KEY

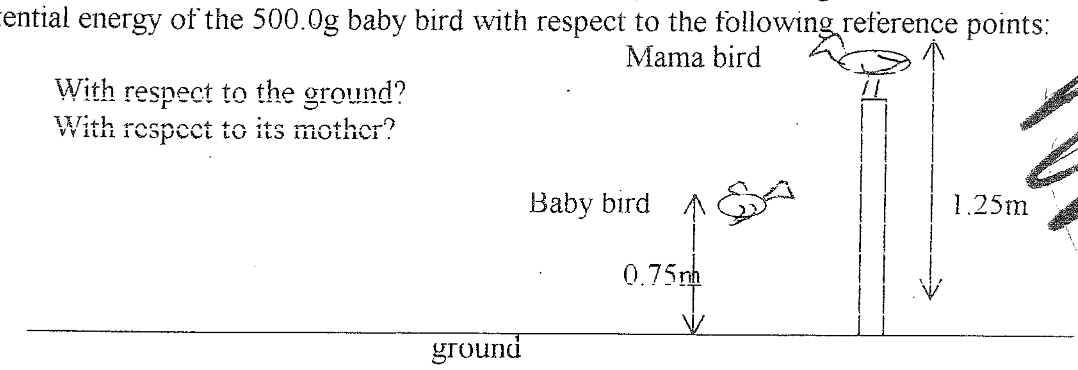
Physics 11: Work – Energy – Power ~~Test~~ Practice Test

1. a) How much work is done in lifting a 10.5 kg box to height of 3.5m?
b) If 105W of power is used in lifting the box, how much time did the lift take?

2. What is the kinetic energy of a 1.5 kg brick if it is moving at a speed of 15.0 m/s?

3. A mother bird watches as her baby learns to fly. What is the gravitational potential energy of the 500.0g baby bird with respect to the following reference points:

a) With respect to the ground?
b) With respect to its mother?



4. While performing an experiment, a student accidentally drops a 0.100 kg mass from a height of 1.25 m onto the floor. After the mass hit the floor it bounced back up to a height of 0.95 m.
a) Calculate the total potential energy of the mass before it was dropped.
b) What is the speed of the mass after it has fallen 30.0 cm below the point from which it was dropped?
c) Calculate the speed of the mass the instant before it hits the ground.
d) Calculate the potential energy of the mass at the top of its bounce.
e) What percentage of the mechanical energy of the mass is lost on impact with the floor?
f) Where did the "lost" energy go?

5. How much energy would a 100.0W fluorescent lamp use if it were left on for 3 weeks?

6. What is the speed of an oxygen molecule (mass = 2.66×10^{-26} kg) if it has a kinetic energy of 8.33×10^{-20} J?

7. It takes 18.0s to lift a 55.0 kg box to a height of 2.0m.
a) How much work is done in lifting the box?
b) How much power used in lifting the box?

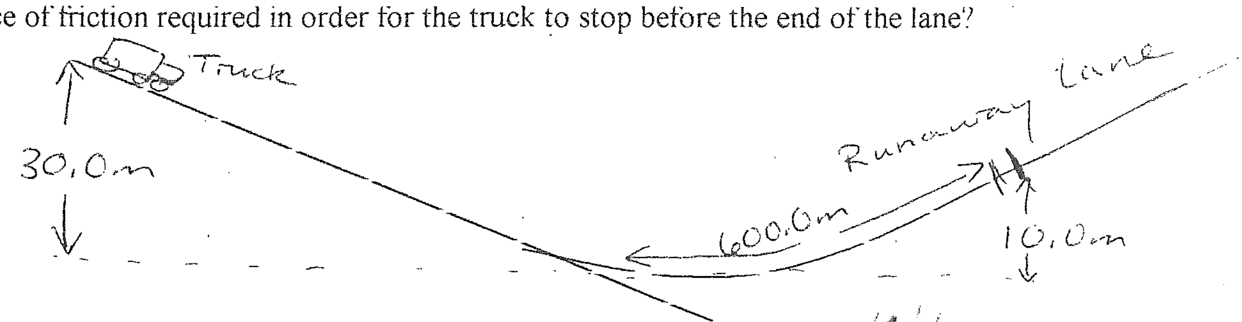
8. When writing, the force of friction acting on the tip of the pen is 0.50 N. How much work is done against friction when you use a 10.0 g pen to draw a straight line 50.0 cm long?

9. A 4.0×10^3 kg truck travels down a steep hill on a mountain road. At a height of 30.0 m from the bottom of the hill the truck's brakes failed. At that instant the truck was moving at 80.0 km/h downhill.

a) Assuming that no mechanical energy was lost as it continued downhill, how fast was the truck moving when it got to the bottom of the hill?

b) As luck would have it, there was a runaway lane at the base of the hill. How high up the hill on the runaway lane did the truck go before finally stopping? (Assuming no losses due to friction)

c) In a real life situation, friction would be a significant factor on the runaway lane. If the runaway lane is 600.0 m long and 10.0 m high at the end, what is the minimum force of friction required in order for the truck to stop before the end of the lane?

