### 251 day 7

**September 16, 2014**

#### Click a question to preview it. Expand a question to view student scores.

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<thead>
<tr>
<th>Questions</th>
<th>First assignment attempt</th>
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<th>Best assignment attempt</th>
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<td>Example 5 - 11.1 Example 5</td>
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<td>Sec. Ex. 37 - Parametric Graphs</td>
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</table>
Select the correct answer for $t$ such that $r(t)$ and $r'(t)$ are perpendicular.

$r(t) = \langle 6 \cos t, 2 \sin t \rangle$

$r'(t) = \langle -6 \sin t, 2 \cos t \rangle$

$r \cdot r' = -36 \sin t \cos t + 4 \sin t \cos t = 0$

$\sin t \cos t = 0$

$\sin t = 0 \quad \cos t = 0$

$t = \frac{\pi}{2}, \eta = t$
Choose the sketch of the curve and estimate its arc length.

\[ r(t) = (t, t^2 - 1, t^3), \quad 0 \leq t \leq 2 \]

\[ \int_{t=0}^{2} \sqrt{(x')^2 + (y')^2 + (z')^2} \, dt \]

\[ \int_{t=0}^{2} \sqrt{1 + (2t)^2 + (3t^2)^2} \, dt \]
Problem? Adjust speed for all students

9. 10:00 points

$r(t) = (t, t^2 - 1, t^3)$, $0 \leq t \leq 2$

\[
\begin{align*}
x &= t \\
y &= x^2 - 1 \\
z &= x^3
\end{align*}
\]
Position $\vec{r}(t)$
Velocity $\vec{v}(t) = \vec{\dot{r}}(t)$
Acceleration $\vec{a}(t) = \vec{\ddot{r}}(t)$
Speed $= |\vec{v}(t)|$
Find the position function from the given velocity function.

\[ v(t) = \langle 6t, -12t + 8 \rangle, \quad r(0) = \langle 2, 2 \rangle \]

\[ r(t) = \langle 6t^2 + 4, -6t^2 + 9t + 2 \rangle \]

\[ r(0) = \langle 6(0)^2 + 4, -6(0)^2 + 9(0) + 2 \rangle = \langle 2, 2 \rangle \]

\[ r(t) = \langle 6t^2 + 4, -6t^2 + 9t + 2 \rangle \]
<table>
<thead>
<tr>
<th>Library Practice</th>
<th>Description</th>
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<tbody>
<tr>
<td>Medical Practitioners</td>
<td>These updates supplement Mercer County's printed edition.</td>
</tr>
<tr>
<td>Kansas City Community College's premier author subject index to English language journals within the field of Mortuary Science. If you require articles from this database please fill out an inter-library loan form located here.</td>
<td></td>
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**General**

<table>
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<tr>
<th>Database</th>
<th>Description</th>
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<tbody>
<tr>
<td>Academic Search Overview (by Course)</td>
<td>Provides full text for nearly 4,000 scholarly publications, including full text for more than 3,100 peer-reviewed journals. Coverage spans virtually every area of academic study and offers information dating as far back as 1975.</td>
</tr>
<tr>
<td>Esco Host (full databases)</td>
<td>Use the link to the left to search multiple databases available from Ebsco Host.</td>
</tr>
<tr>
<td>JSTOR</td>
<td>JSTOR's Arts &amp; Sciences Collection includes the complete back runs of 115 titles in fifteen disciplines. Established in 1997, it is JSTOR's first collection and includes many of the core research and society published journals in economics, history, political science, and sociology, as well as in other key fields in the humanities and social sciences. This collection also includes a selection of titles in the more science-oriented fields of ecology, mathematics, and statistics.</td>
</tr>
<tr>
<td>ProQuest Central</td>
<td>Provides access to over 9,700 full text titles. Access is provided to numerous scholarly journals, newspapers, and other periodical resources. The database covers virtually all areas of academic scholarship and includes industry reports, company profiles, and dissertations.</td>
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**Health Sciences**

<table>
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<tr>
<td>CINAHL - Complete</td>
<td>Provides indexing and abstracting with some full-text articles for over 1,500 current nursing and allied health journals and publications dating back to 1937, totaling over 3.7 million records. This is an authoritative resource for nursing and allied health professionals, students, educators, and researchers.</td>
</tr>
<tr>
<td>Journal of Psychosocial Nursing</td>
<td>The Journal of Psychosocial Nursing provides the most up-to-date, practical information available for today's psychosocial nurse, including short contributions about psychopathology, case studies with treatment how-tos, mental health care of older adults, and childhood/adolescent disorders and issues.</td>
</tr>
<tr>
<td>Nursing and Allied Health Source</td>
<td>Find complete, full-text information from leading nursing, allied health, and related publications. Designed to meet the needs of researchers at health-care facilities as well as students enrolled in nursing and allied health programs at academic institutions.</td>
</tr>
<tr>
<td>ProQuest Health</td>
<td>ProQuest Health Management is designed to meet the needs of researchers studying the field of health administration. This high-demand healthcare management content provides the in-depth, unbiased, and relevant information on a wide range of topics, including hospitals, various, law, statistics, business management, personnel management, ethics, health, and other public policy issues.</td>
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</tbody>
</table>
Find
\( \vec{v}(t) \) and units
\( \vec{a}(t) \) and units
and
average speed as archlenth/time
Find the curvature of the parabola \( y = 11x^2 + 23x + 3 \). Also, find the limiting value of the curvature as \( x \to \infty \).

