Honors Physics (Spring 2014)
Final Exam Review

Newton's Laws

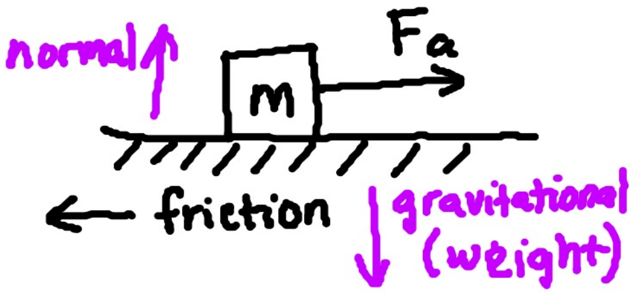
$F_a = ?\ N$

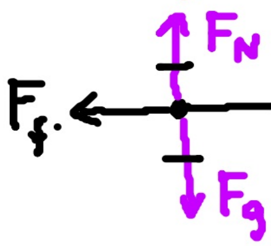
Determine the applied force required to accelerate a 3.25-kg object rightward with a constant acceleration of 1.20-m/s² if the force of friction opposing the motion is 18.2 N. (Neglect air resistance.)

m, a, F_f

$\sum F_x = F_a - F_f$

$F_{net} = ma$





$F_a - F_f = ma$

$+F_f \quad +F_f$

$F_a = ma + F_f$

$F_a = 22.1\ N$

Conservation of Momentum

A 45.0-kg ice skater stands at rest on the ice. A friend tosses the skater a 5.0-kg ball. The skater and ball move backwards across the ice with a speed of 0.50 m/s. What was the speed of the ball before the skater caught it?

m_c (45.0 kg) $\quad$ m_D (5.0 kg) $\quad$ $V_{ci} = 0\,\frac{m}{s}$ (rest) $\quad$ V_{cf} (0.50 m/s)

$$m_c V_{ci} + m_D V_{Di} = m_c V_{cf} + m_D V_{Df}$$

$$(45)(0) + (5)V_{Di} = (45)(.5) + (5)(.5)$$

$$\frac{5V_{Di}}{5} = \frac{25}{5}$$

$$V_{Di} = 5.0\,\frac{m}{s}$$

Impulse

A force of 16 N exerted against a stationary rock with an impulse of 0.8 kg m/s causes the rock to fly off the ground with a speed of 4.0 m/s. What is the mass of the rock?

F = 16 N; ΔP = 0.8 kg m/s; $V_i = 0\ \frac{m}{s}$; V_f = 4.0 m/s

$m = ?\ kg$

$$\Delta p = m\Delta V = m(V_f - V_i)$$

$$\frac{\Delta p}{\Delta V} = \frac{m\Delta V}{\Delta V}$$

$$\therefore m = \frac{\Delta P}{(V_f - V_i)} = \frac{(.8)}{(4-0)} = \boxed{.2\ kg}$$

Work and Kinetic Energy

4.00×10^5 J of work are done on a 1110 kg car while it accelerates from 10.0 m/s to some final velocity. Find this final velocity.

W m v_i

$$W = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

$$400{,}000 = \frac{1}{2}(1110) v_f^2 - \frac{1}{2}(1110)(10)^2$$

$$400{,}000 = 555 v_f^2 - 55500$$

$$+55{,}500 \qquad\qquad +55{,}500$$

$$\frac{455{,}500}{555} = \frac{555 v_f^2}{555}$$

$$\sqrt{820.7207207} = \sqrt{v_f^2}$$

$$v_f = 28.6 \ \frac{m}{s}$$

Power

A child pulls on a wagon with a force of 75 N. If the wagon moves a total of 42 m in 3 min, what is the average power generated by the child?

75 N → F

42 m → Δd

power → $P = ?\ W$

$t = 3\,\text{min} = 180\,\text{s}$

$$P = \frac{W}{t} = \frac{F\Delta d}{t} = \frac{(75)(42)}{180} =$$

17.5 W	3 SF
18 W	2 SF
20 W	1 SF

Power and Force

An electric motor develops 65 kW of power as if lifts a loaded elevator 17.5 m in 35 s. How much force does the motor exert?

