Question34042

a) We are given initial conditions $v|_{t=0}=-10\frac{m}{s}; v|_{t=2}=10\frac{m}{s}$. Acceleration by definition is $a=\frac{dv}{dt}$, hence integrating this equation gives $v(t)=\int_0^t a(t')dt'=k\int_0^t t'^2 dt'=\frac{kt^3}{3}+C$. Plugging in initial conditions gives $-10=C; 10=\frac{8}{3}k+C$, which yields $C=-10; k=\frac{30}{4}$. Thus, velocity as a function of time is $v(t)=\frac{30}{4}\frac{t^3}{3}-10=2.5t^3-10$.

b) Velocity is by definition $v(t)=\frac{dx}{dt}$. Knowing law of velocity from previous task, and integrating previous expression, obtain $x(t)=\int_0^t v(t')dt'=\frac{10}{4}\frac{t^4}{4}-10t+C'=\frac{5}{8}t^4-10t+C'$. From initial condition $x|_{t=2}=0$ derive $0=\frac{5}{8}\cdot 16-10\cdot 2+C'\Rightarrow C'=10$. Thus, finally equation of motion is $x(t)=\frac{5}{8}t^4-10t+10$.