ACADEMIC DISHONESTY POLICY

Academic honesty is one of the foundations of the educational mission and Catholic commitment of this University. Academic dishonesty, including such practices as cheating, plagiarism and fabrication, undermines the learning experience, and, as it involves fraud and deceit, is corrosive of the intellectual principles and is inconsistent with the ethical standards of this University. Academic dishonesty damages the sense of trust and community among students, faculty and administrators.

Types of Academic Dishonesty

Plagiarism is the act of presenting the work or methodology of another as if it were one's own. It includes quoting, paraphrasing, summarizing or utilizing the published work of others without proper acknowledgment, and, where appropriate, quotation marks. Improper use of one's own work is the unauthorized act of submitting work for a course that includes work done for previous courses and/or projects as though the work in question were newly done for the present course/project. Fabrication is the act of artificially contriving or making up material, data or other information and submitting this as fact. Cheating is the act of deceiving, which includes such acts as receiving or communicating or receiving information from another during an examination, looking at another's examination (during the exam), using notes when prohibited during examinations, using electronic equipment to receive or communicate information during examinations, using any unauthorized electronic equipment during examinations, obtaining information about the questions or answers for an examination prior to the administering of the examination or whatever else is deemed contrary to the rules of fairness, including special rules designated by the professor in the course.

By Signing below, I verify that I have taken this test honestly and have neither cheated nor helped anyone else cheat; this is a mark of academic integrity.

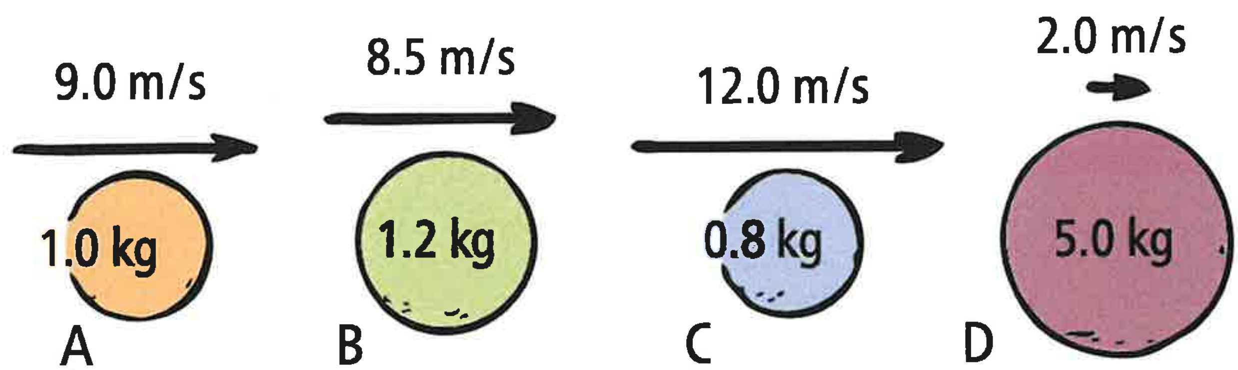
Student Name (Please Print): CARLOS YERO (SOLUTIONS)

Student Signature: ______________________ Date: Apr 10, 2025

Student ID #: ______________________ Course Title/Number: PHYS 101

1	2	3	4	5	TOTAL
10	20	15	15	20	80

1) **(10 pts)** Each ball has different masses and speeds. Calculate the following and rank them from greatest to least.



(a) **(4 pts)** **calculate** the momentum in each case $p = mv$

A: $p = 9 \cdot 1 = \boxed{9\ kg \cdot m/s}$

B: $P = (1.2\ kg)(8.5\ m/s) = \boxed{10.2\ kg \cdot \frac{m}{s}}$

C: $P = (0.8)(12) = \boxed{9.6\ kg\ \frac{m}{s}}$

D: $P = (5)(2) = \boxed{10\ kg\ \frac{m}{s}}$

(b) **(1 pts)** **rank** the momentum from greater to least

B	D	C	A
greatest			least

(c) **(4 pts)** **calculate** the impulses needed to *stop* the balls (*Hint*: think of change in speed) $I = \Delta(mv) = \Delta P = P_f - P_i = 0 - P_i$