$P = 65{,}000\ W$

Δd

t

$F = ?\ N$

$$t * P = \frac{F\Delta d}{t} * t$$

$$\frac{t \cdot P}{\Delta d} = \frac{F\Delta d}{\Delta d}$$

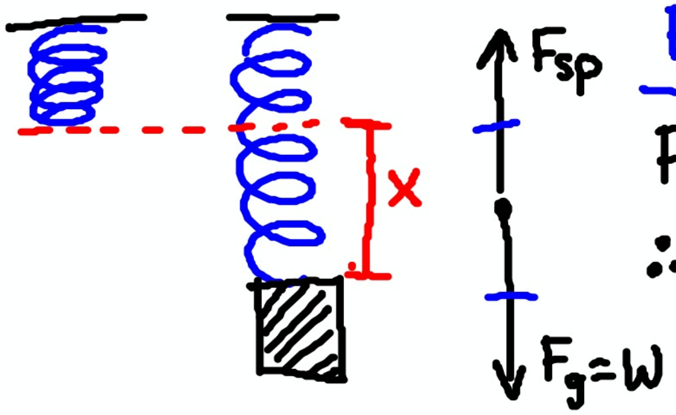
$$\therefore F = \frac{P \cdot t}{\Delta d} = \frac{(65000)(35)}{(17.5)}$$

$$F = 130000\ N = 1.3 \times 10^5\ N$$

Spring Force

$x = 0.12\,m$

A spring stretches by 12 cm when an object weighing 3.2 N is suspended from it. What is the spring constant of the spring?



$F_{sp} = W = 3.2\,N$

$F_{sp} = -kx$

$\therefore k = \frac{F_{sp}}{-x} = \frac{3.2\,N}{-(-.12)}$

$k = 27\,N/m$

Potential Energy of Spring

How much potential energy is stored in a spring with a spring constant of 27 N/m if it is stretched by 16 cm?

PE = ? J

k

$x = 0.16$ cm

$PE = \frac{1}{2}kx^2 = \frac{1}{2}(27)(.16)^2 = .3456$

$PE = .35$ J

Potential Energy of Spring

A toy rocket-launcher contains a spring constant of 35 N/m. How far must the spring be compressed to store 1.5 J of energy?

K → 35 N/m; PE → 1.5 J; compressed → $x = ?\,m$

$$2 * PE = \frac{1}{2} K x^2 * 2$$

$$\frac{2PE}{K} = \frac{K x^2}{K}$$

$$\sqrt{\frac{2PE}{K}} = \sqrt{x^2}$$

$$x = \sqrt{\frac{2PE}{K}} = \sqrt{\frac{2(1.5)}{35}} = .29\,m$$

Period of a Pendulum

How long must a pendulum be to have a period of 2.3 s on the Moon, where g = 1.6 m/s2?

$l = ?\,m$

T ; g

$$\frac{T}{2\pi} = \frac{2\pi}{2\pi}\sqrt{\frac{l}{g}}$$

$$\left(\frac{T}{2\pi}\right)^2 = \left(\sqrt{\frac{l}{g}}\right)^2$$

$$g * \left(\frac{T}{2\pi}\right)^2 = \frac{l}{g} * 1.6$$

$$l = g\left(\frac{T}{2\pi}\right)^2 = (1.6)\left(\frac{2.3}{2 * 3.14}\right)^2$$

$$l = .21\,m$$

Wave Properties

A harmonic wave is traveling along a rope. It is observed that the oscillator that generates the wave completes 40.0 vibrations in 30.0 s. Also, a given maximum travels 425 cm along a rope in 10.0 s. What is the wavelength? $\Delta d = 4.25\,m$ t

$$f = \frac{\text{vibrations}}{\text{second}} = \frac{40.0 \text{ vibr.}}{30.0\,s} = 1.33\,Hz$$

$$V = \frac{\Delta d}{t} = \frac{4.25\,m}{10.0\,s} = .425\,\frac{m}{s}$$

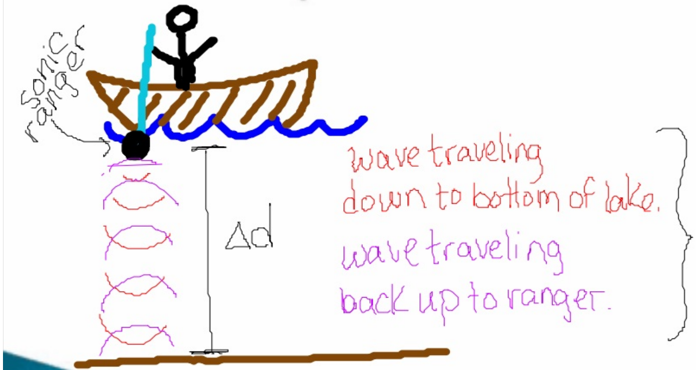
$$\lambda = \frac{V}{f} = \frac{.425}{1.33} = .32\,m$$

Wave Properties

A fisherman uses a sonic ranger to determine the depth of a lake. The sound waves travel at 1210 m/s through the water and require 0.020 seconds to travel to the lake's bottom and back to the boat. How deep is the lake?

v t

$$V = \frac{\Delta d}{t}$$



wave travel $2 * \Delta d$

$$V = \frac{2 * \Delta d}{t}$$

$$\therefore \Delta d = \frac{vt}{2} = \frac{(1210)(.020)}{2}$$

$$\Delta d = 12.1\,m$$