

MA125 Exam 2 Version 1

**Name:**

- 1) A quart of milk is removed from a refrigerator at a temperature of  $33^{\circ}F$  and placed on a table in a room where the temperature is  $73^{\circ}F$ . After 30 minutes, it has warmed to  $38^{\circ}F$ . How long after it is removed from the refrigerator does the milk reach  $45^{\circ}F$ ?

2) A particle starts at  $(0, 1)$  and moves along the **line tangent to**

$$y = \cosh x + \frac{\sinh x}{2} \quad \text{at } x = 0$$

What is the  $y$ -coordinate of the particle (on the tangent line) when the  $x$ -coordinate is 1?

**3)** Assume that a tumor begins with a single cell and the rate of change of the number of cells at time  $t$  is proportional to the number of cells at time  $t$ , that is,

$$\frac{dP(t)}{dt} = k \cdot A(t)$$

After two weeks, the tumor has 32 cells.

a) What is the value of the growth constant  $k$ ?

b) How many cells are in the tumor after 5 weeks?

c) What is the doubling time of the tumor?

4) A particle moves along the curve  $y = \sqrt{1 + 2x}$  in the first quadrant ( $x \geq 0, y \geq 0$ ). The  $x$ -coordinate is increasing at a rate of 0.3cm/sec. How fast is the distance from the particle to the origin increasing when  $x = 1.5$ ?

5) At a certain point in time ship A is 20km west of a port and sailing towards it at 30km/hr. Ship B left the port an hour earlier and has been sailing north at 25km/hr. What is the rate of change of the distance between the two ships at this point in time?

6) A cylindrical tank has a radius of 20ft at its base. If water is being added at  $5\text{ft}^3/\text{min}$ , how fast is the water rising in the tank?

7) According to the special theory of relativity, the mass  $m$  of a particle depends on its velocity  $v$  according to the equation

$$m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where the following are constants:

- $m_0$  is the mass when the particle is at rest ( $v = 0$ )
- $c$  is the speed of light

If the velocity is changing (i.e., the particle is accelerating), what is the rate of change of  $m$  with respect to  $v$ ? (i.e., what is the change in  $m$  per unit change in  $v$ ).

8) A well-known trigonometric identity states that

$$\cos(x + y) = \cos x \cos y - \sin x \sin y$$

Use this identity to find an expression for  $y'$  given that  $x$  and  $y$  satisfy the equation

$$\cos(x + y) = x^2$$



9) The equation relating pressure and volume for a monatomic ideal gas undergoing a reversible adiabatic process is:

$$PV^{\frac{5}{3}} = k$$

where  $P$  is the pressure,  $V$  is the volume, and  $k$  is a constant. What is the rate of change of volume per unit change in pressure  $P$ ?

**10)** One angle of a triangle has measure  $C = \pi/3$  in radians. Side  $b$  is adjacent to angle  $C$  and has length 10cm. Side  $a$  is also adjacent to angle  $C$  and is increasing at a rate of 2cm/sec. How fast is side  $c$  (which is opposite angle  $C$ ) increasing when the length of side  $a$  is 15cm?

Formulas:

Volume of a sphere  $V = \frac{4}{3}\pi r^3$

Volume of a cylinder  $V = \pi r^2 h$

Volume of a cone  $V = \frac{1}{3}\pi r^2 h$

Surface area of a sphere  $A = 4\pi r^2$

Hyperbolic functions  $\sinh x = \frac{e^x - e^{-x}}{2}$   $\cosh x = \frac{e^x + e^{-x}}{2}$

Pythagorean theorem  $c^2 = a^2 + b^2$

Law of cosines  $c^2 = a^2 + b^2 - 2ab \cos C$

