**Math & Computer Science – Winter 2018**

**Case Study – Algorithm Cover - 420-204-RE**

Team members: **Deadline: 27-February-2018**

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Student 1 (last name, first name) Student 2 (last name, first name) Student 3 (last name, first name)

(Do not fill in these boxes. They will be used for grading)

|  |  |  |  |
| --- | --- | --- | --- |
| Text describing entire problem/5% | Complexity of the problem/5% | Efficiency of the algorithm/5% | Algorithm/5% |

Use Word to fill in these boxes to give **an estimate of the total number of these constructs** appearing on the algorithm

|  |  |  |  |
| --- | --- | --- | --- |
| Beans | 5 | Properties | 8 |
| Interfaces | 7 | Abstract classes | 10 |
| Protected members | 15 | Private members | 20 |

Fill in the table below by specifying the animating formulas and properties.

|  |  |  |
| --- | --- | --- |
| **Physics topic** | **Formula 1** | **Formula 2** |
| **Mechanics  (203-NYA)** | Formula:  Energy:  K = m  U = mgh  Name of the student in charge of this formula : Steven | Formula:  Kinematic:  Name of the student in charge of this formula : Salvatore |
| **Electricity & Magnetism  (203-NYB)** | Formula:  Parallel circuit:  Itotal = I1 + I2 + I3 + … + In  Name of the student in charge of this formula : Jasen | Formula:  Dipole moment:  Name of the student in charge of this formula : Steven |
| **Waves & Modern Physics (203-NYC)** | Formula:  Doppler effect:  Name of the student in charge of this formula : Salvatore | Formula:  Transverse wave:  Name of the student in charge of this formula : Jasen |

1. **Mechanics:**
   1. **Description:** 
      1. Mechanics is an branch of physical science that deals with the behaviour of physical bodies when subjected to forces or displacements and with motion, comprised of kinetics, statics, and kinematics, and their subsequent effects of the bodies on their environment. It is a branch of classical physics that deals with particles that are either at rest or are moving with velocities less than the speed of light. It is also known as the branch of science that deals with the motion of and forces on objects.
   2. **Energy: Potential & Kinetic Energy**
      1. K = m

U = mgh

* + 1. **Description:**
       1. The energy acquired by the objects upon which work is done is known as mechanical energy. this is the energy that is going to be used in this part of the problem. This is the energy that is held by an object due to its motion or due to its position is space. this energy can either be kinetic energy (energy of motion) or potential energy (stored energy of position). Both of these type of energy is going to be used in this problem. Any object that has motion has kinetic energy. We will focus upon translational kinetic energy. The amount of translational kinetic energy that an object in motion has depends upon two variables: the mass (m) of the object and the speed (v) of the object. The following equation is used to represent the kinetic energy (K) of an object: “K = ½\* m\*”. Where m = mass of object, v = speed of object.

<http://www.physicsclassroom.com/class/energy/Lesson-1/Potential-Energy>

<http://www.physicsclassroom.com/class/energy/Lesson-1/Kinetic-Energy>

* + 1. **Efficiency:**
       1. By using this computer animation, students can investigate how these two variables m and V (mass and velocity) affect the kinetic and the variables m and h (mass and height) affect the potential energy.
       2. The equation for kinetic energy reveals that the kinetic energy of an object is directly proportional to the square of its speed.
          1. That means that for a double increase in speed, the kinetic energy will increase by a factor of four. The kinetic energy is dependent upon the square of the speed.
       3. The gravitational potential energy is directly proportional to the mass of an object.
       4. The gravitational potential energy is also directly proportional to the height of an object.
          1. This means the higher that an object is elevated, the greater the gravitational potential energy.
          2. This also means a doubling of the height will result in a doubling of the gravitational potential energy. A tripling of the height will result in a tripling of the gravitational potential energy.
       5. This also means a doubling of the height will result in a doubling of the gravitational potential energy. A tripling of the height will result in a tripling of the gravitational potential energy.
    2. **Complexity:** 
       1. The energy formulas have a complexity of velocity of max
       2. A max mass, m, of

* 1. **Kinematics:**
     1. **Description:** 
        1. Kinematics describe the motion of points, objects and systems of bodies without considering the mass or the forces of the objects causing the motion. Kinematic analysis is the process of measuring the kinematic quantities used to describe motion. In other words, kinematics deals with the motion of particles not the causes of the motion. There is a variety of variables associated with the motion of objects, such as displacement, velocity, acceleration, and time.The kinematic equation is useful to predict information about the motion of an object if other information is known. The kinematics equations used are: Each symbol in the above equations has its own specific meaning related to a variable. The symbol “d” stands for the displacement of the object. The symbol “t” stands for the time for which the object moved. The symbol “a” stands for the acceleration of the object. And the symbol “v” stands for the velocity of the object; a subscript of i after the v indicates the initial velocity value and a subscript of f indicates the final velocity value.