Taking \( f(x) = 11x^2 + 23x + 3 \), we have that \( f'(x) = 22x + 23 \) and \( f''(x) = 22 \).

Now we have \( \kappa = \frac{|22|}{\left[ 1 + (22x + 23)^2 \right]^{3/2}} \).

Taking the limit as \( x \to \infty \), we have

\[
\lim_{x \to \infty} \kappa = \lim_{x \to \infty} \frac{|22|}{\left[ 1 + (22x + 23)^2 \right]^{3/2}} = 0.
\]

In other words, as \( x \to \infty \), the parabola straightens out. You’ve certainly observed this in the graphs of parabolas for some time. Now, we have verified that this is not some sort of optical illusion; it’s reality. It is a straightforward exercise to show that the maximum curvature occurs at the vertex of the parabola \( \left( x = -\frac{23}{22} \right) \).
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\[
\begin{align*}
& x = 1250 \text{ cm} \\
& y = 1250 \text{ cm}
\end{align*}
\]

\[
\begin{align*}
& x = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix} \\
& y = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix}
\end{align*}
\]

\[
\begin{align*}
& \vec{xy} = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix}
\end{align*}
\]

\[
\begin{align*}
& 2500 \text{ cm} = 748.5 \text{ m} \\
& \Rightarrow t = 53.7 \text{ s} \quad (\text{for one loop})
\end{align*}
\]

\[
\begin{align*}
& S = \sum_{i=0}^{n} \cos \left( \theta_i \right) \\
& (\theta_1, \theta_2) = (-80^\circ, 90^\circ, 15^\circ)
\end{align*}
\]

\[
\begin{align*}
& V = \frac{d}{dt} = 93.34 \text{ m/s}
\end{align*}
\]

\[
\begin{align*}
& \vec{S} = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix}
\end{align*}
\]

\[
\begin{align*}
& \vec{S}_2 = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix}
\end{align*}
\]

\[
\begin{align*}
& \vec{S}_3 = \begin{pmatrix} 1250 \text{ cm}, & 1500 \text{ cm}, & 1062 \text{ cm} \end{pmatrix}
\end{align*}
\]

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Supporting Work:
\[ \begin{align*}
  x &= 300 \cos t \\
  y &= 300 \sin t \\
  z &= \frac{t}{2} \\
  r(t) &= (300 \cos t, 300 \sin t, \frac{t}{2}) \\
  \dot{r}(t) &= (\dot{x}, \dot{y}, \dot{z}) = (-300 \sin t, 300 \cos t, 1) \\
  \ddot{r}(t) &= (\ddot{x}, \ddot{y}, \ddot{z}) = (-300 \cos t, -300 \sin t, 0) \\
\end{align*} \]

\[ \begin{align*}
  L &= \int_0^T \sqrt{300^2 \cos^2 t + 300^2 \sin^2 t + \left(\frac{t}{2}\right)^2} \, dt \\
  &= \int_0^T \sqrt{300^2 \left(\cos^2 t + \sin^2 t\right) + \frac{t^2}{4}} \, dt \\
  &= \int_0^T \sqrt{300^2 \cdot 1 + \frac{t^2}{4}} \, dt \\
  &= \int_0^T \sqrt{90000 + \frac{t^2}{4}} \, dt \\
  &= \left[ \frac{1}{2} \left(90000 \sqrt{90000 + \frac{t^2}{4}} + \frac{1}{2} t \sqrt{90000 + \frac{t^2}{4}} + 15000 \right) \right]_0^T \\
  &= \left[ \frac{1}{2} \left(90000 \sqrt{90000 + \frac{T^2}{4}} + \frac{1}{2} T \sqrt{90000 + \frac{T^2}{4}} + 15000 \right) \right]_0^T \\
  &= 18853.046 \\
\end{align*} \]
Average Speed = 1.047 m/s

Supporting work:

Arc length: \( \int_{0}^{2\pi} \sqrt{(100 \cos(t))^2 + (100 \sin(t))^2} \, dt \)

\[ = \int_{0}^{2\pi} \sqrt{100^2 \cos^2(t) + 100^2 \sin^2(t)} \, dt \]

\[ = \int_{0}^{2\pi} 100 \, dt \]

\[ = 200 \pi \approx 628.32 \text{ m} \]

\( \mathbf{r}'(t) = \langle -100 \sin(t), 100 \cos(t), \frac{\pi}{t} \rangle \)

Velocity: \( \mathbf{v}(t) = \mathbf{r}'(t) \)

\[ = \langle -100 \sin(t), 100 \cos(t), \frac{\pi}{t} \rangle \]

\( \mathbf{a}(t) = \frac{d}{dt} \mathbf{v}(t) \)

\[ = \langle -100 \cos(t), -100 \sin(t), 0 \rangle \]

