/35

Name: Key

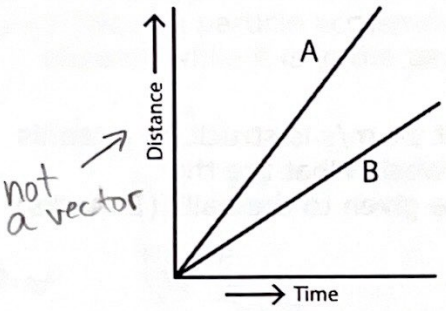
Physics 12
"PRACTICE" Midterm

Which test/quiz would you like to replace with your midterm % (only if you do better on the midterm of course): _____
What was your mark on this test/quiz? _____

Show ALL your work.

Physics 11 Review

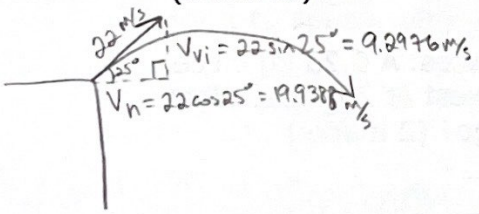
1. The graph shown below displays distance versus time for a moving object.



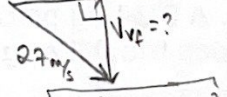
The slope of this graph represents the object's: (1 mark)

Speed

2. A ball is launched at 25° off a roof at 22 m/s. After leaving the roof, how long (t) will the ball take to reach a total speed of 27 m/s? (2 marks)



want to get to
$V_{vf} = ?$



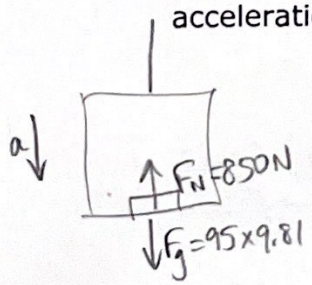
$V_{vf} = \sqrt{27^2 - 19.9388^2}$
$= -18.2056\ m/s$
since down

So how long to get to that V_{vf}?

$V_{vf} = -18.2056\ m/s$
$t = ?$
$V_{vi} = 9.2976\ m/s$
$a = -9.81\ m/s^2$

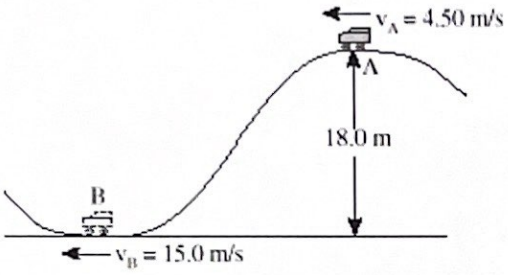
$V_f = V_i + at$
$t = \frac{V_f - V_i}{a}$
$= \frac{-18.2056 - 9.2976}{-9.81}$
$t = 2.85$

3. A 95 kg man stands on a scale while accelerating downwards in an elevator. If the scale reads 850 N, what is the magnitude of the acceleration of the elevator? (2 marks)



$F_{net} = F_{app} - F_{ag}$
$ma = F_g - F_N$
$(95)(a) = (95 \times 9.81) - 85DN$
$a = 0.86\ m/s^2$

4. A 705 kg roller coaster car travels past points A and B with speeds shown in the diagram below. How much heat energy is produced between these points? (2 marks)



$E_{TA} - E_{heat} = E_{TB}$

$E_{KA} + E_{PA} - E_{heat} = E_{KB}$

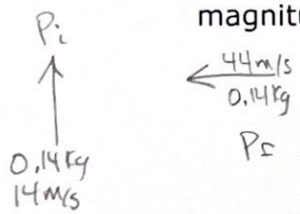
$\frac{1}{2}(705)(4.5)^2 + (705)(9.81)(18) - E_{heat} = \frac{1}{2}(705)(15)^2$

$7138.125 + 124488.9 - 79312.5 = E_h$

$5.2 \times 10^4 J = E_{heat}$

Momentum

5. A 0.14 kg tennis ball travelling north at 14 m/s is struck by a tennis racquet, giving it a velocity of 44 m/s west. What are the magnitude and direction of the impulse given to the ball? (2 marks)

