**University of Arkansas Rich Mountain**

**Calculus 1**

**Fall 2020**

**Project/ Presentation: Applications of Derivatives**

**Name: (Removed)**

**Instructions:**

1. **a) Give a summary (1 paragraph) on the applications of rates of change in Natural and Social Sciences such as: physics, biology, chemistry, and Economics.**

[ Your summary must have at least one sentence describing an application for each subsection]

Rates of change has many applications in natural and social sciences. In physics, we can apply our knowledge of rates of change to find velocity and acceleration of a moving particle. In chemistry, it can be applied to find the average or instantaneous rate of reaction during a chemical reaction of two or more substances. In Biology, it is applied to find average or instantaneous growth rate of a particular population such as bacteria growth.

**b) Define instantaneous velocity and instantaneous acceleration using the concept of derivatives**

Given a position function, s, the velocity v(t) is the rate of change of displacement with respect to time which is given by the first derivative of the position function.

The instantaneous acceleration is the rate of change of velocity with respect to time. This is obtained by taking the first derivative of your velocity function or taking the second derivative of the position function.

**c) Perform the required research needed to solve the following questions. During our class discussion/Presentation, you will be asked to present on any section.**

**The position of a particle is given by s= $t^3$-6$t^2$+9t**

**i) Find the velocity in terms of t**

V(t) = ds/dt = $3t^2$-12t+9

**ii) Find the velocity after 5 second**

V (5) = 3(25)-12(5) +9

= 24m/s

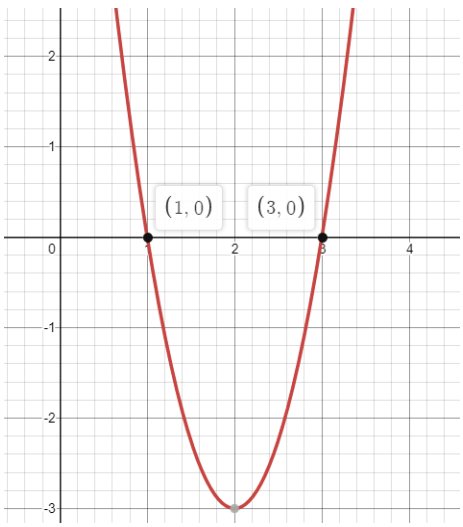
**iii) Determine when the particle is at rest**
**The particle is at rest when v(t)= 0**

$3t^2$-12t+9 =0
3($t$−3)(t-1) =0
$t = 3 \; or \; t = 1$
Therefore, the particle is at rest after 1 second and after 3 seconds

**iv) Determine when the particle is moving forward**

The particle is moving forward when v(t) is >0, that is when the velocity is positive.

$3t^2$-12t+9 >0
3($t$−3)(t-1) >0




V(t) is positive when t< 1 and when t > 3 ( Note that t cannot be less than zero)