<http://www.physicsclassroom.com/class/1DKin/Lesson-6/Kinematic-Equations>

* + 1. **Efficiency:**
       1. By using this computer animation, students can investigate how the four variables a, v, d, and t (acceleration, velocity, position and time) affect the motion of an object.
       2. A kinematics problem begins by describing the geometry of the system and declaring the initial conditions of any known values of position, velocity and/or acceleration of points within the system. Then, using arguments from geometry, the position, velocity and acceleration of any unknown parts of the system can be determined.
       3. The shapes of the position versus time graphs for constant velocity motion and accelerated motion reveal that the slope of the line on a position-time graph reveals useful information about the velocity of the object. If the velocity is constant, then the slope is constant, a straight line. If the velocity is changing, then the slope is changing, a curved line. If the velocity is positive, then the slope is positive, moving upwards and to the right. This very principle can be extended to any motion of an object.
       4. The shapes of the velocity vs. time graphs for constant velocity motion and accelerated motion reveal that the slope of the line on a velocity-time graph reveals useful information about the acceleration of the object in motion. If the acceleration is zero, then the slope will also be zero, a horizontal line. If the acceleration is positive, then the slope is positive, an upward sloping line. If the acceleration is negative, then the slope is negative a downward sloping line. This very principle can be extended to any motion of an object. The slope of a velocity-time graph reveals information about an object's acceleration.
       5. Therefore, the slope of a p-t graph reveals information about the velocity of the object and the slope of a v-t graph reveals information about the acceleration of an object.
    2. **Complexity:** 
       1. This formula requires a complexity of a max velocity of
       2. And a max acceleration of

1. **Electricity & Magnetism:**
   1. **Description:**
      1. Electricity and magnetism are the result of a single underlying electromagnetic force. Electromagnetism is a branch of physical science that describes the interactions of electricity and magnetism, both as separate phenomena and as a singular electromagnetic force. A magnetic field is created by a moving electric current and a it can induce movement of charges (electric current). Electricity at high voltages can carry energy across extended distances with little loss. Magnetism derived from that electricity can then power vast motors. But electromagnetism can also be employed in a more delicate fashion as a means of communication, either with wires (as in the telephone), or without them (as in radio communication). It also drives motors and provides current for electronic and computing devices.
   2. **Total Resistance in a parallel circuit:**

Itotal = I1 + I2 + I3 + … + In

* + 1. **Description:**
       1. Resistors are said to be connected together in “Parallel” when both of their terminals are respectively connected to each terminal of the other resistor or resistors. In a parallel resistor network the circuit current can take more than one path as there are multiple paths for the current. Then parallel circuits are classed as current dividers. In a resistance in a parallel circuit the equivalent circuit resistance RT is calculated by adding the reciprocal ( 1/R ) value of the individual resistances together instead of the resistances themselves with the inverse of the algebraic sum giving the equivalent resistance. This is the concept of equivalent resistance. The equivalent resistance of a circuit is the amount of resistance that a single resistor would need in order to equal the overall effect of the collection of resistors that are present in the circuit. For parallel circuits, the mathematical formula for computing the equivalent resistance (Req) is , where R1, R2, and R3 are the resistance values of the individual resistors that are connected in parallel.

<http://www.physicsclassroom.com/class/circuits/Lesson-4/Parallel-Circuits>

* + 1. **Efficiency:**
       1. By using this computer animation, students can investigate how the variables Rn and In (value of resistors in ohm and value of current in amps) affect the parallel circuit system. These formulas can be used to analyze a parallel circuit and determine the values of the current at each of the resistors in a parallel circuit.
       2. The goal is to use the formulas to determine the equivalent resistance of the circuit (Req), the current through the battery (Itot), and the current for each of resistors.   
          The inverse of the equivalent resistance of two or more resistors connected in parallel is the algebraic sum of the inverses of the individual resistances.
       3. Note that the equivalent resistance is always less than the smallest resistor in the parallel network so the total resistance, RT will always decrease as additional parallel resistors are added.   
          The act of adding more resistors to a parallel circuit results in the rather unexpected result of having less overall resistance.   
          In a parallel circuit, current divides up into separate branches such that there can be more current in one branch than there is in another.
       4. The current outside the branches is the same as the sum of the current in the individual branches. It is still the same amount of current, only split up into more than one pathway.
       5. Therefore, the resistance is inversely proportional and the current is directly proportional.
    2. **Complexity:** 
       1. This formula requires a complexity of max resistance of 1000 ohms.
  1. **Dipole moment:**
     1. **Description:**

**1.** The electric dipole moment for a pair of opposite charges of magnitude q is defined as the magnitude of the charge times the distance between them and the defined direction is toward the positive charge.The electric-field strength of the dipole is proportional to the magnitude of dipole moment. The dipole's direction usually points from the negative charge towards the positive charge.

