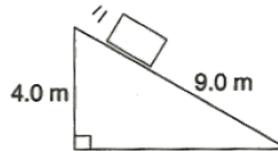


Physics 112/111
Exam Review – Problems

1. A meteor falls from the sky to the Earth. The meteor already had an initial velocity downward when it was spotted. If it hit the Earth at 335 m/s after being seen for 30 seconds, then what was the initial velocity of the meteor? (41 m/s, downward)
2. A red laser has a wavelength of 630 nm. If the frequency of the light is 4.76×10^{14} Hz, how fast is the laser beam moving? (3.00×10^8 m/s)
3. How high do you have to lift a 5.0 kg box to give it 98 J of E_g ? (2.0 m)
4. A block of mass 8.0 kg, starting from rest, is pulled along a rough horizontal tabletop by a constant force of 2.0 N. It is found that this body moves a distance of 3.0 m in 6.0 s.
 - a) What is the acceleration of the body? (0.17 m/s^2 , right)
 - b) What is the net force acting on the body? (1.4 N, right)
 - c) What other force is involved in this problem? Find its magnitude. (force of friction, 0.60 N)
5. It is determined that light travels at a speed of 1.87×10^8 m/s in a substance. Determine the index of refraction of the substance. (1.60)
6. An 8.0 kg object is dropped from a height of 7.0 m. What is the kinetic energy of this object as it hits the ground? (5.5×10^2 J)
7. A car moving on a straight road increases its speed at a uniform rate from 10 m/s to 20 m/s in 5.0 s.
 - a) What is its acceleration? (2.0 m/s^2 right)
 - b) How far did it go during the 5.0 s? (75 m)
8. A 20.0 N object is lifted at a constant velocity from the floor to a height of 1.50 m. How much work is done on the object? (30.0 J)
9. How much power does it take to lift 250 N 40 m high in 2.0 s? (5.0×10^3 W)
10. A 5.0×10^4 kg train is rolling along a track at 5.0 m/s. A force of 2.0×10^3 N is used to stop the train. How long does it take to stop the train? (1.3×10^2 s)
11. A parachutist descending at a speed of 10 m/s drops a camera from an altitude of 50 m.
 - a) How long does it take the camera to reach the ground? (2.3 s)
 - b) What is the velocity of the camera just before it hits the ground? (33 m/s down)
12. How much work can be done by a 300 W motor in 60 sec? (1.8×10^4 J)
13. While looking out a window you see a ball traveling upwards. Your fine tuned skills of observation tell you the ball is traveling 22.0 m/s upward. How much time will it take to travel up another 15.0 m? (0.839 s)
14. A beam of light is shined through water ($n = 1.33$) into a block of Lucite ($n = 1.51$) at an angle of 33.0° . What is the refracted angle in the Lucite? (28.7°)
15. A baseball player does 1234 Joules of work when hitting a baseball into left field. Assuming the baseball landed 100 meters away from home plate, how much force did the player use to hit the ball? (12.3 N)
16. An Atwood Machine is loaded on one side with a 28 kg block and a 15 kg block on the other side. The system is released from rest. Find the tension of the cable and the acceleration of the system when released. (1.9×10^2 N up, 3.0 m/s^2 down for the 28 kg block, 3.0 m/s^2 up for the 15 kg block)

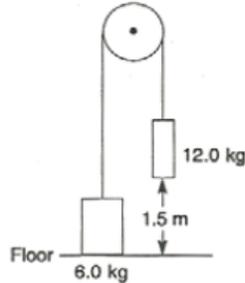
17. A machine operates at a power consumption of 3.5 kW for 10.0 minutes. In the process it produces 5.0×10^5 J of heat energy. Estimate the machine's efficiency. (24%)
18. Angela uses a force of 25 N to lift her grocery bag while doing 50 J of work. How far did she lift the grocery bag? (2.0 m)
19. A car has a kinetic energy of 4.32×10^5 J when traveling at a speed of 23 m/s. What is its mass? (1.6×10^3 kg)
20. How much work does an elephant do while moving a circus wagon 20 meters with a pulling force of 200N? (4.0×10^3 J)
21. A heavy box slides down a frictionless incline as shown in the diagram. If the box starts from rest at the top of the incline, what is its speed at the bottom? (8.9 m/s)



