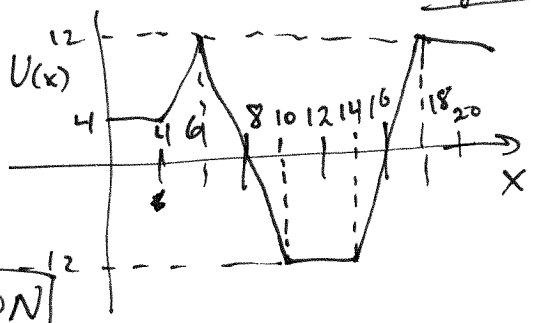
Chapter 8

Problem 50



$m = 0.50\,kg$

a) What is the force at

$x = 2.0\,m \longrightarrow$ No slope $\therefore$ $\boxed{F(2.0m) = 0N}$

$x = 5.0\,m \rightarrow$ Slope $= \frac{12-4}{6-4} = \frac{8}{2} = 4 \therefore \boxed{F(5) = -4N}$ Force equals

$x = 8.0\,m \rightarrow$ slope $= \frac{-12-12}{10-6} = \frac{-24}{4} = -6 \therefore \boxed{F(8) = 6N}$ $F_x = -\frac{\partial U}{\partial x}$

$x = 12.0\,m \rightarrow$ slope $= 0 \therefore \boxed{F(12) = 0N}$

[Find the negative of the slope]

b) If $E = -6.0\,J$, find the min + max positions.

The only place where $E = U + K = -6.0\,J$ is when $K = 0\,J$ and $U = -6.0\,J$. From the diagram, $U = -6.0\,J$ occurs at $\boxed{x = 9.0\,m}$ and $\boxed{x = 15.0\,m}$

c) What are these positions if $E = 2.0\,J$?

If $K = 0$ and $E = U$, then

$U = +2.0\,J$ occurs at ~~$x = 2$~~ between 12

Find the equation of the line between $x = 6$ + $x = 10$

slope $= -6$ $\quad U = -6x + b$ $\quad m$

using $U = 12$ at $x = 6$ gives $12 = -6(6) + b$

$b = +48$

so $U = -6x + 48$

solve for x gives

$U - 48 = -6x \rightarrow x = 8 - \frac{U}{6}$

at $U = 2\,J \rightarrow x = 8 - \frac{2}{6}$

$= 8 - 1/3$

$= \boxed{7.67\,m}$

Likewise, between $x = 16$ + $x = 18$ the equation of the line is

$U = 6x - 96 \rightarrow x = 16 + \frac{U}{6}$

at $U = 2\,J \rightarrow x = 16 + 2/6$

$= 16 + 1/3$

$= \boxed{16.33\,m}$

d) If $E = 16\,J$, what are the min + max?

Since $U_{max} = 12\,J$, even there the Kinetic energy is greater than 0. The ~~one~~ no bounds

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d) continued.

What are the speeds at ___?

$x = 2.0\ m$ $E = 16\ J = K + U$

$U(2.0m) = 4.0\ J \longrightarrow E = 16\ J = K + 2.0\ J \longrightarrow K = 14.0\ J$ (4.0 J, 12.0 J)

since $K = \frac{1}{2} m v^2 \longrightarrow v = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2(14.0\ J)}{0.50\ kg}}$

$v(2) = 7.48\ m/s$ (6.9 m/s)

$x = 5.0\ m$

$U(5.0m) = 8.0\ J$ (Halfway between $x = 4.0$ $U = 4.0$ and $x = 6.0$ $U = 12$)

$E = K + U \rightarrow 16\ J = K + 8.0\ J \rightarrow K = 8.0\ J$

$v = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2(8.0\ J)}{0.50\ kg}}$

$v(5m) = 5.66\ m/s$

$x = 8.0\ m$

$U(8.0m) = 0 \longrightarrow E = 16\ J = K + 0\ J \rightarrow K = 16\ J$

$v(8.0m) = \sqrt{\frac{2(16\ J)}{0.5\ kg}}$

$v(8.0m) = 8.0\ m/s$

$x = 12.0\ m$

~~U~~ $U(12\ m) = -12\ J$

$E = K + U \rightarrow 16\ J = K - 12\ J \rightarrow K = 28\ J$

$v = \sqrt{\frac{2K}{m}} = \sqrt{\frac{2(28\ J)}{0.50\ kg}}$

$v(12\ m) = 10.6\ m/s$