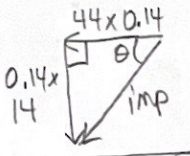


$\vec{impulse} = \Delta\vec{P}$

$= P_f - P_i$

$= \leftarrow - \uparrow$

$= \leftarrow + \downarrow$



$\tan\theta = \frac{(0.14)(14)}{(0.14)(44)}$

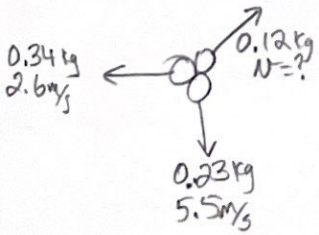
$\theta = 18°$ S of W

$imp = \sqrt{(44 \times 0.14)^2 + (14 \times 0.14)^2}$

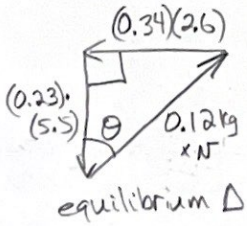
$= 6.5$ N·s

$imp = 6.5$ N·s [18° S of W]

6. An exploding firecracker breaks into three pieces. A 0.23 kg piece flies south at 5.5 m/s. A 0.34 kg piece flies west at 2.6 m/s. What speed and direction does the 0.12 kg piece go? (2 marks)



must all add to $\vec{P} = 0$ (since $\vec{P_i} = 0$)



$\tan\theta = \frac{(0.34)(2.6)}{(0.23)(5.5)}$

$\theta = 35°$ E of N

$(0.12\,N)^2 = (0.23 \times 5.5)^2 + (0.34 \times 2.6)^2$

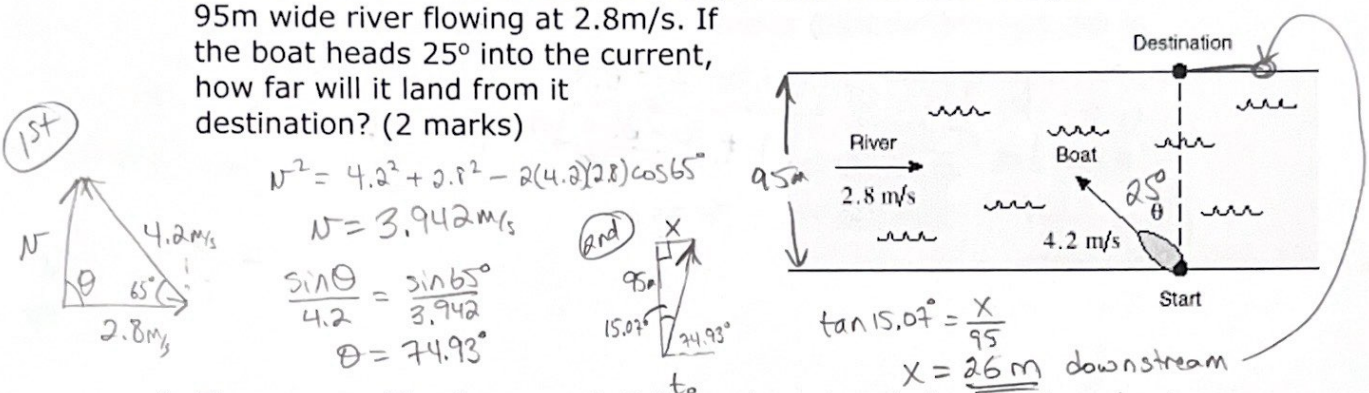
$v = 12.8606$

$= 13$ m/s

$\vec{v} = 13\frac{m}{s}$ [35° E of N]

Relativity

7. A boat shown below travels at 4.2 m/s relative to the water, in a 95m wide river flowing at 2.8m/s. If the boat heads 25° into the current, how far will it land from it destination? (2 marks)