final momentum when ball comes to a stop

initial momentum

A: $\boxed{I = -9\ kg\ \frac{m}{s}}$

B: $\boxed{I = -10.2\ kg\ \frac{m}{s}}$

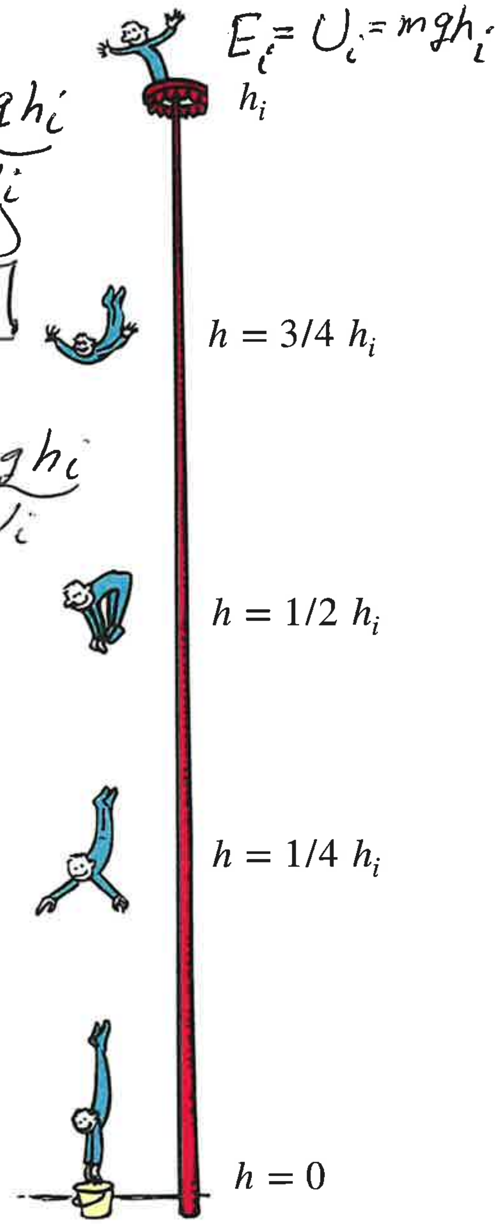
C: $\boxed{I = -9.6\ kg\ \frac{m}{s}}$

D: $\boxed{I = -10\ kg\ \frac{m}{s}}$

(d) **(1 pts)** **rank** the impulses from greater to least

B	D	C	A
greatest			least

2) **(20 pts)** A circus diver at the top of a pole of a height h_i has a potential energy of $U = 15{,}000$ J . As he dives, his potential energy is converted to kinetic energy K.



(a) **(5 pts)** calculate the potential and kinetic energy at 3/4 of the initial height ?

$E_i = K + U \rightarrow U = mgh = \frac{3}{4}\underbrace{mgh_i}_{U_i}$

$K = E_i - U$ $\quad U = \frac{3}{4}(15{,}000\text{ J})$

$= 15{,}000 - 11{,}250$

$\boxed{K = 3{,}750\text{ J}}$ $\quad \boxed{U = 11{,}250\text{ J}}$

(b) **(5 pts)** calculate the potential and kinetic energy at half of the initial height ?

$E_i = K + U \rightarrow U = mgh = \frac{1}{2}\underbrace{mgh_i}_{U_i}$

$K = E_i - U$ $\quad U = \frac{1}{2}(15{,}000\text{ J})$

$= 15{,}000 - 7500$

$\boxed{K = 7{,}500\text{ J}}$ $\quad \boxed{U = 7{,}500\text{ J}}$

(c) **(5 pts)** calculate the *potential* and *kinetic* energy at 1/4 of the initial height ?