<http://hyperphysics.phy-astr.gsu.edu/hbase/electric/dipole.html>

* + 1. **Efficiency:**

1.By using this computer animation, students can investigate how the magnitude (q) affect the dipole moment vector ().

2. As the magnitude of dipole moment increases, the electric-field strength of the dipole increases.

3. One can conclude that the electric-field strength of the dipole is proportional to the magnitude of dipole moment.

* + 1. **Complexity:**

1. This formula requires a complexity of max magnitude is 150.

1. **Waves, Optics & Modern Physics:**
   1. **Description:**
      1. Waves, Optics & Modern Physics includes simple harmonic motion, damping; resonance, definition and properties of waves, application to sound and matter waves, and application to electromagnetic waves. Geometrical optics (laws of lenses, mirrors, and optical instruments) and physical optics (interference and diffraction). In the Modern Physics portion, topics chosen from the following: Special Relativity (postulates, space-time, mass-energy), Quantum Physics (origin and development), Nuclear Physics (radioactivity, fission, fusion), and Elementary Particles. To analyze various situations or phenomena associated with waves, optics and modern physics using basic principles. This subject is intended to introduce the student to a broad range of physical phenomena involving waves (mechanical waves, sound waves, and electromagnetic waves), geometrical and physical optics, matter waves, and quantum physics.
   2. **Doppler effect:**
      1. **Description:**
         1. The Doppler effect is observed whenever the source of waves is moving with respect to an observer. The Doppler effect can be described as the effect produced by a moving source of waves in which there is an apparent upward shift in frequency for observers towards whom the source is approaching and an apparent downward shift in frequency for observers from whom the source is receding. <http://www.physicsclassroom.com/class/waves/Lesson-3/The-Doppler-Effect>
      2. **Efficiency:**
         1. By using this computer animation, students can investigate how the variable v (velocity of source and observer) affect the frequency of the particle.
         2. We are most familiar with the Doppler effect because of our experiences with sound waves. Perhaps you recall an instance in which a police car or emergency vehicle was traveling towards you on the highway. As the car approached with its siren blasting, the pitch of the siren sound (a measure of the siren's frequency) was high; and then suddenly after the car passed by, the pitch of the siren sound was low. That was the Doppler effect - an apparent shift in frequency for a sound wave produced by a moving source.
         3. Vo is positive if the receiver is moving towards the source (and negative in the other direction);
         4. Vs is positive if the source is moving away from the receiver (and negative in the other direction).
         5. The frequency is decreased if either is moving away from the other.
         6. If the source approaches the observer at an angle, the observed frequency that is first heard is higher than the object's emitted frequency.
         7. When the observer is very close to the path of the object, the transition from high to low frequency is very abrupt.
         8. When the observer is far from the path of the object, the transition from high to low frequency is gradual.
         9. One can conclude that the frequency is inversely proportional to the velocity.
      3. **Complexity:** 
         1. This has a complexity of max frequency of 1000Hz and max velocity of 1000m/s.
   3. **Transverse wave:**
      1. **Description:**
         1. A transverse wave is a wave in which particles of the medium move in a direction perpendicular to the direction that the wave moves. Transverse waves are always characterized by particle motion being perpendicular to wave motion. There are two independent directions in which wave motion can occur. In this case, these motions are the Y and X, while the wave propagates away in the z direction. The formula above explains this function. Where A is the amplitude, k is the wave speed and w is the angular frequency. By looking at graph, one can see the relationship between the variables.

<http://www.physicsclassroom.com/class/waves/Lesson-1/Categories-of-Waves>

* + 1. **Efficiency:**
       1. By using this computer animation, students can investigate how these two variables x and t (position and time) affect the motion of the particle.
       2. If you do place a position on an particle, it will change with time.
       3. This position is directly proportional to the time.
       4. If a transverse wave is moving in the positive x-direction, its oscillations are in up and down directions that lie in the y–z plane.
       5. With the proportionality of the variables we can conclude that the graph will be a sinus function.
    2. **Complexity:** 
       1. This formula has a complexity of max Amplitude of 100 m. and time max of 300s

**Others**:

* Submit a hierarchical organization of the classes appearing on this algorithm
* The algorithm must contain no Java statement. Can refer to any Java keyword as an example only.
* Use meaningful names
* Make sure that any text appearing within any flowchart symbol provides complete, accurate and enough-detailed information for coding every task in the algorithm. Finally,
* The information appearing on the algorithm must permit the programmer to use any programming language for writing the code of the application by asking no questions at all.