does a displacement versus time graph look like for a car that is slowing down? (a curved line)
36. What trig function is used to find the horizontal component of a vector with respect to a horizontal angle? (cosine)
37. What equation is used to find the horizontal distance for a rock thrown off of a roof? ($\Delta x = v_x t_f$)
38. What equation will you use to find the tension force in an elevator going up? ($F_T = m(g+a)$)
39. What is the equation for the potential energy of a spring? ($1/2 kx^2$)
40. What are the common units for energy? (Joules)
41. What are the common units for force? (Newtons)
42. What are the common units for work? (joules)
43. What are the SI units of: Force? (kgm/s²) Power? (kgm²/s³) Work? (kgm²/s²)
44. What is the two things stick together equation? ($m_1 v_1 + m_2 v_2 = (m_1 + m_2)v_f$)
45. What are the common units for power? (Watts or Horsepower)
46. What is the equation for gravitational potential energy? (mgh)
47. What is the gravitational equation? ($F_g = G \frac{m_1 m_2}{r^2}$)
48. What is the equation for kinetic energy? (KE = 1/2 mv²)
49. A 5 kg body moving 6 m/s collides and sticks to a 10 kg body at rest on a frictionless surface.
What is the final velocity of the combined mass? (2.0 m/s)
50. What are the common units for angular displacement? (radians)
51. What is the radial equivalent for force? (torque)
52. What is the radial equivalent for mass? (moment of inertia)
53. What is the equation for angular momentum? (L = Iω)
54. How do you convert radians per second to meters per second? (multiply by the radius)
55. How do you convert revolutions to radians? (multiply by 2π)
56. What is the equation for centripetal force? ($F_c = \frac{mv^2}{r}$)
57. What is the range equation? ($R = \frac{v_o^2 \sin 2\theta}{g}$)
58. What trig function do you use to find the vertical component of the velocity of a projectile? (sine)
59. A bullet strikes a block of wood that then slides to a stop on a rough surface. What is the equation for the initial velocity of the block and bullet system? ($v = \sqrt{2g\mu d}$)
60. What causes the centripetal force on a roller coaster car rounding the top of a hill? (gravity and normal force)
61. What causes the centripetal force on a banked curve? (friction and normal force)

62. If a velocity versus time graph shows a diagonal line going up, what will the displacement versus time graph look like? (a curved line going up)
63. What is the minimum velocity of something completing an upside-down loop with a radius of 25 meters? (15.65 m/s)
64. Of the following dimensions, which are vectors, which are scalars, and which can only be (+)?
- | | | |
|--------------------------|-----------------------------------|--------------------------|
| a) power (scalar) | d) potential (scalar) | g) displacement (vector) |
| b) work (scalar) | e) kinetic energy (scalar + only) | h) acceleration (vector) |
| c) time (scalar, + only) | f) velocity (vector) | i) speed (scalar) |
65. What happens to the force of a ball swung in a circle if the velocity doubles but the radius stays the same? (the force increases 4x) What if the force stays the same and the velocity doubles? (the radius increased 4x)
66. What force opposes motion parallel to the surface? (friction)
67. What force is exerted by a surface perpendicular to a body? (normal)
68. In what direction does gravitational acceleration point? (down only and always)
69. In what direction does centripetal acceleration point? (toward the center of the circle)
70. In what direction does frictional force point for something sitting on a revolving disk? (toward the center of the disk)
71. What is the direction of acceleration for a projectile? (down only and always)
72. What does the area under the curve of a force vs. time graph represent? (impulse)

73. Match the astronomer to his description. If there is more than one choice, you need them all!

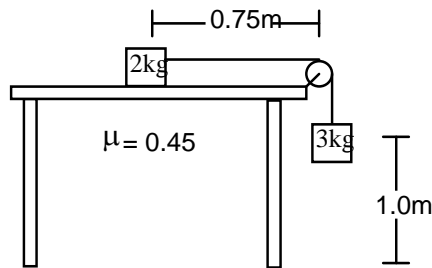
- | | |
|------------------------|--|
| | a) Derived three Laws of Planetary Motion |
| Henry Cavendish (e) | b) Danish astronomer, got his nose cut off in a sword fight |
| Eratosthenes (d) | c) First to suggest a heliocentric model of the universe |
| Copernicus (i) | d) Determined the circumference of the earth using shadow angles and estimations |
| Tycho Brahe (b, g) | e) Was able to measure the value of the gravitational constant |
| Issac Newton (f) | f) Derived the gravitational equation and 3 laws of motion |
| Johannes Kepler (a, k) | g) Recorded more data and more accurate data on the planets and the stars than in all of history before him. |
| Ptolemy (j) | h) First to estimate the size of the sun to be much larger than the earth |
| Aristarchos (c,h) | i) Designed a very complicated heliocentric solar system that didn't work as well as the geocentric model at that time, and ended up creating quite a bit of controversy |
| | j) Designed a geocentric solar system that worked very well for 1400 years |
| | k) Called "The Wandering Mathematician," Brahe hired him to prove his own geocentric model of the universe. |