$E_i = K + U \rightarrow U = \frac{1}{4}mgh_i$

$K = E_i - U$ $\quad U = \frac{1}{4}(15{,}000\text{ J})$

$= 15{,}000 - 3{,}750$

$\boxed{K = 11{,}250\text{ J}}$ $\quad \boxed{U = 3{,}750\text{ J}}$

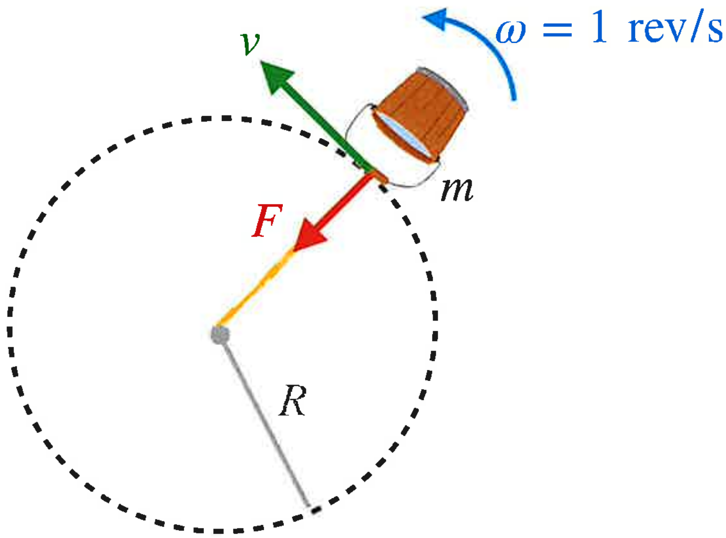
(d) **(5 pts)** calculate the potential and kinetic energy right before hitting the ground floor ?

$\boxed{U = 0\text{ J}}$ (since $h \sim 0$)

All energy has been converted to kinetic energy

$\rightarrow \boxed{K = 15{,}000\text{ J}}$

3) **(15 pts)** A 5-kg bucket filled with water is spun with an angular speed of $\omega = 1$ revolution per second which traces out a circular path of radius $R = 1$ m.



(a) **(2 pts)** Calculate the angular speed in units of radians per second (rad/s) *hint:* 1 revolution ≡ 2π radians

$$\omega = 1 \frac{\cancel{rev}}{s} \times \frac{2\pi \text{ rad}}{1 \cancel{rev}} \rightarrow \boxed{\omega = 2\pi \text{ rad/s}}$$

(b) **(3 pts)** Calculate the tangential speed of the bucket (hint: $v = \omega R$, where ω needs to be in units of rad /s)

$$v = \omega R = (2\pi \text{ rad/s})(1 \text{ m})$$

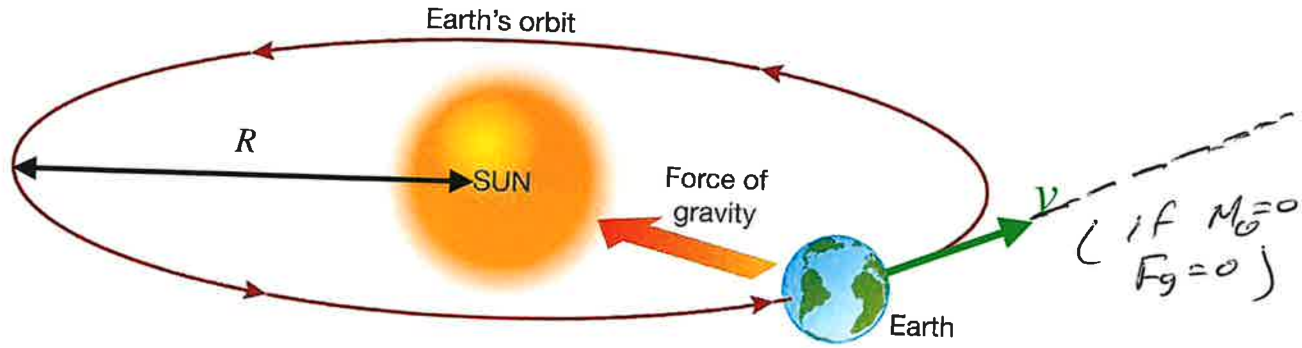
$$\boxed{v = 2\pi \text{ m/s} \simeq 6.28 \text{ m/s}}$$

(c) **(10 pts)** Calculate the tension force exerted on the rope attached to the bucket as it is spun (*hint:* note in this example the centripetal force is in fact the tension on the rope)

$$F_{net} = \frac{m v^2}{R} \quad (\text{uniform circular motion})$$

$$= \frac{(5 \text{ kg})(6.28 \text{ m/s})^2}{1 \text{ m}} \Rightarrow \boxed{F_T \simeq 197 \text{ N}}$$

4) **(15 pts)** Earth orbits the sun with due to a gravitational pull that the sun exerts on Earth, $F_g = GM_E M_{\odot}/R^2$.