Acceleration: \( \mathbf{a}(t) = \langle -100 \cos(t), -100 \sin(t), 0 \rangle \)

Average Speed = \( \frac{628.32 \text{ m}}{600 \text{ min}} = 1.047 \text{ m/s} \)
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Supporting work:

Solving for:

\[ \begin{align*}
\mathbf{f}(a) &= \left( 10 \cos t, 10 \sin t, \frac{10t}{\pi} \right) \\
\mathbf{f}'(t) &= \left( -10 \sin t, 10 \cos t, \frac{10}{\pi} \right) \\
\mathbf{f}''(t) &= \left( -10 \cos t, -10 \sin t, 0 \right)
\end{align*} \]

8. Assume 12 m/min. Area LENGTH: Rev. 1 face:

\[ \frac{1}{2} \left( 10 \cos t \right)^2 + \left( 10 \sin t \right)^2 + \left( \frac{10t}{\pi} \right)^2 \]

\[ \int_0^{2\pi} \left( 10 \sin t \right)^2 + \left( 10 \cos t \right)^2 + \frac{100t^2}{\pi^2} \, dt = \frac{100\pi + 200\pi}{\pi^2} \]

8. RC face: \( e = \langle 0, 10, 10 \rangle \) = 10.12 m/min
Supporting work:

\[ t = 2x \]

\[ t(x) = y(x) = \frac{v(x)}{\sqrt{1 - \frac{v^2}{c^2}}} \]

\[ c = \frac{\mu}{\beta} \]

\[ \beta(x) = \frac{\mu}{\beta} \]

\[ \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \]

\[ \int_0^\infty \frac{1}{\sqrt{x(x+1)}} \, dx = 0.256 \text{ Jy} \]
A stationary merry-go-round of radius 9 feet is started in motion by a push consisting of a force of 18 pounds on the outside edge, tangent to the circular edge of the merry-go-round, for 1 second. The moment of inertia of the merry-go-round is \( I = 81 \). Find the resulting angular velocity of the merry-go-round.

We first compute the torque of the push. The force is applied 9 feet from the center of rotation, so that the torque has magnitude

\[
\tau = (\text{Force})(\text{Distance from axis of rotation}) = (18)(9) = 162 \text{ foot-pounds}.
\]

From \( \tau = Io \) we have

\[
162 = 81a, \quad \text{so that } a = 2.
\]

Since the force is applied for one second, this equation holds for \( 0 \leq t \leq 1 \). Integrating both sides of the equation \( \omega' = a \) from \( t = 0 \) to \( t = 1 \),

we have by the Fundamental Theorem of Calculus that

\[
\omega(1) - \omega(0) = \int_{0}^{1} a \, dt = \int_{0}^{1} 2 \, dt = 2.
\]

If the merry-go-round is initially stationary, then \( \omega(0) = 0 \) and \( \omega(1) = 2 \text{ rad/s} \).
A force of 24 pounds is applied to the outside of a stationary merry-go-round of radius 3.9 feet for 0.5 second. The moment of inertia is $I = 11$. Find the resultant change in angular velocity of the merry-go-round.

The torque has magnitude

$$\tau = (24)(3.0) = 91.6 \text{ foot-pounds}$$

Since $\tau = I\alpha$, we get

$$\alpha = 8.509 \text{ rad/s} \text{ for } 0 \leq t \leq 0.5.$$ 

So the change in angular velocity is given by

$$\Delta \omega = \int_{0}^{0.5} \alpha \, dt = 0.5 \int_{0}^{0.5} 8.509 \, dt = 4.2545 \text{ rad/s}$$
If the angular velocity increases from 0 to 11.5 rad/s, find $\omega$.

Since

$$\theta(t) = \frac{\omega t^2}{2}$$

we know that $\theta = 0$ and $\theta = \pi$ correspond to $t = 0$ and $t = \sqrt{\frac{2\theta}{\omega}}$, respectively.

The change in angular velocity is then

$$\int_{0}^{(2\pi)^{1/2}} \omega \, dt = 11.5$$

$$\omega \sqrt{\frac{2\pi}{a}} = 11.5$$

Therefore

$$\omega = 21.02 \text{ rad/s}^2$$
For a satellite in earth orbit, the speed $v$ in miles per second is related to the height $h$ miles above the surface of the earth by
$$v = \sqrt{\frac{95,600}{4000 + h}}$$.

Suppose a satellite is in orbit 7500 miles above the surface of the earth. How much does the speed need to decrease to raise the orbit to a height of 13600 miles?

A satellite 7500 mi above the Earth's surface travels at a velocity of
$$v_1 = \frac{95600}{4000 + 7500} = 2.883 \text{ mi/s}$$
Round to three decimal places, if needed.

A satellite 13600 mi above the Earth's surface travels at a velocity of
$$v_2 = \frac{95600}{4000 + 13600} = 2.331 \text{ mi/s}$$
Round to three decimal places, if needed.

Therefore, the velocity must decrease by
$$\Delta v = 0.552 \text{ mi/s}$$
for the height of the orbit to increase from 7500 mi to 13600 mi.