Be able to identify by name, all the major equations we have used: VAT, VAX, VATX, Newton's 2nd Law, Angular and linear Momentum equations, KE, PE of a spring and gravitational PE, time to fall, force down an incline, frictional force on an incline and on the horizontal, normal force on an incline and the horizontal, 2-things-stick-together, something-blows-up, moment of inertia, range equation, gravitational equation, horizontal distance of a falling object, centripetal force and two torque equations.

Sample Problems:

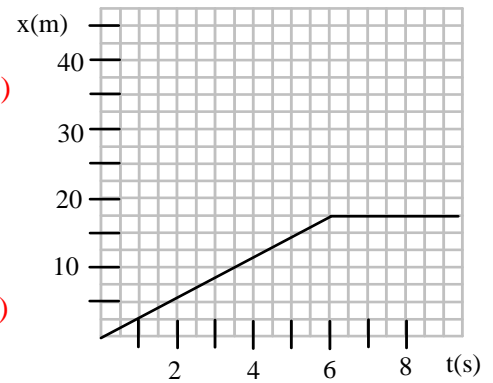
1. Consider the system shown:

- What the acceleration of the system? (4.12 m/s²)
- How much time will pass before the 3 kg: mass hits the floor? (0.60 s)
- How fast will the 2kg mass be traveling just before it hits the pulley? (2.48 m/s)
- What is the potential energy of the system? (29.4 J)



2. For the following distance vs. time graph:

- a) What is the average velocity between 0 and 6 seconds? (2.91 m/s)
- b) What is the average velocity between 6 and 8 seconds? (0 m/s)
- c) How far has the object travelled in 3.5 seconds? (10 m)
- d) What is the object doing from 0 - 6 seconds?
(moving at constant velocity)
- e) What is the object doing between 7 and 9 seconds? (it was stopped)



3. A ball is kicked and travels 52 meters in 4 seconds:

- a) What is the horizontal velocity of the ball? (13 m/s)
- b) What is the initial vertical velocity of the ball? (19.6 m/s)
- c) How high did the ball go? (19.6m)
- d) What was the initial horizontal acceleration of the ball? (0 m/s²)
- e) What was the initial vertical acceleration of the ball? (-9.8 m/s²)

4. A 0.075 kg bullet is fired into a 1.2 kg block of wood. It slides to a halt on a rough surface of $\mu = 0.75$ after moving a distance of 2.5 meters.

- a) What is the initial speed of the block of wood? (6.06m/s)
- b) What was the muzzle speed of the bullet? (103m/s)
- c) What was the kinetic energy of the bullet? (398J)

5. What is the recoil velocity of a 2.3 kg rifle that fires a 0.025 kg bullet at 530 m/s? (-5.76m/s)

- a) What is the kinetic energy of the bullet just after it was shot? (3511.25J)
- b) What was the kinetic energy of the system before the bullet was shot? (0J)
- c) What was the kinetic energy of the rifle during the recoil? (38.15J)

6. A 6 kg rocket is launched from a 10 meter cliff with an initial velocity of 32 m/s at a 30° angle.

- a) With what velocity did it hit the ground below? (34.9m/s)
- b) How much work did gravity do? (588J)
- c) If the rocket was in the air for 3.2 seconds, how far from the base of the cliff did it land? (88.7m)

7. A soccer ball ($r = 20$ cm and $m = 0.46$ kg) rolls down an incline from an altitude of 3 meters. At the bottom of the ramp, it has a linear velocity of 5.9 m/s.

- a) What is the angular velocity at the bottom of the ramp? (29.5 rad/s)
- b) If the moment of inertia is $\frac{2}{3}MR^2$, what is the rotational KE at the bottom of the ramp? (5.34J)

8. A 24 pound rock is launched at a 32° angle from the edge of a 25 meter cliff with an initial velocity of 18m/s.

- a) With what velocity will the rock hit the water? (28.53)
- b) How much work was done by gravity? (2673.7J)

9. A toy gun shoots a 15 gram dart from an altitude of 2 meters. If the initial velocity was 10 m/s and the spring was compressed 5 cm before it was released:

- a) What was the spring constant of the dart gun? (600N/m)
- b) What kind of energy did the gun possess before the dart was shot? (spring potential and gravitational potential)
- c) What kind of energy did the dart possess after it was shot? (gravitational potential and kinetic)
- d) What would a KE vs time graph of the dart look like? (A curved line going up)
- e) What would a PE vs time graph of the dart look like? (A diagonal line going down)