By how much would the force of gravity between the Sun and Earth change if:

(a) **(5 pts)** distance between the Sun and Earth *doubled* from its original value $F_g = \frac{GM_E M_{\odot}}{R^2}$ (original)

if $R \to (2R)$ doubles, $\Rightarrow F_g = \frac{GM_E M_{\odot}}{(2R)^2} = \frac{1}{4}\frac{GM_E M_{\odot}}{R^2}$

Force would be reduced by a quarter $\Rightarrow \boxed{F_g = \frac{1}{4}\frac{GM_E M_{\odot}}{R^2}}$

(b) **(5 pts)** the Sun's mass increases by *3 times* its original value

$F_g = \frac{GM_E M_{\odot}}{R^2}$ (original)

if $M_{\odot} \to 3M_{\odot} \Rightarrow \boxed{F_g = \frac{3GM_E M_{\odot}}{R^2}}$

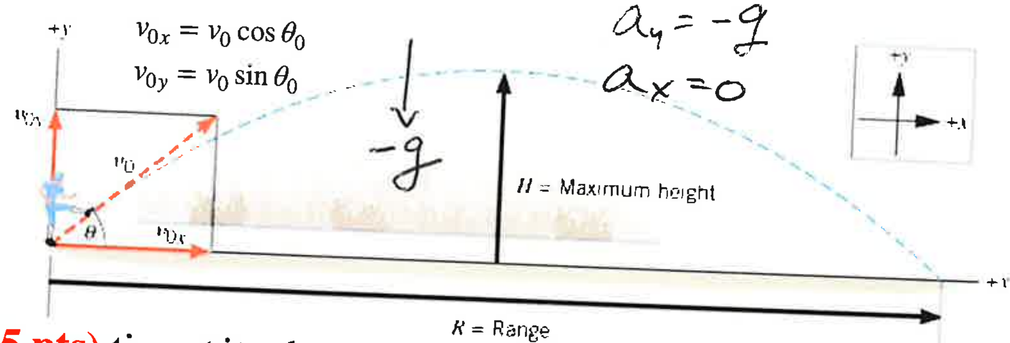
Force would be 3x (times) larger

(c) **(5 pts)** if the Sun were to disappear what would the the gravitational force ? what path would the Earth follow ? Draw the path (in the figure) you think Earth would follow in this case.

No sun $\rightarrow M_{\odot} = 0 \Rightarrow \boxed{F_g = 0}$

If there is no force the Earth would just follow a straight path along its direction of the velocity

5) **(20 pts)** You kicked a football with a velocity of v_0, which leaves the ground at an angle of θ_0. Find a general expression for the following:



(a) **(5 pts)** time t it takes to reach the maximum height H (*hint*: start with $v_y = v_{0,y} + a_y t$ and solve for t) $v_y = 0, \quad a_y = -g$

$$0 = v_0 \sin\theta_0 - gt \Rightarrow \frac{\cancel{g}t}{\cancel{g}} = \frac{v_0 \sin\theta_0}{g}$$

$$\boxed{t = \frac{v_0 \sin\theta_0}{g}}$$

(b) **(5 pts)** maximum height H reached during flight in terms of v_0, θ_0 and g (*hint*: start with $y = y_0 + v_{0,y}t + (1/2)a_y t^2$, substitute result from part (a), and solve for the height) $v_{0y} = v_0 \sin\theta_0 \quad a_y = -g$

$$H = 0 + v_0 \sin\theta_0 \left(\frac{v_0 \sin\theta_0}{g}\right) - \frac{1}{2} g \left(\frac{v_0 \sin\theta_0}{g}\right)^2$$

$$= \frac{v_0^2 \sin^2\theta_0}{g} - \frac{1}{2}\frac{v_0^2 \sin^2\theta_0}{g} \Rightarrow \boxed{H = \frac{1}{2}\frac{v_0^2 \sin^2\theta_0}{g}}$$

(c) **(5 pts)** total time T it travelled before hitting the ground (*hint:* the time it takes to reach max height is the same time it takes to come back down, hence $T = 2t$; substitute answer for part (a))

$$T = 2t \Rightarrow \boxed{T = \frac{2 v_0 \sin\theta_0}{g}}$$

(d) **(5 pts)** range R it covered before hitting the ground in terms of v_0, θ_0 and g (*hint*: start with $x = x_0 + v_{0,x}t + (1/2)a_x t^2$, and recall that the time corresponding to the range is the total time travelled, T)

$$\underbrace{(x - x_0)}_{R} = v_0 \cos\theta_0 \cdot T + \frac{1}{2} a_x t^2$$

$$= v_0 \cos\theta_0 \cdot \left(\frac{2 v_0 \sin\theta_0}{g}\right) \quad 0 \text{ (no force along } x)$$

$$\Rightarrow \boxed{R = \frac{2 v_0^2 \sin\theta_0 \cos\theta_0}{g}}$$