1. Übungsblatt zur Vorlesung Theoretische Physik I (Mechanik)

Abgabe: Mittwoch, 30.Oktober 2002 in den Übungen.

Aufgabe A1: (6 Punkte)
Ein eindimensionaler Oszillator schwinge ungedämpft mit der Eigenfrequenz ω_0 und werde durch eine äußere periodische Kraft $F_A(t) = f_0 \cos(\Omega t)$ getrieben. Das System wird dann durch die Differentialgleichung (DGL)

$$\ddot{x} + \omega_0^2 x = f_0 \cos(\Omega t)$$

beschrieben.

a) Berechnen Sie mit Hilfe des Ansatzes $x_p(t) = C\cos(\Omega t)$ eine partikuläre Lösung dieser DGL.

b) Im Resonanzfall $\Omega = \omega_0$ versagt die in Aufgabenteil a) gefunde partikuläre Lösung. Berechnen Sie für diesen Fall eine partikuläre Lösung mittels der Methode der Variation der Konstanten.

c) Wie hängen die Lösungen aus a) und b) zusammen ? Warum funktioniert der Grenzübergang $\Omega \to \omega_0$ bei x_p aus Teil a) nicht ?

Tipp: Man kann natürlich nur Bewegungen vergleichen, die dasselbe Anfangswertproblem lösen, z.B. $x(0) = \dot{x}(0) = 0$

Aufgabe A2: *Eindimensionale Bewegung, Reibungswiderstand* (5 Punkte)
Der Reibungswiderstand, den das Wasser einem fahrenden Schiff entgegenstellt, sei

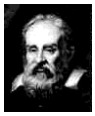
$$F_R = -m\,\alpha\,v - m\,\beta\,v^2\frac{v}{|v|} \qquad \text{für } |v| \geq u$$
$$F_R = -m\,\alpha\,v - m\,\beta\,u^2\frac{v}{|v|} \qquad \text{für } |v| \leq u$$

mit den Konstanten $\alpha, \beta > 0$ und $u = \frac{\alpha}{\beta}$. Dabei ist m die Masse und v die Geschwindigkeit des Schiffes. Wie lange benötigt ein Schiff, das bei $v_0 = 3u$ den Motor abstellt, bis es zur Ruhe kommt. Welchen Weg legt dieses Schiff von dem Moment, in dem der Motor abgestellt wurde, bis zum Stillstand zurück ?

Aufgabe A3: (4 Punkte)
Eine Perle bewege sich mit betragsmäßig konstanter Geschwindigkeit v längs einer Spirale mit Radius R und Ganghöhe h. Es sei $\vec{r}(t=0) = (R, 0, 0)$. Bestimmen Sie $\vec{v}(t)$ und $\vec{r}(t)$.

Galileo Galilei

Born: 15 Feb 1564 in Pisa (now in Italy)
Died: 8 Jan 1642 in Arcetri (near Florence) (now in Italy)



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Galileo Galilei's father, Vincenzo Galilei (c.1520 - 1591), who described himself as a nobleman of Florence, was a professional musician. He carried out experiments on strings to support his musical theories. Galileo studied medicine at the university of Pisa, but his real interests were always in mathematics and natural philosophy. He is chiefly remembered for his work on free fall, his use of the telescope and his employment of experimentation.

After a spell teaching mathematics, first privately in Florence and then at the university of Pisa, in 1592 Galileo was appointed professor of mathematics at the university of Padua (the university of the Republic of Venice). There his duties were mainly to teach Euclid's geometry and standard (geocentric) astronomy to medical students, who would need to know some astronomy in order to make use of astrology in their medical practice. However, Galileo apparently discussed more unconventional forms of astronomy and natural philosophy in a public lecture he gave in connection with the appearance of a New Star (now known as 'Kepler's supernova') in 1604. In a personal letter written to Kepler (1571 - 1630) in 1598, Galileo had stated that he was a Copernican (believer in the theories of Copernicus). No public sign of this belief was to appear until many years later.

In the summer of 1609, Galileo heard about a spyglass that a Dutchman had shown in Venice. From these reports, and using his own technical skills as a mathematician and as a workman, Galileo made a series of telescopes whose optical performance was much better than that of the Dutch instrument. The astronomical discoveries he made with his telescopes were described in a short book called *Message from the stars* (Sidereus Nuncius) published in Venice in May 1610. It caused a sensation. Galileo claimed to have seen mountains on the Moon, to have proved the Milky Way was made up of tiny stars, and to have seen four small bodies orbiting Jupiter. These last, with an eye on getting a job in Florence, he promptly named 'the Medicean stars'.

It worked. Soon afterwards, Galileo became 'Mathematician and [Natural] Philosopher' to the Grand Duke of Tuscany. In Florence he continued his work on motion and on mechanics, and began to get involved in disputes about Copernicanism. In 1613 he discovered that, when seen in the telescope, the planet Venus showed phases like those of the Moon, and therefore must orbit the Sun not the Earth. This did not enable one to decide between the Copernican system, in which everything goes round the Sun, and the Tychonic (Tycho Brahe) one in which everything but the Earth (and Moon) goes round the Sun which in turn goes round the Earth. Most astronomers of the time in fact favoured the Tychonic system. However, Galileo showed a marked tendency to use all his discoveries as evidence for Copernicanism, and to do so with great verbal as well as mathematical skill. He seems to have made a lot of enemies by making his opponents look fools. Moreover, not all of them actually were fools.

There eventually followed some expression of interest by the Inquisition. Prima facie, Copernicanism was in contradiction with Scripture, and in 1616 Galileo was given some kind of secret, but official, warning that he was not to defend Copernicanism. Just what was said on this occasion was to become a subject for dispute when Galileo was accused of departing from this undertaking in his *Dialogue concerning the two greatest world systems*, published in Florence in 1632. Galileo, who was not in the best of health, was summoned to Rome, found to be *vehemently suspected of heresy*, and eventually condemned to house arrest, for life, at his villa at Arcetri (above Florence). He was also forbidden to publish. By the standards of the time he had got off rather lightly.

Galileo's sight was failing, but he had devoted pupils and amanuenses, and he found it possible to write up his studies on motion and the strength of materials. The book, *Discourses on two new sciences*, was smuggled out of Italy and published in Leiden (in the Netherlands) in 1638.

Galileo wrote most of his later works in the vernacular, probably to distance himself from the conventional learning of university teachers. However, his books were translated into Latin for the international market, and they proved to be immensely influential.

Article by: *J. V. Field*, London,

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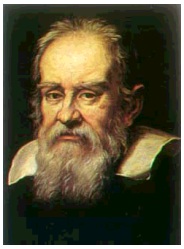
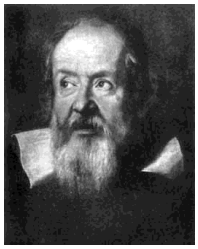
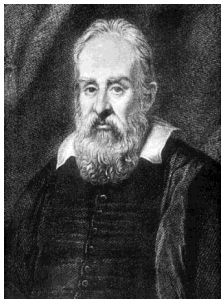
Galileo Galilei





Two portraits by Justus Sustermans painted in 1636



A portrait in crayon by Leoni

Quellen: http://www-groups.dcs.st-and.ac.uk/ history/Mathematicians/Galileo.html,

http://www-groups.dcs.st-and.ac.uk/ history/PictDisplay/Galileo.html