Math 101 – WORKSHEET 5
INDEFINITE INTEGRALS

Theorem (Net change). Suppose $f'$ is continuous. Then $\int_a^b f'(t) \, dt = f(b) - f(a)$.

(1) (Net change theorem)

(a) A particle moves with velocity $v(t) = \pi \sin(\pi t)$. What is its displacement between the times $t = 0$ and $t = 2$?

(b) What is the total distance covered by the particle?

(c) According to Newton’s law of universal gravitation, the gravitational acceleration at distance $r$ from a star of mass $M$ is $a(r) = -\frac{GM}{r^2}$. The gravitational potential $\phi(r)$ is defined by $\phi'(r) = -a(r)$. What is the change in the gravitational potential between the surface of the Earth ($R_1 \approx 6,400\text{km}$) and geostationary orbit ($R_2 \approx 42,000\text{km}$)? You may use $M_{\text{earth}} = 6 \cdot 10^{24}\text{kg}$ and $G \approx 6.7 \cdot 10^{-11}\text{m}^3/(\text{kg} \cdot \text{s}^2)$. 

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(2) Find the indefinite integrals
   (a) For $n \neq -1, \int x^n \, dx =$

   (b) $\int \left( \frac{1}{2} x^{3/2} - e^{-x/3} + 7 \right) \, dx =$

   (c) $\int_4^9 \left( x^{5/2} + e^{2x} \right) \, dx =$

   (d) $\int x \left( e^{x^2} + 1 \right) \, dx =$