22. A 4.0 kg mass sits on a table that has 5.0 N of friction. If Maria applies a 25 N force to the mass, how fast will it accelerate? (5.0 m/s^2 , right)
23. Joe throws a 4.0 kg stone straight up and it reaches a height of 5.0 m. What is its E_g at its highest point? (2.0×10^2 J)
24. Martha drops a 1.0 kg rock off the top of Black Oak Canyon which is 100 m deep. What is the E_k of the rock the instant before it hits bottom? (9.8×10^2 J)
25. A block of flint glass ($n = 1.63$) is put in water ($n = 1.33$). What is the critical angle for the glass? (54.7°)
26. If it takes 20 N to move a box, how long will it take a 20 W motor to move the box 5.0 m? (5.0 s)
27. A bowling ball of mass 2.0 kg strikes a stationary pin of mass 5.0×10^2 g. The collision lasts for 0.60 s after which the pin moves off with a velocity of 12.0 m/s [W]. Calculate the force exerted by the bowling ball on the pin. (10 N, west)
28. A crane moved a 200 kg hot tub from the ground to the top of the hotel, 53m above the ground. If the crane used 200,000J of energy, how efficient was the crane? (52%)
29. Your bicycle has a mass of 9.1 kg. You accelerate at a rate of 1.79 m/s^2 . Calculate the net force that is accelerating the bicycle. (16 N, right)
30. What is the output when the efficiency of a device is 62 % and the input is 39 J? (24 J)
31. How much impulse is required to change the velocity of a 2500 kg truck by 15 m/s? (3.8×10^4 kgm/s, right)
32. What is the input work when the output is 2841 J and the efficiency is 15 %? (1.894×10^4 J)
33. What is the efficiency of a lever if the effort force is 28 N, the effort distance is 7.0 cm, the resistance force is 16 N and the resistance distance is 8.0 cm. Use the formula below: (65%)
- $$\% \text{ Efficiency} = FR \times dR / FE \times dE * 100$$
34. You push with a force of 200 N to slide a refrigerator across a floor at constant velocity. What is the force of friction acting on the fridge? (200 N left)

35. Melissa threw a penny straight down off the Empire State building. The building is 354 m tall. If Melissa threw the penny down such that it left her hand at 35 m/s,
- How fast will the coin be traveling when it hits the pavement? (90 m/s)
 - How long will the coin be in the air? (5.6 s)
36. A 1.0 kg toy car is moving across a smooth floor with a velocity of 5.0 m/s. An unbalanced force of 2.0 N acts on the car for 4.0 s. Determine the velocity of the car at the end of the interval in each of the following cases.
- the force acts in the direction of motion of the car (13 m/s right)
 - the force acts in the opposite direction to the motion of the car (3.0 m/s left)
37. What is the mass of an object that has 32 J of E_k when moving at 2.0 m/s? (16 kg)
38. An elevator and its contents have a combined mass of 6000 kg. It is suspended by a single cable.
- What force must the cable exert on the elevator when it is at rest? (5.88×10^4 N up)
 - What force must the cable exert on the elevator when it is moving upward at 2.0 m/s²? (7.08×10^4 N up)
39. Calculate the acceleration of a car if the force on the car is 450 N and the mass is 1300 kilograms. (0.346 m/s² right)
40. You are hanging a 5.0 kg weight from a string. What is the tension in the string? (49 N up)
41. How fast will a 1200 kg car be travelling when its momentum is 2400 kgm/s? (2.0 m/s)
42. Fred throws a 6.0 kg stone into the air with an upward velocity of 10 m/s. What will be the E_g of the stone at its highest point? (3.0×10^2 J)
43. An 1100 kg car is travelling at 22 m/s. What force is needed to stop it in 2.0 s? (1.2×10^4 N left)
44. What power is exerted by a weight lifter, who clean and jerks 350 kg from the floor to a height of 2.14 m in 1.5 s? How many horsepower has the weight lifter produced? (6.6 hp)
45. It takes 12 s for a 75 N force to stop an object that was going 30 m/s. Find the object's mass. (30 kg)
46. On the moon, Bob weighs 160 N while on earth Fred weighs 882 N. Who has the greater mass? (Bob: 97.6 kg)
47. A 15 kg box is pulled along a horizontal frictionless surface by a horizontal force of 35 N. If the box accelerates uniformly from rest, how fast is it travelling after 3.5 m? (4.0 m/s)
48. A surfer estimated that he was traveling at a speed of 17.5 m/s and that the distance between the wave crest he was riding and the one in front of him was about 20 m. What was the frequency of the set of waves he was riding? (0.88 Hz)
49. An airplane can go from rest to its top speed of 48 m/s in 4.37 s. What is the length of runway required for takeoff? (1.0×10^2 m)
50. A 755 N diver drops from a board 10.0 m above the water's surface.
- Find the diver's speed 5.00 m above the water's surface. (9.9 m/s)
 - Find the diver's speed just before striking the water. (14 m/s)
 - If the diver leaves the board with an initial upward speed of 2.00 m/s, find the diver's speed when striking the water. (10 m/s)
51. What is the frequency of ultraviolet light having a wavelength of 6.0×10^{-7} m? (5.0×10^{14} Hz)
52. What was the average net force exerted on a 4.5×10^{-3} kg bullet by a gun while accelerating it from rest to a speed of 1.0×10^3 m/s through a displacement of 0.70 m? (3.2×10^3 N, right)

