The Theoretical Minimum

Classical Mechanics - Solutions

I01E01

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Exercise 1. *Using a graphic calculator or a program like Mathematica, plot each of the following functions. See the next section if you are unfamiliar with the trigonometric functions.*

$$\begin{aligned} f(t) &= t^4 + 3t^3 - 12t^2 + t - 6 \\ g(x) &= \sin x - \cos x \\ \theta(\alpha) &= e^\alpha + \alpha \ln \alpha \\ x(t) &= \sin^2 t - \cos t \end{aligned}$$

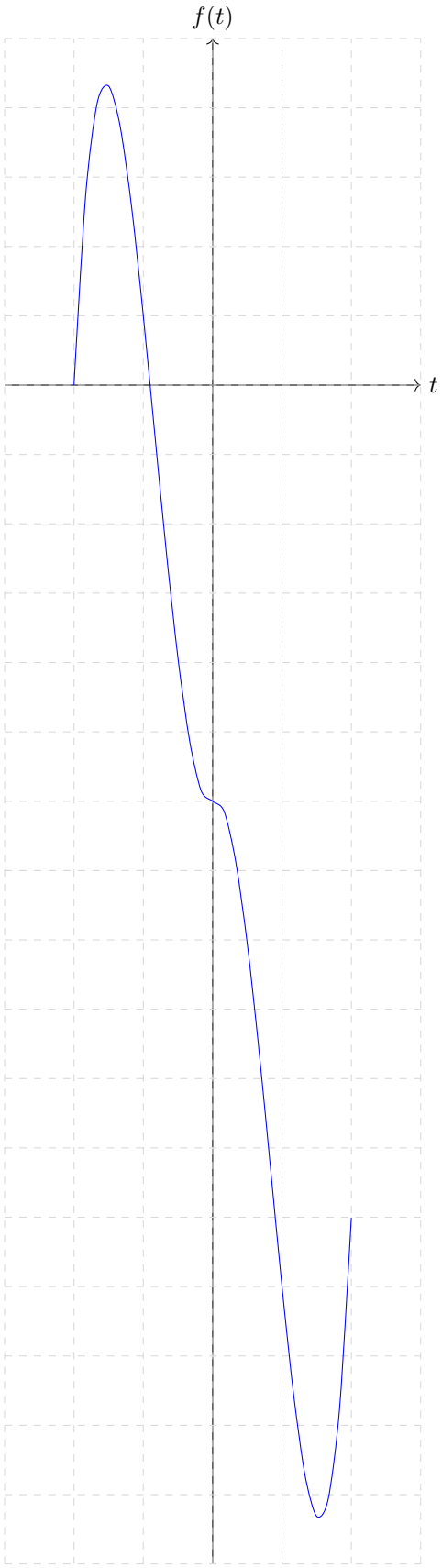

Figure 1: $f(t) = t^4 + 3t^3 - 12t^2 + t - 6$

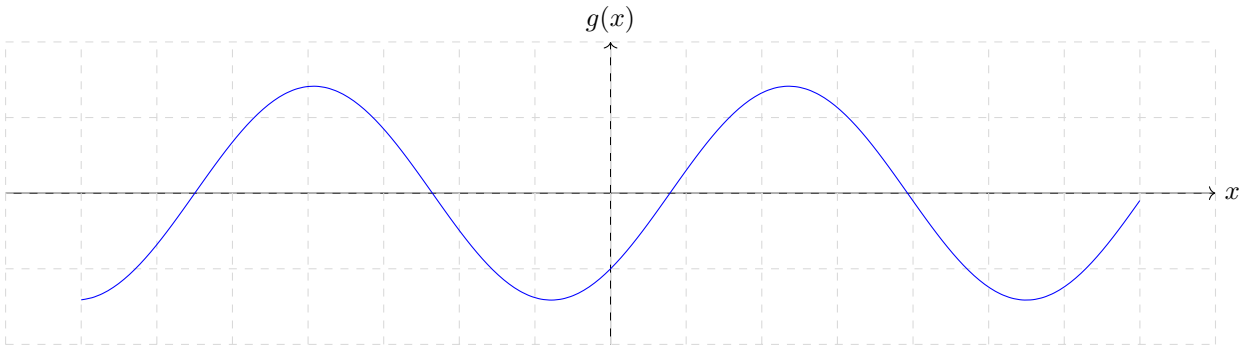

Figure 2: $g(x) = \sin x - \cos x$

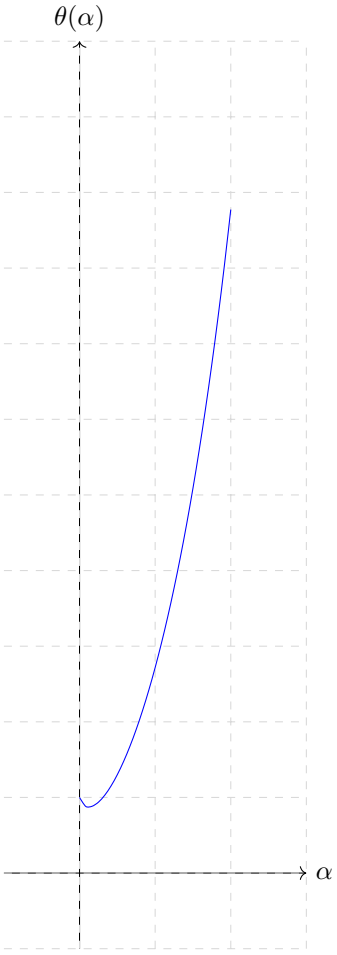

Figure 3: $\theta(\alpha) = e^{\alpha} + \alpha \ln \alpha$

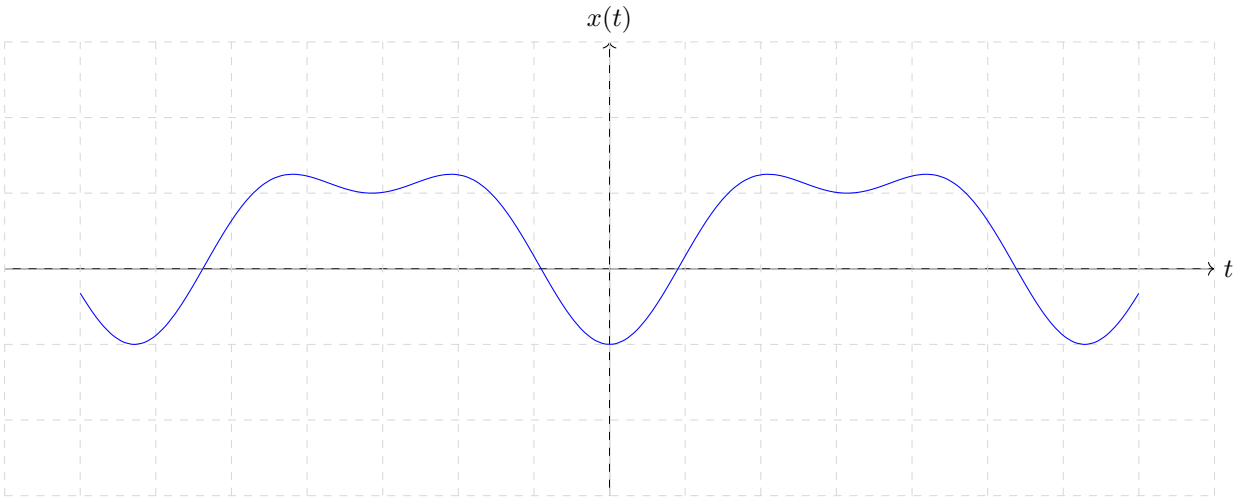

Figure 4: $x(t) = \sin^2 t - \cos t$

Remark 1. *All those plots were created using TiKz (with LaTeX then). For instance, here's the code for the last plot:*

```
\begin{figure}[H]
    \centering
    \begin{tikzpicture}
        \tikzmath{
            \xmin = -7;
            \xmax = 7;
            \ymin = -2;
            \ymax = 2;
        }
        \draw[->] (\xmin-1, 0) -- (\xmax+1, 0) node[right] {$t$};
        \draw[->] (0, \ymin-1) -- (0, \ymax+1) node[above] {$x(t)$};
        \draw[color=gray!30, dashed]
            (\xmin-1,\ymin-1) grid (\xmax+1,\ymax+1);
        \draw[scale=1, domain=\xmin:\xmax, smooth, samples=100, variable=\t, blue]
            plot ({\t}, {sin(\t r)^2 - cos(\t r)});
    \end{tikzpicture}
    \caption{$x(t) =  \sin^2t - \cos t$}
\end{figure}
```