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)

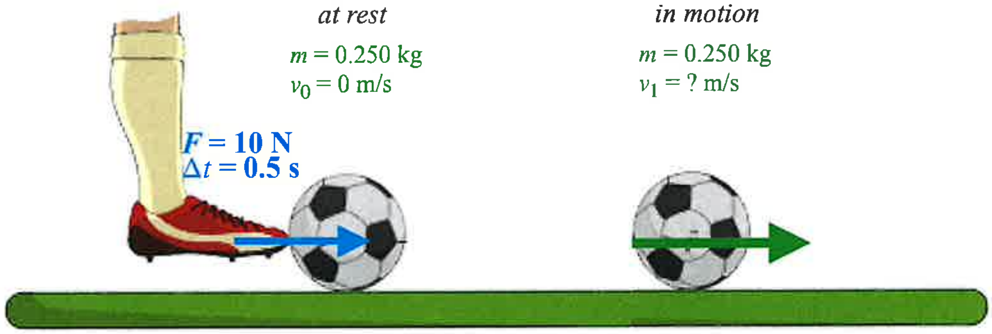
Student Signature: ______________________ Date: Apr 10, 2025

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

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

PHYS 101 **Spring 2025** **EXAM IIB**

1) **(20 pts)** A soccer ball of mass $m = 0.250$ kg initially at *rest* gets kicked with a force of $F = 10$ N for a brief period of time, $\Delta t = 0.5$ sec.



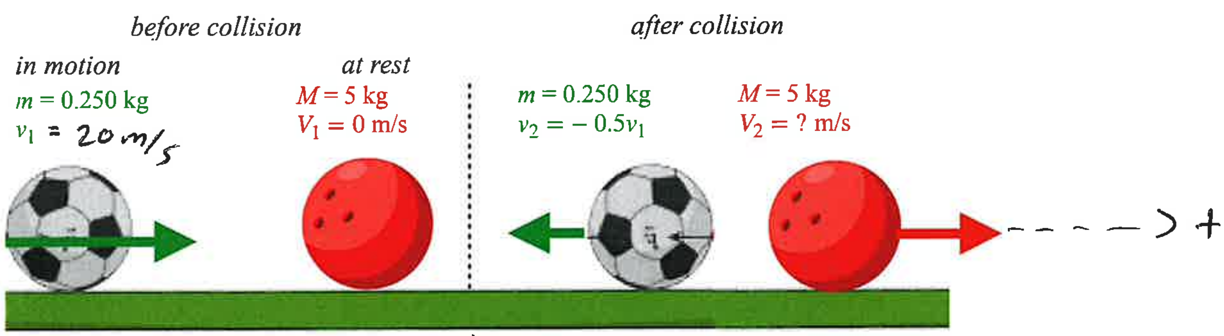
(a) **(5 pts)** calculate the *impulse* of the kick to get the ball from *rest* into *motion* $\text{Impulse} = F\Delta t = (10\ N)(0.5s) \Rightarrow \boxed{I = 5\ N\cdot s}$

(b) **(5 pts)** calculate the final speed v_1 of the ball *in motion*

$$F\Delta t = \Delta(mv) = m\Delta v = m(v_1 - \cancel{v_0})$$

$$\Rightarrow v_1 = \frac{F\Delta t}{m} = \frac{5\ N\cdot s}{0.250\ kg} \Rightarrow \boxed{v_1 = 20\ m/s}$$

(c) **(10 pts)** the soccer ball *in motion* with the speed (v_1) determined in the previous part *collides* with a 5-kg bowling ball at *rest* and after the collision the soccer ball bounces back with half as much speed (choose $+x$ to the right), calculate the final speed (V_2) of the bowling ball as it moves forward



Momentum conservation

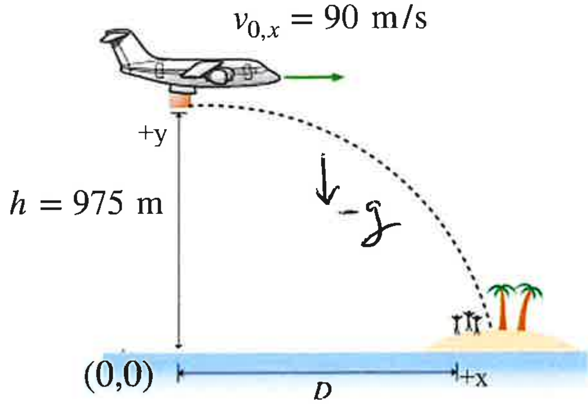
$$P_{before} = mv_1 \quad \Big| \quad P_{after} = mv_2 + MV_2 = -0.5mv_1 + MV_2$$

