

Name: _____

Panther ID: _____

Worksheet 10/11

MAC-2313

Fall 2018

1. The temperature at a point (x, y) on a metal plate in the xy -plane is given by $T(x, y) = 2x^2 - y^3 + x$ degrees Celsius. Assume x, y are measured in centimeters. Suppose a bug is positioned initially at the point $(2, 1)$ on the plate and suppose the bug moves with unit speed.

(a) In which direction should the bug go to experience the most rapid increase in temperature? Give your answer as a unit vector, but also as an (approximate) geographical direction.

(b) In which direction should the bug go to experience the most rapid decrease in temperature? Give your answer as a unit vector, but also as an (approximate) geographical direction.

(c) If the bug decides to go straight to the origin (there is a morsel of food there), what rate of change of temperature does it experience just as it starts this trip? What rate of change of temperature does it experience when it is half way there? Does the rate of change of temperature have the same sign during its entire trip? Can you justify your answer?

(d)* Suppose $(x(t), y(t))$ describe the trajectory of a “heat-seeking” bug moving on the metal plate, where t is the time in seconds. A “heat-seeking” bug always moves in the direction of the most rapid increase of the temperature. Write a system of differential equations that describes the trajectory of a “heat-seeking” bug (for convenience, you can still assume that the bug moves at unit speed, but you can also think what the system would be if you drop this assumption).