MATH 152

Today

1. WeBWorK/Questions
2. 7.6 Work integrals
3. 9.3 Polar coordinates

Goals:

1. 7.6 Work Integrals (Understand how to set up integrals giving the work required to perform various tasks)
2. 9.3 Polar Coordinates (Understand how to interpret polar coordinates and convert between polar and Cartesian coordinates)

Where is today's material used?

1. Physics: Work is a fundamental notion in physics.
2. Polar coordinates are useful for describing phenomena with some kind of circular symmetry.

7.6 Work

1. Recall that the force F needed to provide a mass m with an acceleration a is given by $F = ma$. In particular then weight of a mass m is $W = mg$, where $g \approx 9.8\text{m/s}^2$ is the acceleration due to gravity.
2. **Definition (from physics):** If a constant force F moves an object a distance D (in the same direction as F), the **work** done by the force is FD.
3. **Theorem:** The work done by a continuously varying force in moving an object in a straight line from $x = a$ to $x = b$ is given by $W = \int_a^b F(x)dx$.

4. Alternative perspective: Consider incremental amounts of force applied over distance and add them up (i.e., integrate).

5. Examples: 7.6, p. 408: 15, 10, 13, 17

9.3 Polar Coordinates

1. **Definition:** Let P be a point in the xy-plane and let O denote the origin. The **polar coordinates** of P are (r, θ), where $|r|$ is the distance from O to P and θ is the angle from the positive x-axis to the ray $\overrightarrow{OP}$ measured counterclockwise. We allow $r < 0$, interpreting it as opposite the direction θ would indicate.

2. $x = r\cos\theta, y = r\sin\theta$

3. $x^2 + y^2 = r^2$, $\tan\theta = \dfrac{y}{x}$ **(CAUTION!** $\arctan(y/x) \in (-\pi/2, \pi/2)$**)**

4. Typical form for a polar curve: $r = f(\theta)$.

5. Can view polar curves parametrically: $x = r\cos\theta = f(\theta)\cos\theta, y = r\sin\theta = f(\theta)\sin(\theta)$.

6. Examples: 9.3, p. 522: 13-16, 23-40, 46, 47, 53

Next Time

1. Finish 9.3: Polar coordinates

2. Turn in WeBWorK 7.6/9.3 Set17-WorkPolar: 3, 4