$$\hookrightarrow P_{before} = P_{after} \Rightarrow mv_1 = -0.5mv_1 + MV_2$$

$$\Rightarrow MV_2 = mv_1 + 0.5mv_1 = 1.5mv_1$$

$$V_2 = 1.5\left(\frac{m}{M}\right)v_1 = 1.5\left(\frac{0.250}{5}\right)(20) \Rightarrow \boxed{V_2 = 1.5\ m/s}$$

2) **(20 pts)** A relief airplane is delivering a food package to a group of people stranded on an island. The island is too small for the plane to land on and it must drop the package at a distance *D* to ensure it lands on the island



$a_x = 0$
$a_y = -g$

(a) **(5 pts)** *how long* (time) does it take the package to hit the ground ?

$y = y_0 + v_{0y} \cdot t + \frac{1}{2} a_y t^2 \rightarrow v_{0y} = 0 \quad a_y = -g \quad y = 0$

$0 = h - \frac{1}{2} g t^2 \rightarrow t^{\cancel{2}} = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2(975 m)}{10 m/s^2}}$

$\Rightarrow \boxed{t = 13.96 s}$

(b) **(5 pts)** calculate the *horizontal distance D* the package needs to cover to land on the island

$x = x_0 + v_{0x} \cdot t + \frac{1}{2} a_x t^2 \quad a_x = 0 \quad x = D \quad x_0 = 0$

$D = 0 + v_{0x} t \xrightarrow{0} D = (90 m/s)(13.96 s)$

$\Rightarrow \boxed{D \cong 1256 m}$

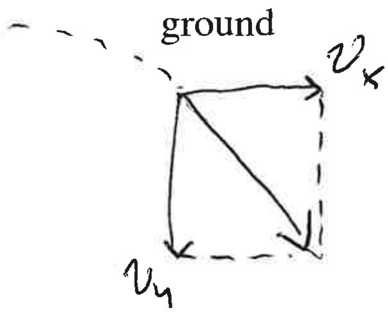
(c) **(5 pts)** calculate the *vertical* and *horizontal* (v_y, v_x) component of the velocity of the package right before it hits the ground

$\boxed{v_x = v_{0x} = 90 m/s}$

$v_y = v_{0y} + a_y t = -gt \rightarrow v_y = (-10)(13.96)$

$\boxed{v_y \cong -140 m/s}$

(d) **(5 pts)** calculate the final speed of the package right before it hits the ground



$v = \sqrt{v_x^2 + v_y^2}$

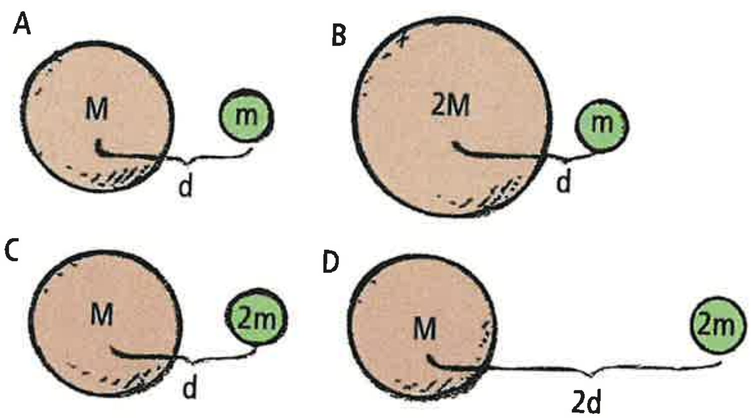
$= \sqrt{(90)^2 + (-140)^2}$

$\boxed{v \approx 166 m/s}$

3) **(10 pts)** A planet and its moon gravitationally attract each other. For each of the figures below:

general formula

$$F_g = G\frac{Mm}{d^2}$$



(a) **(8 pts)** **calculate** the general expression for the force of attraction between each pair