53. A beam of light is shined at an angle of 25.0° into a pane of glass ($n = 1.5$).
- Does the beam bend toward or away from the normal? (toward the normal)
 - What angle relative to the normal does the refracted beam bend? (16°)
54. A system containing a frictionless pulley is described in the diagram. If this system is released, at what speed does the 12.0 kg object hit the floor? (3.1 m/s)

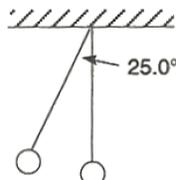


55. A beam of light is shined from air into a block of zircon at an angle of 45.0° . The refracted beam is measured to have an angle of 22.0° . What is the index of refraction of zircon? (1.89)
56. What is the wavelength of a microwave oven operating at a frequency of 2.45 GHz? (0.122 m)
57. A block of unknown substance is submerged in water. A light ray in the water strikes the substance at an angle of 45° from the normal. If the refracted ray in the substance is at an angle of 16° , what is the index of refraction of the unknown substance? (3.4)
58. What is the critical angle for a medium having an index of refraction of 1.85? (32.7°)
59. A heavy object is dropped from a vertical height of 8.0 m above the ground. What is the speed of this object as it hits the ground? (13 m/s)
60. A ball rolls down a hill with a constant acceleration of 3.0 m/s^2 .
- If it starts from rest, what is its speed at the end of 4.0 s? (12 m/s)
 - How far did the ball move in that 4.0 s? (24 m)
61. The speed of light in vinegar is $2.30 \times 10^8 \text{ m/s}$. Calculate the index of refraction for vinegar. (1.30)
62. A block with a mass of 5.7 kg slides on a frictionless table with a speed of 1.2 m/s. It is brought to rest by compressing a spring in its path. By how much is the spring compressed if its force constant is 1500 N/m? (7.4 cm)
63. How much force is required to accelerate an 8.4 kg mass at 5.0 m/s^2 if there is 14 N of friction? (56 N)
64. A 75 kg bobsled is pushed along a horizontal surface by two athletes. After the bobsled is pushed distance of 4.5 m starting from rest, its speed is 6.0 m/s. Find the magnitude of the net force on the bobsled. ($3.0 \times 10^2 \text{ N}$)
65. A 28 N force acts on a 100 kg object for 5.0 s. By how much will the object's velocity change? (1.4 m/s)
66. A pile driver drops from a height of 35 meters before landing on a piling. What is the speed of the driver when it hits the piling? (26 m/s)
67. A pendulum bob is released from some initial height such that the speed of the bob at the bottom of the swing is 1.9 m/s. What is the initial height of the bob? (0.18 m)
68. A 2.20 N object is held 2.20 m above the floor for 10.0 s. How much work is done on the object? (0 J)

