

**McGill University**  
**Math 262: Intermediate Calculus**  
**Written Assignment 2**

All Questions are of equal value

This assignment is to be returned to your instructor  
by the beginning of class on Wednesday November 30

Make sure your name and your instructors name  
are at the top of your assignment

1. Let  $C$  be the curve given in vector parametric form by the equation

$$\mathbf{r}(t) = e^t(\cos t \mathbf{i} + \sin t \mathbf{j} + \mathbf{k}).$$

- (a) Compute the arc length of that part of  $C$  corresponding to  $0 \leq t \leq 2$ .
  - (b) Find the unit tangent, principal normal and binormal vectors  $\mathbf{T}, \mathbf{N}, \mathbf{B}$  as functions of  $t$ .
  - (c) Compute the curvature  $\kappa$  and the torsion  $\tau$  at  $t = \frac{\pi}{2}$ .
2. Suppose that  $T(x, y, z) = x^3y + y^3z + z^3x$  is the temperature at the point  $(x, y, z)$  in 3-space.
- (a) Calculate the directional derivative of  $T$  at the point  $P(2, -1, 0)$  in the direction from  $P$  to the point  $Q(1, 1, 2)$ .
  - (b) A mosquito is flying through space with constant speed 5 in the direction of increasing temperature. If the mosquito's direction of flight at any given point is always normal (perpendicular) to the level surface of  $f(x, y, z) = 2x^2 + 3y^2 + z^2$  passing through this point, find the rate of change of temperature experienced by the mosquito when it is at the point  $(2, -1, 0)$ . Hint:  $\frac{dT}{dt} = \nabla T \cdot \vec{v}$ .