A: $\boxed{F_g = G\frac{Mm}{d^2}}$

B: $\boxed{F_g = 2G\frac{Mm}{d^2}}$

C: $F_g = G\frac{M(2m)}{d^2}$

$\boxed{F_g = 2G\frac{Mm}{d^2}}$

D: $F_g = \frac{G M (2m)}{(2d)^2}$

$= 2G\frac{Mm}{4d^2}$

$\boxed{F_g = \frac{1}{2} G\frac{Mm}{d^2}}$

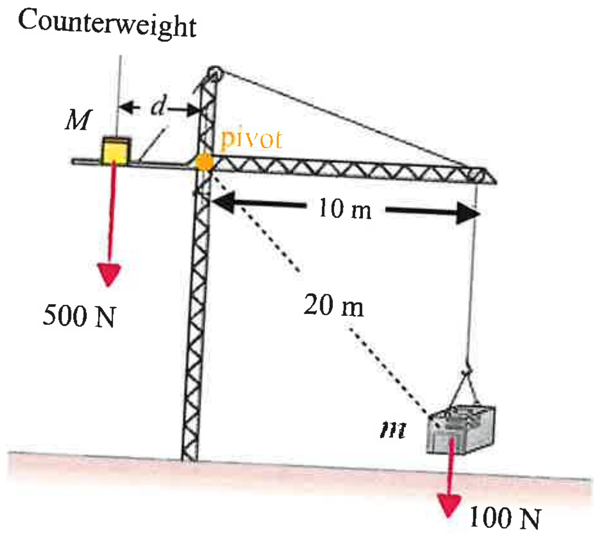
(b) **(2 pts)** **rank** the forces from greater to least

(tie)

B/C ____ A ____ D ____ ____

greatest   least

4) **(15 pts)** A crane lifting an air-conditioning (AC) unit of 100 N must be balanced with a counterweight box of 500 N so that there is no net torque tending to tip it.



(a) **(5 pts)** find a general expression for the torque on the counterweight

$$\boxed{\tau_c = (500\ N) \cdot d}$$

(b) **(5 pts)** calculate the torque on the AC unit

$$\tau_{AC} = (100\ N)(10\ m)$$

$$\boxed{\tau_{AC} = 1000\ N \cdot m}$$

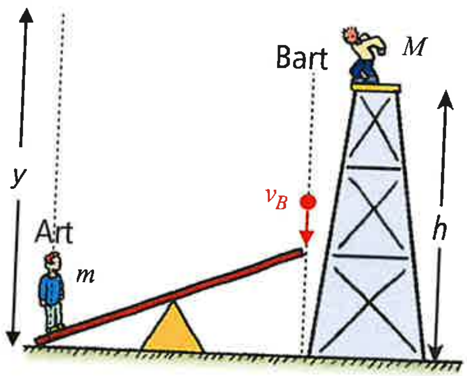
(c) **(5 pts)** at what distance d from the pivot must the counterweight be to balance out the torque from the AC unit

At equilibrium, all torques must balance out

$$\tau_c = \tau_{AC} \rightarrow (500\ N) \cdot d = 1000\ N \cdot m$$

$$d = \frac{1000\ \cancel{N} \cdot m}{500\ \cancel{N}} \Rightarrow \boxed{d = 2\ m}$$

5) **(15 pts)** Art, of mass m stands on the left of a seesaw. Bart, of mass M jumps from a height h onto the right end of the seesaw, thus propelling Art into the air to an arbitrary height, y.



(a) **(5 pts)** write a general expression for (i) the total energy of Bart, E_B, right before he jumps and (ii) the total energy of Art, E_A, once he reaches the highest point y.

(i) $\boxed{E_B = Mgh}$ (ii) $\boxed{E_A = mgy}$

(b) **(5 pts)** show that the general expression for the *speed* of Bart (v_B) *half-way* ($h/2$) from his fall is given by $v_B = \sqrt{gh}$

$$E_B = \frac{Mgh}{2} + \frac{1}{2}Mv_B^2 = Mgh$$

$$\cancel{\tfrac{1}{2}}\cancel{M}v_B^2 = \cancel{\tfrac{1}{2}}\cancel{M}gh \Rightarrow \boxed{v_B = \sqrt{gh}}$$

(c) **(5 pts)** show that the general expression for the maximum height (y) Art can reach in terms of M, m and h is given by $y = \frac{M}{m}h$

Energy conservation: $E_B = E_A$

$$M\cancel{g}h = m\cancel{g}y \Longrightarrow \boxed{y = \frac{M}{m}h}$$