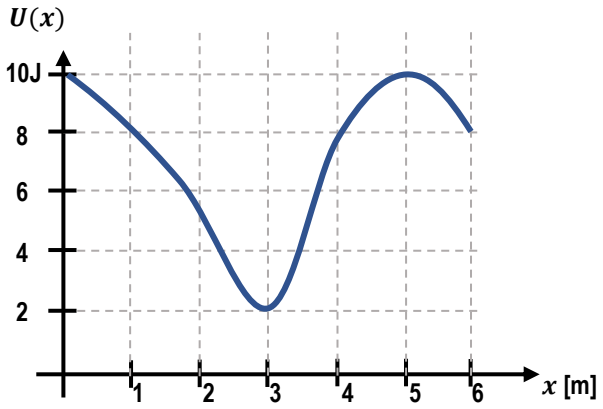
CONCEPT: INTRO TO POTENTIAL ENERGY GRAPHS

● Potential Energy ***U(x)*** graphs plot the **potential energy** of an object in the y-axis vs. _____ in the x-axis**.**

- TOTAL Mech**.** Energy **M.E =** _____ at any point and is always conserved (**W_{NC} = 0**)**.**

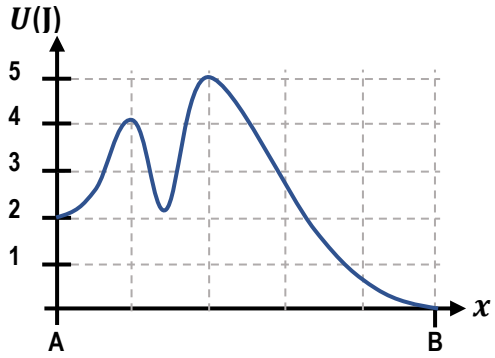
- Kinetic Energy is the _____ between **M.E.** and **U(x).**

EXAMPLE**:** A 0.5 kg marble moves according to the potential energy graph shown**.** If you release the marble from rest at x_0 = 1m, **a)** What is the total Mechanical Energy of the marble? **b)** What is the marble's kinetic energy at x = 3m? **c)** Calculate the speed of the marble at x = 4m**. d)** Without touching the marble again, can it ever reach x = 5m?



● If no energy is added, objects remain "stuck" underneath the line for **M.E.**, between two **TURNING POINTS.**

PROBLEM: A particle with a mass of 0.1kg moves according to the Potential Energy graph shown. What minimum speed does the particle need at Point A to reach Point B?



CONCEPT: FORCES AND EQUILIBRIUM POSITIONS IN POTENTIAL ENERGY GRAPHS

● In $U(x)$ graphs, the sign of $\boldsymbol{F}$**(x)** at any point is the *opposite* sign of the _____.

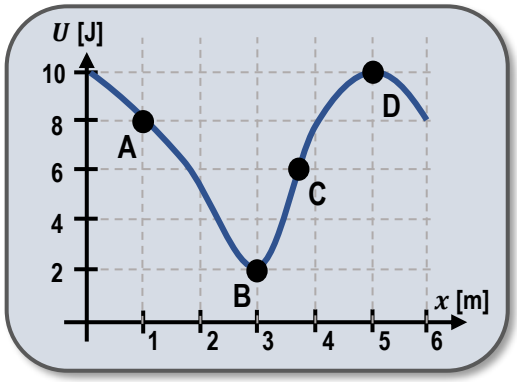
- When slope of $U(x)$ is DOWN/negative, $\boldsymbol{F}$ is **[+ | – | 0]**
- When slope of $U(x)$ is FLAT/horizontal, $\boldsymbol{F}$ is **[+ | – | 0]** → **Equilibrium Points**
- When slope of $U(x)$ is UP/positive, $\boldsymbol{F}$ is **[+ | – | 0]**

● There are two *TYPES* of Equilibrium points:

1) STABLE Equil.: $U(x)$ has a local **[MINIMUM | MAXIMUM],** curves ____. If "nudged", objects _____ return.

2) UNSTABLE Equil.: $U(x)$ has a local **[MINIMUM | MAXIMUM],** curves _____. If "nudged", objects _____ return.

EXAMPLE: A ball moves according to the potential energy graph shown.



a) Determine if the Force acting on the ball is **[+ / – / 0]** for Points A–D.

b) Determine the positions of stable equilibrium.

c) Determine the positions of unstable equilibrium.

PROBLEM**:** A marble moves along the x-axis according to the potential-energy function shown below**. a)** At which of the labeled points is the force on the marble zero? **b)** Which of the labeled x-coordinates is a position of stable equilibrium?