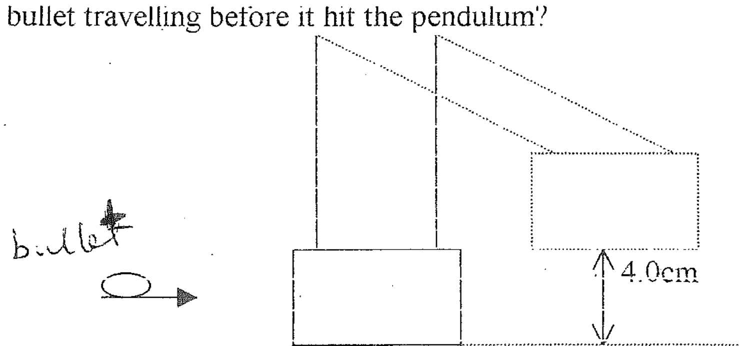


10. A diver dives off a cliff 10.0m high. Mass = 50.0kg

a) If he starts his jump from rest, what is the speed of the diver the instant before he hits the water below? (Use energy methods!)

b) The upward force of the water stops him when he is 2.5 m below the surface. What is the value of the force of the water on the divers body?

11. A 1.5 g bullet hits a 0.50kg "ballistic pendulum" and becomes imbedded within the block. If the pendulum swings to a height of 4.0 cm before stopping, how fast was the bullet travelling before it hit the pendulum?



Bonus

A 15.0g arrow is shot at a hanging 2.2 kg target which swings in an arc with a radius of 1.2m. With what speed must the arrow hit the target in order to spin the target all the way around in circle around the post that it's hanging on?

KEY

1. (a) $w = mg\Delta h = (0.5\,kg)(9.8)(3.5) = \boxed{3.6\times10^2\,J}$ (2)

(b) $P = \frac{w}{t}$; $t = \frac{w}{P} = \frac{3.6\times10^2\,J}{105\,W} = \boxed{3.4\,s}$ (2)

2. $KE = \frac{1}{2}mv^2 = \frac{1}{2}(1.5)(15)^2 = \boxed{1.7\times10^2\,J}$ (2)

3. (a) $PE = mgh = \boxed{3.7\,J}$ (2)

(b) $PE = mg\Delta h$ $\boxed{-2.4 \text{ or } -2.5\,J}$ (2)

4. (a) $PE = mgh = \boxed{1.2\,J}$ (2)

(b) $KE = mg\Delta h = \frac{1}{2}mv^2$ $\boxed{v = 2.42\,m/s}$ (2)

$v = \sqrt{\frac{2mg\Delta h}{m}}$

(c) $v = \sqrt{2g\Delta h} =$ $\boxed{v = 4.95\,m/s}$ (2)

(d) $PE = mgh$ $\boxed{PE = 0.93\,J}$ (2)

(e) $\%\,loss = \frac{E_f - E_i}{E_i}\times100\% = \boxed{24\%}$ (2)

(f) - sound, heat due to friction on impact (2)

5. $E = P\times t = (100\,W)\times(3\,wks)\times(7\,d/wk)\times(24\,h/day)\times(3600\,s/h)$

$\boxed{E = 1.814\times10^8\,J}$ (2)

6. $KE = \frac{1}{2}mv^2 \therefore v = \sqrt{\frac{2KE}{m}}$ $\boxed{v = 2.50\times10^3\,m/s}$ (2)

7. (a) $W = mg\Delta h$ $\boxed{= 1.1\times10^3\,J}$ (2)

(b) $P = \frac{W}{t}$ $\boxed{6.0\times10^1\,W}$ (2)

8. $W = F_f \times d$ $\boxed{0.25\,J}$ (2)

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9. (a) $KE_f = KE_i + PE_i$

$= \frac{1}{2}mv_i^2 + mgh_i$

$= \frac{1}{2}(4\times10^3)(\frac{80}{3.6})^2 + (4\times10^3)(9.8)(30)$

$KE_f = 9.88\times10^5 + 1.176\times10^6$

$\frac{1}{2}mv_f^2 = 2.1637\times10^6 J$ (4)

$v_f = \sqrt{\frac{2KE_f}{m}} = \boxed{33 m/s} = \underline{118 km/h}$

(32.89)

(b) $KE_i = PE_f$ (3)

$\frac{1}{2}mv_i^2 = mgh_f$

$h_f = \frac{v_i^2}{2g} = \frac{(32.89)^2}{2(9.8)} = \boxed{55 m}$

(c) $KE_i = PE_f + E_{loss}$ (3)

$E_{loss} = KE_i - PE_f = \frac{1}{2}m(32.89)^2 - mg(10)$

$= 1.77\times10^6 J$

$F_f = \frac{E_{loss}}{d} = \frac{1.77\times10^6 J}{600 m} = \boxed{2.95\times10^3 N}$

10. (a) $\frac{1}{2}mv^2 = mgh$ (2)

$v = \sqrt{2gh} = \boxed{14.0 m/s}$

(b) $W = \Delta E = mg\Delta h = F_{H_2O} \times d_{H_2O}$

$F = \frac{50(9.8)(12.5)}{2.5} = \boxed{2.5\times10^3 N}$ (2)

11. pendulum $mgh = \frac{1}{2}mv^2$ cons of p $m_b v_b = (m_b + m_B)\sqrt{2gh}$

$v = \sqrt{2gh}$

$\boxed{v_b = 296 m/s}$ (3)

$\boxed{= 3.0\times10^2 m/s}$

Bonus $KE_i = PE_f = mg(2.4m)$

$\frac{1}{2}(m_a)v_a^2 = (m_a + m_T)(9.8)(2.4)$ (3)

$\boxed{V_a = 83 m/s}$

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