KIT - International Department GmbH

Pre-Semester Physics - Exercises Summer 2010

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Sheet 1
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1. Exercise:

Differentiate the following functions with respect to the arguments two times and sketch the following functions:

(a) $f(x) = -\frac{1}{2}x^2 + \frac{3}{2}x + \frac{1}{4}$

(b) $g(y) = 1 - \mathrm{e}^{-3y}$

(c) $h(z) = \sin(2z)$

(d) $j(z) = 2\sin(z)\cos(z)$

(e) $k(t) = \mathrm{e}^{-t/4}\cos(2t)$

2. Exercise:

With $\vec{u}_x = \begin{pmatrix}1\\0\\0\end{pmatrix}$, $\vec{u}_y = \begin{pmatrix}0\\1\\0\end{pmatrix}$ and $\vec{u}_z = \begin{pmatrix}0\\0\\1\end{pmatrix}$ calculate

(a) $\vec{v}_{xy} = \vec{u}_x + \vec{u}_y$ and $\vec{v}_{xz} = \vec{u}_x + \vec{u}_z$,

(b) $|\vec{v}_{xy}|$ and $\vec{u}_{xy} = \frac{\vec{v}_{xy}}{|\vec{v}_{xy}|}$,

(c) $\vec{u}_x \cdot \vec{u}_y$ and $\vec{v}_{xy} \cdot \vec{v}_{xz}$,

(d) the angle $\phi_{x,xy}$ between $\vec{u}_x$ and $\vec{u}_{xy}$,

(e) $\vec{u}_x \times \vec{u}_y$, $\vec{u}_y \times \vec{u}_z$ and $\vec{u}_x \times \vec{u}_z$,

(f) $\vec{u}_x \times \vec{v}_{xy}$ and $\vec{u}_z \times \vec{v}_{xy}$,

(g) the representation of $\vec{v}_{xy}$, $\vec{u}_{xy}$, $\vec{v}_{xz}$, $\vec{u}_z \times \vec{v}_{xy}$ in a polar coordinate system where the first two Cartesian components are replaced by polar ones.

3. Exercise:

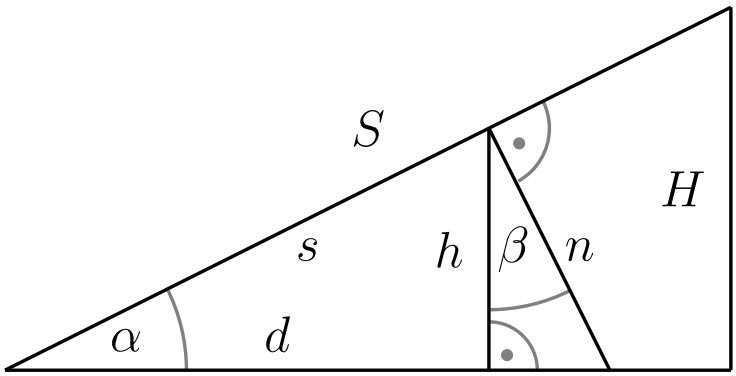
Sketch the following paths $\vec{r}(t) : [0, \pi] \to \mathbb{R}^2$:

(a) $\vec{r}(t) = \begin{pmatrix}t/\pi\\t/\pi\end{pmatrix}$

(b) $\vec{r}(t) = \begin{pmatrix}t/\pi\\(-t^2+t)/\pi\end{pmatrix}$

(c) $\vec{r}(t) = \begin{pmatrix}\cos(t)\\\sin(t)\end{pmatrix}$

4. Exercise:



Determine in the figure above

(a) $H(S, s, h)$,

(b) $H(S, \alpha)$,

(c) $h(d, \alpha)$,

(d) $\beta(\alpha)$,

(e) $d(s, \beta)$,

(f) $n(h, \alpha)$.

5. Exercise:

State the following numbers with a more convenient SI-prefix and in scientific notation:

(a) $0.032\,\mathrm{m}$

(b) $2000\,\mathrm{m}$

(c) $1000000\,\mathrm{m}^2$

6. Exercise:

An engineer is asked to build a pipe. The instructor told him that the circumference used for the winding is 9 cm long. After a short consideration he decides to take a slip of 1 mm and build a pipe with a diameter (including the other winding) of 2.8 cm. However, when the final machine is put together the pipe does not fit. What has he done wrong?

7. Exercise:

A pizza for two persons has a certain diameter d. What diameter is needed, if four persons want to share the pizza (and get the same size as before)?

Exercises and solutions on the web:
www.tkm.uni-karlsruhe.de/∼kremer/ph10.html