**Faculty of Engineering and Department of Physics**

**Engineering Physics 131**

**Midterm Examination**

**Saturday February 12, 2022; 14:00 – 15:30**

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1. Closed book exam. No notes or textbooks allowed. Formula sheets are allowed.
2. This is Part 2 of the exam, containing 4 questions and is out of **36 points**. Attempt all questions.
3. *For Questions 2-1, 2-2, 2-3, 2-4, details and procedures to solve these problems will be marked.* Show all work in a neat and logical manner.
4. Write your solution directly on the PDF file downloaded or write on papers and then convert to a **SINGLE PDF file**, and upload to the exam page. Solutions to different questions must be written on different pages, i.e., DO NOT write solutions to different questions on the same page.
5. Write your Name and Student ID on the first page of your PDF file, and name the PDF file using your last name.

LAST NAME: _____

FIRST NAME: _____

ID#: _____

## Please do not write in the table below.

| **Question** | **Value (Points)** | **Mark** |
|---|---|---|
| 2-1 | 9 | |
| 2-2 | 9 | |
| 2-3 | 9 | |
| 2-4 | 9 | |
| **Total** | 36 | |

**2-1. [9 Points]** A flying saucer wishes to fly from A to B, a distance of 2 km. It first accelerates at *0.8 g* (*g = 9.81 m/s*$^2$) and then decelerates at *0.4 g*. Assume that it travels along a straight path directly from A to B, and that it starts and ends at *rest*.

(a) What maximum speed will it reach during the trip?
(b) Determine the travel time from A to B.

**2-2. [9 Points]** Your EN PH professor, a big golf enthusiast, has promised you an A in the course if you can make what he claims is an impossible hole-in-one shot (a hole-in-one means hitting the golf ball into the flag hole in one shot). Unfortunately for you, today the wind is particularly crazy, creating an additional acceleration for the golf ball, *a*, in the direction shown in Figure 2-2.

Given that the launch speed of the ball is $v_0$, the direction of the initial velocity is $\theta = 30^0$, and the gravitational acceleration is $g = 9.81\ m/s^2$,

(i) if the coordinates (*x* and *y*) are defined as shown in Figure 2-2 and the ball is at the origin when t = 0 s, write down the horizontal and vertical coordinates *x* and *y* of the ball as functions of *t* and $v_0$, and

(ii) determine the initial velocity $v_0$ at which the ball must be shot to sink it.

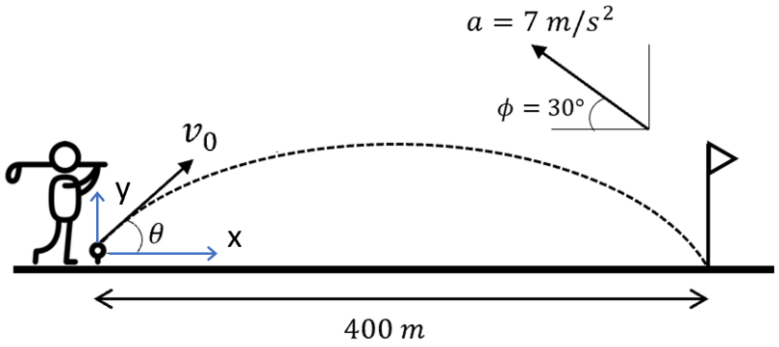


Figure 2-2

**2-3. [9 Points]** A particle moves on a curve path which is shown in Figure 2-3.

The particle's position vector as a function of time *t* is given by:

$$\vec{r}(t) = x(t)\vec{\imath} + y(t)\vec{\jmath} = [-0.31(t^2) + 7.2(t) + 28]\vec{\imath} + [0.22(t^2) - 9.1(t) + 30]\vec{\jmath}$$

with *r* in meters and time *t* in seconds and $\vec{\imath}$ and $\vec{\jmath}$ are the unit vectors in x and y directions.

(a) Find the velocity vector for the particle when t = 15 s in unit-vector notation. Then determine the normal and tangential components of the particle's velocity at that instant.
(b) Find the acceleration vector for the particle when t = 15 s as a magnitude and an angle measured counterclockwise from the positive x axis. Then determine the normal and tangential components of the particle's acceleration at that instant.

*Hint: Find the angle of the acceleration vector measured counterclockwise from the positive n axis to calculate $a_t$ and $a_n$.*

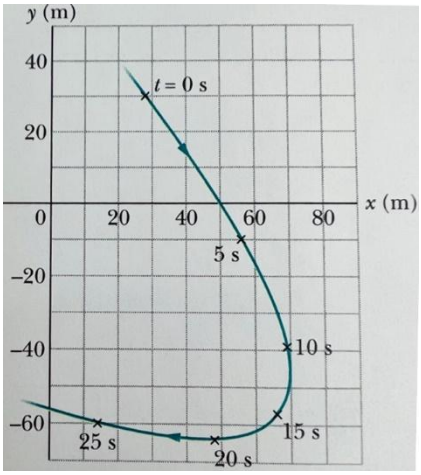

Figure 2-3

**2-4. [9 Points]** Car A is being pulled by truck B. If B is moving to the right with a speed of 6 m/s, and decreasing in speed at a rate of $0.9\ m/s^2$, determine the velocity and acceleration of car A, and the velocity and acceleration of A relative to B.

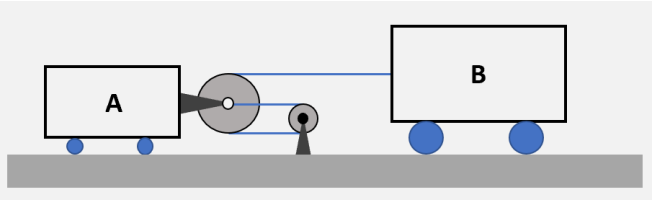


Figure 2-4