2016-2017 Take Home Robotics Test

Part 1: Essay Portion
This test is for all incoming members, both novice and competitive. Members who wish to join novice only need to complete this portion of the test. Please answer each question in 5-7 sentences.

1. Why do you want to join robotics?

2. What would make you a good member?

3. List your related activities/experience etc.

4. How much time can you dedicate to meetings?

5. What do you want to learn from this club?

6. What extracurriculars (clubs, sports) will you have other than this club?

Part 2: Competitive Test

Directions: This portion of the test is for competitive applicants only. Choose one of the two sections below to answer. You only need to complete one of the sections as only one will factor into your score, but are welcome to complete both sections of the test. However, do note that neither section will be solely mechanical/programming - you need at least some knowledge of both. If you think there is more than one answer for any question, list it, but keep in mind that you may be penalized if your answer is incorrect

Write the answers to the questions neatly on a separate sheet of paper. Clearly label the test section you would like to be scored. If it is illegible, you will not receive points.

Questions? Send them to contact@dvhsrobotics.com and we will get back to you shortly.

Mechanical:

Diagrams are encouraged.

1. Using mechanical methods, how do you keep a weighted robotic arm angled at a fixed position when unpowered?
2. What are the pros and cons of a holonomic drive? How do you make a holonomic drive faster? Sketch a holonomic drive.
3. Using mechanical methods, how do you keep two parallel four bars synchronized?
4. How do you create an expansion mechanism that can vertically expand up to 4 times the original height?
5. What are some examples of efficient launching mechanisms?
6. What is a solenoid and how does it work? What is it used for in VEX?
7. What are the pros and cons of omni wheels? How can you make your robot turn without omni wheels?
8. What is differential steering?
9. Given unlimited 12, 30, 36, 48, 60, 90, and 96 tooth gears, draw and/or describe how to construct a gear system where the input rotates at exactly 1/30th the speed of the output shaft.
10. Why might a motor stop turning?

Programming:

Answer all coding questions in C-style pseudocode. For extra points: write code in RobotC (clearly assign each motor to a port).

Send all code files to contact@dvhsrobotics.com or write them by hand. Be sure to include your full name (as it shows up on Schoolloop) and grade in the email's subject line.

1. Your robot has a lift with heavy weights on it, and you want to keep it stable at a certain height h. How do you program a robotic arm to remain angled at a fixed position?

2. Using programming methods, how do you synchronize two parallel, powered four-bars? (pictured in question 3 mechanical)

3. Program an holonomic drive to be controlled by a VEX Joystick. Use appropriate motor ports for the motors on the holonomic drive.

4. How do you keep the velocity of a flywheel constant? Describe the algorithm you would use and how to implement it.

5. How do you code line tracking, given any VEX sensor legal for competition?

6. What is the worst case running time of quicksort? Give an example of a list that meets this worst case running time.
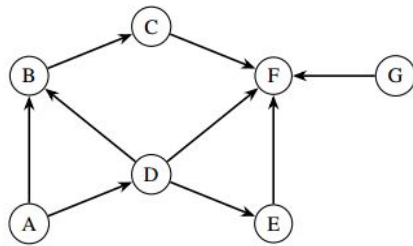
7.

Write the graph above as an adjacency matrix, and then as an adjacency list.

8. Provide an algorithm that finds the shortest directed cycle in a graph in O(EV) time and O(E) space, assuming E > V.

9. Challenge: How do you code position tracking? How would you do it without an accelerometer or gyroscope? (no penalties for this question)