1) (5 points) From Newton's laws of motion what is the most correct definition of the second law?

a) \( \sum \vec{F} = m \vec{a} \)

b) \( \sum \vec{F} = \frac{d \vec{p}}{dt} \)

c) \( \sum \vec{F} = 0 \)

d) \( \sum \vec{F} = m \vec{v} \)

2) You are driving your car around a turn, on level ground, of radius 10m and you have a speed of 20m/s. If the coefficient of friction with the ground is 0.2, do you make the turn?

a) yes

b) no

c) need more information

3) You are a merry-go-round of radius 5m moving with a constant angular speed with a period of 2s. If your mass is 50kg, What force do you need to apply to hold on while it is spinning?

a) 2.42 \( \times 10^2 \) N

b) 5.49 \( \times 10^2 \) N

c) 0.1

d) 2.47 \( \times 10^2 \) N

4) When the space shuttle first lifts off what is the shape of its orbit?

a) parabola

b) dynamic

c) inverted

d) right angles

\( \) none of these

5) Two cars of identical mass turn in a radius of 25m. One uses its tires, and the other is on a frictionless surface with a massless cable attached. Which is larger, the tension in the cable, or the friction on the tires?

a) same

b) friction

c) tension

d) not enough info

6) A starcruiser with a mass of 1.5x10^6 kg flies though deep space at constant velocity of 370m/s. It turns through a half-circle path of radius 20m and comes out with a speed of 250m/s. What is the magnitude of the change in momentum of the starcruiser in 10^8 kgm/s?

a) 0

b) 9.3

c) 1.8

d) 4.8

e) 30

7) You toss a pizza horizontally with an initial speed of 3m/s. You are on a tall building and the pizza is in the air for 5.5 seconds. Neglecting air resistance, how far horizontally does the pizza travel?

a) 4.4m

b) 4.8m

c) 12.5m

d) 16.5m

e) not enough information
8) You are on frictionless ice and push off against your friend who has a mass of 50kg. You have a mass of 60kg and end up going 7.0m/s. What is your friend's final speed in m/s?
   a) 3.2
   b) 6.4
   c) 8.4
   d) 10.2

9) You are driving a truck that weighs 5 tons approaching a bridge with a 5 ton limit. You also have 500lbs of chickens in the back. In order to get across the bridge without destroying it, you decide to get the chickens agitated so they all start flapping their wings. Do you make it across the bridge?
   a) Yes, the chickens flapping their wings makes them apply no weight to the bridge according to Newton's second law
   b) Yes, the chickens are now no longer part of the system of the truck and bridge so you are safe.
   c) No, the chickens weight 500lbs, period, so the bridge collapses
   d) No, the air from the chickens' wings pushes down on the truck with 500lbs of force, so you crash.
   e) No solution possible

10) A fly sits between two blocks resting on a frictionless surface, with mass of block 1 greater than the mass of block 2, m1 > m2. A force is applied to the blocks. The force can be applied to block m1 or block m2, for which of these two cases will the fly stand the greatest chance of surviving?
   a) force applied to m1
   b) force applied to m2
   c) force on fly is same in either case

11) A projectile is fired at an angle of 28 degrees from the horizontal with some initial speed, v. What angle, in degrees, will give the same range of the same initial speed?
   a) 17
   b) 34
   c) 62
   d) 72
   e) 90

12) (5 points) The surface of the Earth is a non-inertial frame. What is the centripetal acceleration at the surface of the Earth in \( \text{m/s}^2 \) if the radius of the Earth 6,000km?
   a) 31.7
   b) 11.7 \( \text{m/s}^2 \)
   c) 5.7
   d) 4.7
   e) 3.7
II. **Written Solution: 30 Points.** Be sure to show all of your work for full credit.

Mass m1 is attached to a cord and moving in a circle of radius r as shown below. Mass m2 sits atop mass m1 as it moves in a circle. There is no friction between the ground and m1, but there is a coefficient of static friction, \( \mu \), between m1 and m2. Assume m2 does not slip.

![Diagram of masses m1 and m2 moving in a circle with friction forces labeled.]

\( \mu = 0 \)

A) Assume the boxes are moving with a constant velocity, draw free body diagrams for the two boxes and system. Label the forces and indicate third law pair forces for full credit.

![Free body diagrams for m1, m2, and the system.]

B) Assuming a constant velocity with a period of rotation t, find the acceleration on block m1 in terms of the variables m1, m2, r, \( \mu \), and g. Note that not all of the variables need be used.

\[
\begin{align*}
\sum F_x &= f_{x1} = m_1 a_c \quad (+3) \\
\sum F_y &= N_{1f} + f_{21} - m_1 g = m_1 a_y \quad (+3) \\
a_c &= \omega^2 r \\
a_c &= \frac{2\pi}{t^2} r \\
a_c &= \frac{(2\pi)^2}{t^2} r \quad (+4)
\end{align*}
\]

Solution: \( a_c = \frac{(2\pi)^2}{t^2} r \)

C) What is the tension in the string in terms of m1, m2, r, \( \mu \), and g? Again, not all variables need be used.

\[
\begin{align*}
\sum F_{1c} &= (m_1 + m_2) a_c = T \quad (+4) \\
T &= (m_1 + m_2) \frac{2\pi^2}{t^2} r \\
T &= \frac{(m_1 + m_2)(2\pi)^2}{t^2} r
\end{align*}
\]

Solution: \( T = \frac{(m_1 + m_2)(2\pi)^2}{t^2} r \)