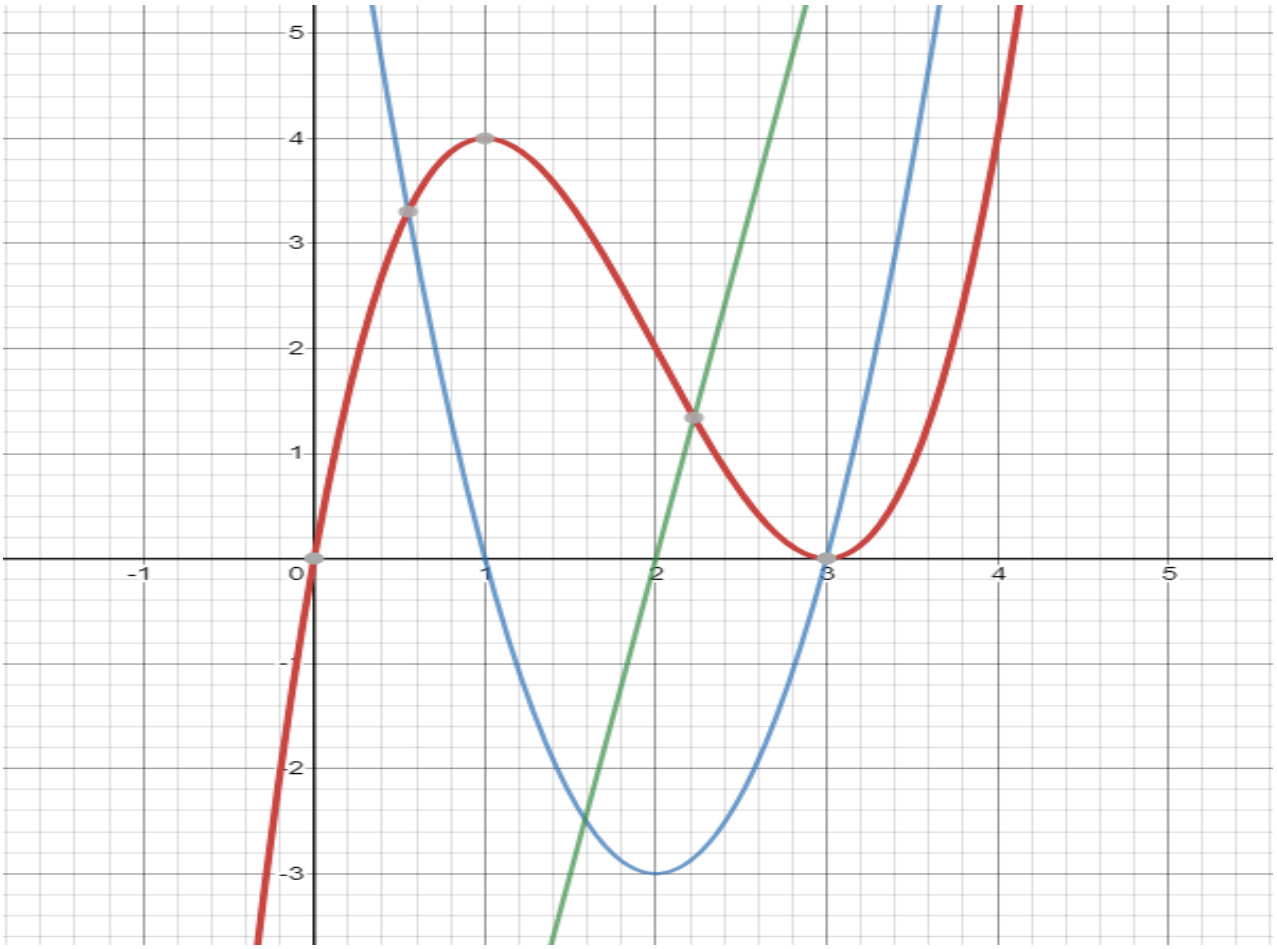
**v) Find the acceleration in terms of t**

a(t) = v'(t) = 6t-12

**vi) Find the acceleration after 3 seconds**

a(6) = 6(3)-12=6 m/$s^2$

**vii) Using your TI-84 Calculators any other suitable form of technology, graph the position, velocity, and acceleration function on the interval [ 0,5]**




**Key:**

Position Function: Red

Velocity Function: Blue

Acceleration function: Green

2. **Give a summary (1 -2sentences) on the applications of rates of change in Social Sciences such as in business/economics**.

   Rate change is also very applicable in the social sciences. In economics it is often used to find marginal values such as marginal cost, marginal revenue, and marginal profit.

**a) Define cost and marginal function**

The cost function is a function that computes the total cost a company incurs in producing x units of a certain item/ product

The marginal cost function is obtained by taking the first derivative of the cost function

**b) Given the cost function C(x) = 2000+ 3x + 0.01$x^2$+0.0002$x^3$**

**i) Find the Marginal Cost Function**

C'(x) = 3 +0.02$x$ + 0.0006$x^2$

**ii) Find C' (100) and explain its significance.**

C' (100) = 3 + 0.02(100) + 0.0006(100) (100)

= $11.

This gives the rate at which the costs are increasing with respect to the production level when x= 100 and predicts the cost of the 101st item.

**Rubric**

| Question Number | Details | Maximum Marks | The Student's Marks |
|---|---|---|---|
| 1a | Summary is concise and accurate | 4 marks | **4** |
| | | | |
| 1b | Terms are defined correctly in terms of derivatives | 2 marks | **2** |
| | | | |
| C (i) | Accuracy | 2 marks | **2** |
| Ii | Accuracy | 1 mark | **1** |
| Iii | Accuracy | 1 mark | **1** |
| Iv | Accuracy | 3 marks | **3** |
| V | Accuracy | 2 marks | **2** |
| Vi | Accuracy | 1 mark | **1** |
| vii | Accuracy | 3 marks | **3** |
| | | | |
| | | | |
| 2a | Terms are defined correctly | 2 marks | **2** |
| b(i) | Accuracy | 2 marks | **2** |
| ii | Students provided the correct answer with the correct meaning given | 3 marks | **3** |
| | | | |
| Presentation | Students present with clarity and respond accurately to questions posed at them. | 5 marks | **5** |
| | | | |
| Reference | Reference page provided | 1 mark | **0** |
| | Total | 32 marks | **30.5/32** |