Student: Jonathan Yee **Submitted:** 01/18/16 2:04pm	**Instructor:** Yousry Elsabrouty **Course:** MATH 277 All Lectures - Winter 2016 **Book:** Adams/Essex: Calculus: A Complete Course, Eighth Edition	**Assignment:** Assignment 1

1. The position of a moving particle in space is vgiven by

$$\vec{r}(t) = (91 - 2t)\,\vec{i} + (243t^3 - 15458)\,\vec{j} + (27t^2 + 42)\,\vec{k}\ ,\ t \geq 0.$$

(i) Determine position , velocity , acceleration and speed of the particle at $t = 3$.

(ii) Find the vector equation of the straight line tangent to the curve at the point

$Q(83,94,474)$.

(i) $\vec{r}(3) = (\ 85\ ,\ -8897\ ,\ 285\ )$ $\vec{v}(3) = (\ -2\ ,\ 6561\ ,\ 162\ )$

$\vec{a}(3) = (\ 0\ ,\ 4374\ ,\ 54\ )$ $\text{Speed} = \|\vec{v}(3)\| =\ 6563$

(ii) Equation of the tangent line $\vec{r}(s) = (83,94,474) + (\ -2\ ,\ 11664\ ,\ 216\ )\,s\ ,\ s \in \mathbf{R}$

YOU ANSWERED: nothing
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2. Find the arc lengh of the space parametric curve given by the vector equation :

$\overrightarrow{r(t)} = (6\,t^2 + 14\,,\ 6\,t^4 - 9\,,\ 4\,t^6)\,,\quad 0 \le t \le 1$

Arc Length = 10

YOU ANSWERED: nothing

3. The acceleration of a moving praticle in three space is given by :

$\mathbf{a}(t) = -5t\,\mathbf{i} - 3t\,\mathbf{j} - t\,\mathbf{k}\,,\quad t > 0$

Find an expression for the velocity of the particle at time t given that its initial velocity is given by $\mathbf{v}(0) = 6\mathbf{i} + 9\mathbf{j} + 3\mathbf{k}$

$\mathbf{v}(t) = \left(-\frac{5}{2}t^2 + 6\right)\mathbf{i} + \left(-\frac{3}{2}t^2 + 9\right)\mathbf{j} + \left(-\frac{1}{2}t^2 + 3\right)\mathbf{k}$

YOU ANSWERED: nothing
nothing
nothing

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4. Find the vector parametric equations of the two straight lines tangent to the given space curve and which pass through the point $P(-49,-24,-135)$ (not on the curve).

$$\mathbf{r}(t) = (2t^2-1)\mathbf{i} + (18t-6)\mathbf{j} + (6t^2+9)\mathbf{k}$$

Let s_1 be a real number parameter. Give the parameterized vector equation

of the first tangent line.

$\mathbf{r}(s_1) = \langle -49,-24,-135\rangle + s_1\langle 16, 18, 48\rangle$

(Type integers or simplified fractions.)

Let s_2 be a real number parameter. Give the parameterized vector equation

of the second tangent line.

$\mathbf{r}(s_2) = \langle 71, -114, 225\rangle + s_2\langle -24, 18, -72\rangle$

(Type integers or simplified fractions.)

YOU ANSWERED: nothing

nothing

nothing

nothing

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nothing

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5. A particle moves at constant speed 171 units along the curve of intersection of the two the two surfaces $y = x^2$ and $z = \frac{2}{3}x^3$ in the direction of increasing x.
Find its velocity when it is at the point $(-3, 9, -18)$.

A the point $(-3, 9, -18)$, the velocity vector is

$\mathbf{v} = 9\,\mathbf{i} + -54\,\mathbf{j} + 162\,\mathbf{k}$.

YOU ANSWERED: nothing
nothing
nothing

6. The position of a particle in space is given by the following vector equation.

$$\mathbf{r}(t) = (t-10)^2\mathbf{i} + \frac{4}{3}\sqrt{13}\,(t-10)^{\frac{3}{2}}\mathbf{j} + 13\sqrt{6}\,(t+34)\mathbf{k}$$

Determine when the speed of the particle will be 39.

The speed of the particle will be 39 at time $t = \frac{33}{2}$.

(Type an integer or a simplified fraction.)

YOU ANSWERED: nothing

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7. Find **T**, **N**, and κ for the space curve $\mathbf{r}(t) = (9 \sin t)\,\mathbf{i} + (9 \cos t)\,\mathbf{j} + 12t\,\mathbf{k}$.

$\mathbf{T}(t) = \left(\frac{3}{5}\cos t\right)\mathbf{i} + \left(-\frac{3}{5}\sin t\right)\mathbf{j} + \left(\frac{4}{5}\right)\mathbf{k}$

$\mathbf{N}(t) = (-\sin t)\,\mathbf{i} + (-\cos t)\,\mathbf{j} + (0)\,\mathbf{k}$

$\kappa(t) = \frac{1}{25}$ (Simplify your answer.)

YOU ANSWERED: nothing

nothing

nothing

nothing

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nothing

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8. Find **B** and τ for the space curve $\mathbf{r}(t) = (4\cos t)\,\mathbf{i} + (4\sin t)\,\mathbf{j} + (3t)\,\mathbf{k}$ given that :

$$\mathbf{T} = \left(-\frac{4}{5}\sin t\right)\mathbf{i} + \left(\frac{4}{5}\cos t\right)\mathbf{j} + \left(\frac{3}{5}\right)\mathbf{k}$$

$$\mathbf{N} = (-\cos t)\,\mathbf{i} + (-\sin t)\,\mathbf{j}$$

What is the binormal vector?

$$\mathbf{B} = \left(\frac{3}{5}\sin t\right)\mathbf{i} + \left(-\frac{3}{5}\cos t\right)\mathbf{j} + \left(\frac{4}{5}\right)\mathbf{k}$$

What is the torsion?

$$\tau = \frac{3}{25}$$

(Type an integer or a simplified fraction.)

YOU ANSWERED: nothing

nothing

nothing

nothing

9. Write **a** in the form $\mathbf{a} = a_T\mathbf{T} + a_N\mathbf{N}$ at the given value of t without finding **T** and **N.**

$\mathbf{r}(t) = (3t+2)\mathbf{i} + (2t)\mathbf{j} + (-t^2)\mathbf{k}, \quad t = 3$

$$a = \left(\frac{12}{7}\right)\mathbf{T} + \left(\frac{2\sqrt{13}}{7}\right)\mathbf{N}$$

(Type exact answers, using radicals as needed.)

YOU ANSWERED: nothing

nothing

10. Find the radius of curvature of the curve $\mathbf{r} = -t^3\mathbf{i} - t^2\mathbf{j} + 2t\mathbf{k}$ at the point where t = 1.

The radius of curvature of the curve $\mathbf{r} = -t^3\mathbf{i} - t^2\mathbf{j} + 2t\mathbf{k}$ at the point where t = 1 is $\frac{17\sqrt{17}}{14}$.

(Type an exact answer.)

YOU ANSWERED: nothing