

**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 geostational orbit ( $R_2 \approx 42,000\text{km}$ )? You may use  $M_{\text{earth}} \approx 6 \cdot 10^{24}\text{kg}$  and  $G \approx 6.7 \cdot 10^{-11}\text{m}^3/(\text{kg} \cdot \text{s}^2)$ .

(2) Find the indefinite integrals

(a) For  $n \neq -1$ ,  $\int x^n dx =$

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

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

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