1st

$v^2 = 4.2^2 + 2.8^2 - 2(4.2)(2.8)\cos 65°$

$v = 3.942 m/s$

$\frac{\sin\theta}{4.2} = \frac{\sin 65°}{3.942}$

$\theta = 74.93°$

2nd

$\tan 15.07° = \frac{x}{95}$

$x = 26 m$ downstream

8. The average life of a muon is 2.2 μs when at rest. A muon travels at $v = 0.89c$ in a particle accelerator. What is the lifetime of the muon you observe while it is in the particle accelerator? (2 marks) $t = ?$

t_o

$$t = \frac{t_o}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{2.2\mu s}{\sqrt{1 - \frac{(0.89c)^2}{c^2}}} = \frac{2.2\mu s}{0.45596} = 4.8\mu s$$

9. How fast ($v = ?$) would a 4.0 m-long (L_o) sports car have to be going past you for it to appear only 2.5 m long (L)? (2 marks)

$$\frac{L}{L_o} = \sqrt{1 - \frac{v^2}{c^2}}$$

$$\frac{L^2}{L_o^2} = 1 - \frac{v^2}{c^2}$$

$$\frac{v^2}{c^2} = 1 - \frac{L^2}{L_o^2}$$

$$v = c\sqrt{1 - \frac{L^2}{L_o^2}}$$

$$v = c\sqrt{1 - \frac{2.5^2}{4^2}}$$

$$= 0.78c = 2.3 \times 10^8 m/s$$

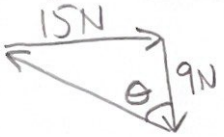
10. Suppose a spaceship heading straight away from the Earth at +0.650c can shoot a canister at 0.700c relative to the ship. What is the velocity of the canister relative to the Earth, if it is shot directly at the Earth? (2 marks)

$$u = \frac{v+u'}{1+\frac{vu'}{c^2}} = \frac{0.65c + -0.7c}{1+\frac{(0.65)(-0.7c)}{c^2}} = \frac{-0.05c}{0.545} = 0.09c \text{ toward } \oplus$$

$$= 2.8\times10^{7} \text{ m/s toward } \oplus$$

Equilibrium

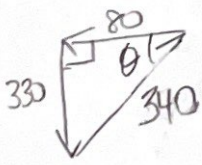
11. Two forces, 15 N east and 9.0 N south, act on an object. What is the direction of a third force that would produce static equilibrium? (2 marks)



$$\tan\theta = \frac{15}{9}$$

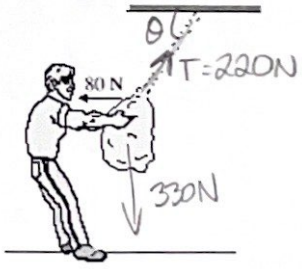
$\theta = 59^\circ$ W of N

12. A 330N bag of potatoes is suspended from a rope as shown in the diagram. A person pulls horizontally on the bag with a force of 80N. If the tension in the rope is 340 N, what angle is being made with the ceiling? (2 marks)



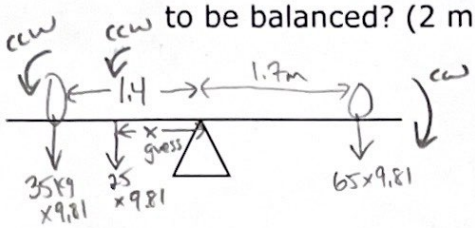
$$\tan\theta = \frac{330}{80}$$

$\theta = 76^\circ$



or $\sin\theta = \frac{330}{340}$ or $\cos\theta = \frac{80}{340}$

13. A 35kg girl sits on one side of a teeter totter, at a distance of 1.4m from the pivot. Her bigger brother, who weighs 65kg, is sitting on the other side of the teeter totter, at a distance of 1.7 m from the pivot. Where should her younger brother sit if the teeter totter is to be balanced? (2 marks)



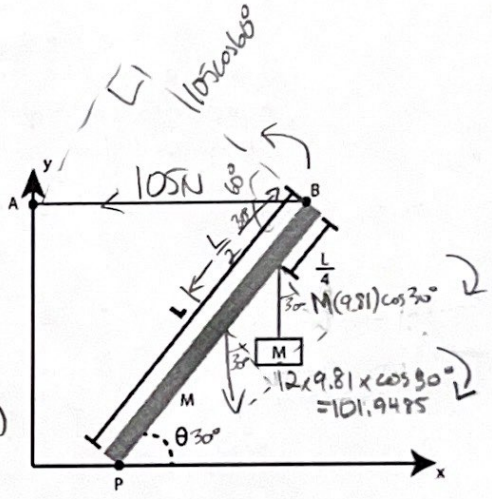
$\Sigma \tau_{ccw} = \Sigma \tau_{cw}$

$35 \times 9.81 \times 1.4 + 25 \times 9.81 \times X = 65 \times 9.81 \times 1.7$

