The remainder of this page has been left blank for your workings.
Very short answer questions

1. 2 marks Each part is worth 1 mark. Please write your answers in the boxes.

(a) Scientists have isolated 16 grams of a strange radioactive element at 12AM. At 4AM only 4 grams of the element is left. What is the half-life of this strange new substance?

Answer:

(b) Consider a function, $h(x)$, whose fourth-degree Taylor polynomial around $x = 1$ is $2016 - 28(x - 1)^2 + 10(x - 1)^4$. What is $h'(1)$?

Answer:
Short answer questions — you must show your work

2. 4 marks Each part is worth 2 marks.

(a) Suppose a particle’s position is given by \( s(t) = \frac{1}{3}t^3 - \frac{3}{2}t^2 + 2t + 2016 \). Over what time interval is the particle moving in the negative direction?

Answer:

(b) Estimate \( \tan^2(0.01) + 0.01 \) using a linear approximation.

Answer:
Long answer question — you must show your work

3. [4 marks] You place a cone-shaped bottle on the table. It is 6cm high. Its circular base (which is resting on the table) has radius 3cm and its volume is $18\pi cm^3$. You fill it with water at rate of $1cm^3$ per second. What is the rate at which the depth of the water changes when it is 3cm deep?

**HINT:** Think about the shape of the air in bottle.
Very short answer questions

1. 2 marks Each part is worth 1 mark. Please write your answers in the boxes.
   (a) Scientists have isolated 12 grams of a strange radioactive element at 1PM. At 7PM only 3 grams of the element is left. What is the half-life of this strange new substance?

   Answer:

   (b) Consider a function, \( h(x) \), whose third-degree Maclaurin polynomial is \( 5 - x - 3x^2 + 4x^3 \). What is \( h''(0) \)?

   Answer:
Short answer questions — you must show your work

2. 4 marks Each part is worth 2 marks.
   (a) Suppose a particle’s position is given by $s(t) = 2t^3 - 9t^2 + 12t$. Over what time interval is the particle moving in the positive direction?

   Answer:

   (b) Estimate $\arctan(1.1)$ using a linear approximation. Leave your answer in terms of $\pi$.

   Answer:
Long answer question — you must show your work

3. \[4 \text{ marks}\] You place a cone-shaped bottle on the table. It is 12cm high and its circular base (which is resting on the table) has radius 4cm and its volume is \(64\pi \text{ cm}^3\). You fill it with water a rate of \(3\text{ cm}^3\) per second. What is the rate at which the depth of the water changes when it is 5cm deep?

**HINT:** Think about the shape of the air in bottle.

Name: 
Student-No: 

Quiz 4.5: Page 4 of 4
First Name: ____________________________ Last Name: ____________________________

Student-No: ____________________________ Section: ____________________________

Grade:

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Very short answer questions

1. **2 marks** Each part is worth 1 mark. Please write your answers in the boxes.

   (a) Scientists have isolated 12 grams of a strange radioactive element at 2PM. At 10PM only 3 grams of the element is left. What is the half-life of this strange new substance?

   Answer:

   (b) Consider a function, \( h(x) \), whose third-degree Maclaurin polynomial is \( x - \frac{3}{2}x^2 + \frac{5}{3}x^3 \). What is \( h''(0) \)?

   Answer:
Short answer questions — you must show your work

2. [4 marks] Each part is worth 2 marks.

(a) Suppose a particle’s position is given by $s(t) = t^3 - 9t^2 + 15t$. Over what time interval is the particle moving in the negative direction?

Answer:

(b) Estimate $\cot \left( \frac{\pi}{4} + \frac{1}{20} \right)$ using a linear approximation.

Answer:
Long answer question — you must show your work

3. [4 marks] You place a cone-shaped bottle on the table. It is 20cm high and its circular base (which is resting on the table) has radius 5cm and its volume is \( \frac{500}{3} \pi \text{cm}^3 \). You fill it with water a rate of \( 4 \text{cm}^3 \) per second. What is the rate at which the depth of the water changes when it is 4cm deep?

**HINT:** Think about the shape of the air in bottle.