

UMPSC
Fall 2023

problem set 2

Notes: You may use any resources to solve these problems. Make sure you understand your solution thoroughly if you submit for credit. Good luck!

Problem 1

A Ramsey number $R(n_1, n_2, \dots, n_m)$ is defined as the minimum number of points needed to ensure that an arbitrary arrangement of these points in space, when pairwise connected by edges of m possible colors, must contain a subset of n_i points whose common edges are all color i .

Part A: Prove that the Ramsey numbers $R(3, 3) = 6$, $R(3, 3, 3) = 17$, and $R(4, 4) = 18$.

Part B: Find the Ramsey number $R(3, 3, 3, 3)$.

Note that Part B is currently an unsolved problem in mathematics, and much harder to solve than Part A.

Problem 2

Research and explain the connection between Brownian motion and the Heat equation.

Problem 3

Use Calculus of Variations to derive the Euler–Lagrange equations of motion from the Principle of Least Action. Also, explain their equivalence to Hamilton’s equations of motion.