$480.69 \quad 245.25X = 1084$

$X = 2.5$ m on sister's side

14. A uniform ~~6.0 m~~ beam of mass 12 kg, hinged at P, is angled at 30° and supports a hanging block as shown. If the tension in the horizontal cord is 105 N, what is the mass of the hanging block? (2 marks)



$\Sigma \tau_{cw} = \Sigma \tau_{ccw}$

$M(9.81)(\cos 30°)(\frac{3}{4}L) + 101.9485(\frac{1}{2}L) = 105N\cos 60°(L)$

$6.37178M + 50.9743 = 105\cos 60°$

$M = 0.24$ kg

Circular Motion and Gravitation

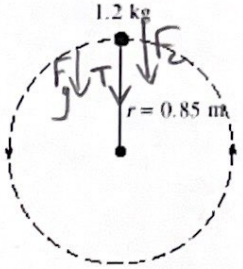
15. What is the gravitational field strength ~~5.5~~ 5500 km above the surface of a star of mass 2.4 X10^{30} kg and radius 5.6 X10^{7} m? (2 marks)

$mg = \frac{GMm}{r^2}$

$g = \frac{(6.67\times10^{-11})(2.4\times10^{30}\,kg)}{(5.5\times10^{6} + 5.6\times10^{7}\,m)^2} = \frac{1.6008\times10^{20}}{3.78225\times10^{15}} = 42324\ m/s^2$

$= 4.2\times10^{4}\ \frac{m}{s^2}$

16. A 1.2 kg mass on the end of a string is rotated in a vertical circle of radius 0.85 m. If the speed of the mass at the top of the circle is 6.7 m/s, what is the tension in the string at this location? (2 marks)



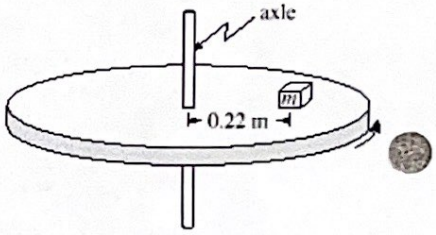
$F_{net} = F_{app} - F_{ag}$

$F_c = T + F_g$

$T = \frac{mv^2}{r} - mg$

$= \frac{(1.2kg)(6.7m/s)^2}{0.85m} - (1.2kg)(9.81m/s^2) = \underline{52\,N}$

17. An object of mass ***m*** is on a horizontal rotating platform with a radius of 0.35 m. The mass is located 0.22 m from the axle and makes one revolution every 1.5 s. The friction force needed to keep the mass from sliding is 24 N. What is the object's mass? (2 marks)

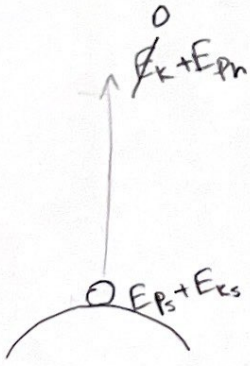


$F_f = F_c$

$24 = \frac{m4\pi^2 r}{T^2}$

$\frac{24(1.5)^2}{4\pi^2(0.22)} = m = \underline{6.2kg}$

18. A 175 kg astronaut stands on the surface of an asteroid of radius 734 m. The astronaut leaves the surface with 25 J of kinetic energy and comes to rest at a height of 250 m above the surface. What is the mass of the asteroid? (2 marks)



$E_{ps} + E_{ks} = E_{ph}$

$-\frac{GMm}{r_s} + 25J = -\frac{GMm}{r_h}$

$-\frac{6.67\times10^{-11}M(175)}{734} + 25 = -\frac{6.67\times10^{-11}M(175)}{984m}$

$-1.59\times10^{-11}M + 1.186\times10^{-11}M = -25$

$-4.0377\times10^{-12}M = -25$

$M = \underline{6.2\times10^{12}kg}$