69. A bicyclist brakes from 21 m/s to a stop in 32.3 m.
 a) What is the acceleration of the bicyclist? (6.8 m/s^2 left)
 b) How much time does it take for the bicyclist to stop? (3.1 s)
70. A 10.0 kg object is accelerated horizontally from rest to a velocity of 11.0 m/s in 5.00 s by a horizontal force. How much work is done on this object assuming the object is on a frictionless surface? (605 J)
71. A student wearing frictionless in-line skates on a horizontal surface is pushed by a friend with a constant force of 45 N. How far must the student be pushed, starting from rest, so that her final kinetic energy is 352 J? (7.8 m)
72. An uncompressed spring is 20.0 cm in length. What is the potential energy of this spring when an average force of 65.0 N compresses it to a length of 13.5 cm? (2.11 J)
73. A winch of power output 5.0 kW can raise a crate with a steady maximum speed of 10.0 m/s. What is the mass of the crate? (51 kg)
74. A 10.0 N object is accelerated uniformly from rest at a rate of 2.5 m/s^2 . What is the kinetic energy of this object after it has accelerated a distance of 15.0 m? (38 J)
75. A box of mass 15.32 kg is being pulled to the right across a horizontal surface by an applied force of 58 N. The box is moving at constant speed. What is the coefficient of kinetic friction? (0.39)
76. The elastic constant for a spring is 750 N/m. How far must you stretch it from equilibrium in order to store 45.0 J of elastic potential in it? (0.346 m)
77. What will be the final velocity of a 1500 kg car, initially at rest, if a 760 N force is applied for 3.5 s? (1.8 m/s right)
78. A heavy object is dropped. If this object reaches the floor at a speed of 3.2 m/s, from what height was it dropped? (0.52 m)
79. A sandbag dropped from a balloon ascending at 4.2 m/s lands on the ground 10.0 s later. What was the altitude of the balloon at the time the sandbag was dropped? ($4.5 \times 10^2 \text{ m}$)
80. A 4.0 N box slides along a frictionless surface, while travelling at a speed of 2.1 m/s. This object hits an ideal spring as shown in the diagram compressing it $2.3 \times 10^{-2} \text{ m}$. What is the spring constant of the spring? ($3.4 \times 10^3 \text{ N/m}$)



81. A student exerts a horizontal force of 225 N to push a heavy box along the school corridor at a constant speed of 2.00 m/s. How much work does she do in 15.0 s? ($6.75 \times 10^3 \text{ J}$)
82. A pendulum is 1.20 m long. What is the speed of the pendulum bob when it passes through its equilibrium position if it is pulled aside until it makes a 25.0° angle to the vertical? (1.48 m/s)



83. A car started from rest and accelerated at 9.54 m/s^2 for 6.5 seconds. How much distance was covered by the car? ($2.0 \times 10^2 \text{ m}$)
84. A 60.0 kg student runs at a constant velocity up a flight of stairs. If the vertical distance of the stairs is 3.2 m, what is amount and type of work done by gravity? ($1.88 \times 10^3 \text{ J}$, negative work)

PHYSICS 112/111
Formulas

$$v_f = v_i + at$$

$$W = Fd$$

$$d = \frac{1}{2}(v_i + v_f)t$$

$$E_k = \frac{1}{2}mv^2$$

$$d = v_i t + \frac{1}{2}at^2$$

$$W = \Delta E_k$$

$$v_f^2 = v_i^2 + 2ad$$

$$E_g = mgh$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$W = \Delta E_g$$

$$F_{net} = ma$$

$$E_e = \frac{1}{2}kx^2$$

$$W = mg$$

$$F_A = kx$$

$$F_f = \mu F_N$$

$$v = f\lambda$$

$$p = mv$$

$$v = \frac{d}{t}$$

$$J = Ft$$

$$v = \frac{\lambda}{T}$$

$$Ft = \Delta p$$

$$f = \frac{\#waves}{t}$$

$$f = \frac{1}{T}$$

$$n = \frac{c}{v}$$

$$n_i \sin i = n_R \sin R$$

$g = 9.80 \text{ m/s}^2$ $c = 3.00 \times 10^8 \text{ m/s}$ $v = 343 \text{ m/s}$
