EXAM #1
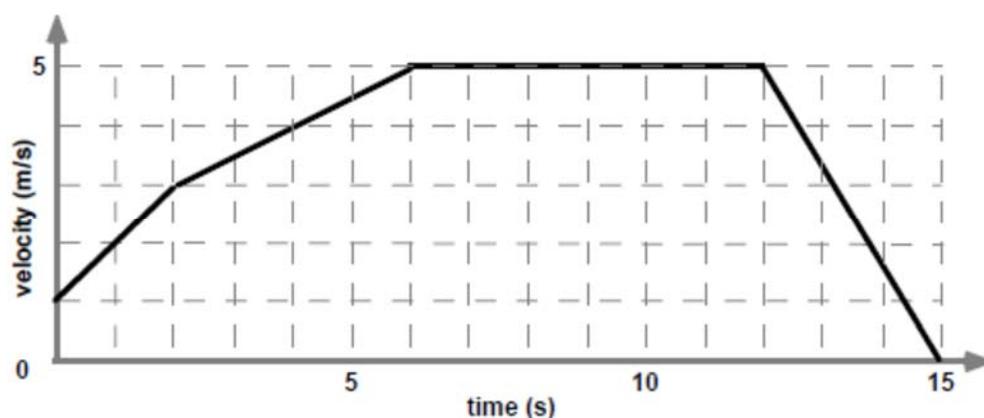*MECHANICS*
15% of the final grade

Winter 2016   Name:_____

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Each multiple-choice question is worth 3 marks.

**1.** The following graph gives the velocity of an object as a function of time.

What was the average velocity of the object during the first 6 seconds?

Answer: _____

2. The figure shows a circular tube securely fastened to a table (and seen from above). A ball enters at point P and emerges from the tube at point R. Which path best represents the path followed by the ball when it comes out of the tube?


❑   1
❑   2
❑   3
❑   4
❑   5
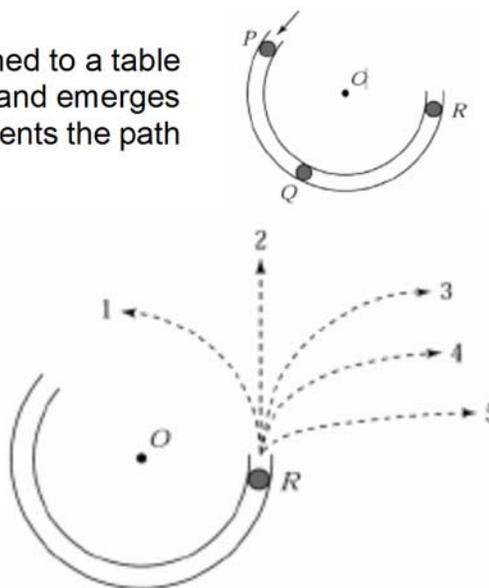
3. The figure shows the trajectories of three shells. Which of the three shells remained in the air for the longest time (neglecting air friction)?

   ❑ A
   ❑ B
   ❑ C
   ❑ The time of flight of shells A and C is the same and is longer than the time of flight of shell B.
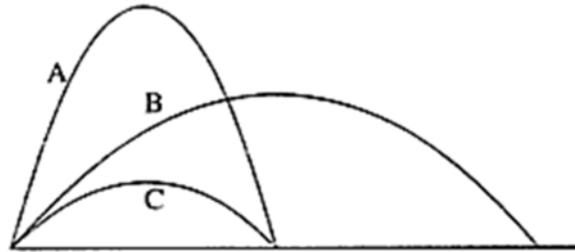
4. Charles's truck has broken down. To him help, Andrik pushes him with his car. Initially, the two vehicles <u>accelerate</u> towards the right. During this phase of acceleration...
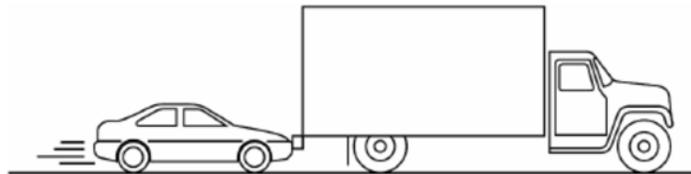
   ❑ the magnitude of the force exerted by the car on the truck is larger than the magnitude of the force exerted by the truck on the car.
   ❑ the magnitude of the force exerted by the car on the truck is smaller than the magnitude of the force exerted by the truck on the car.
   ❑ the force exerted by the car on the truck has the same magnitude as the force exerted by the truck on the car.
   ❑ the car exerts a force on the truck, but the truck does not exert a force on the car.
   ❑ the truck exerts a force on the car, but the car does not exert a force on the truck.
   ❑ there is no force between the car and the truck.

5. A ball is launched into the air and reaches a maximum height h. Taking into account air friction (which is always opposed to the motion), what is the relationship between t_1 (the time it takes the ball to reach its maximum height) and t_2 (the time it takes the ball to come down from its maximum height)?

   ❑ $t_1 = t_2$
   ❑ $t_1 < t_2$
   ❑ $t_1 > t_2$

6. The velocity of an object as a function of time is shown in the graph on the right. Which graph below best represents the net force acting on this object as a function of time?
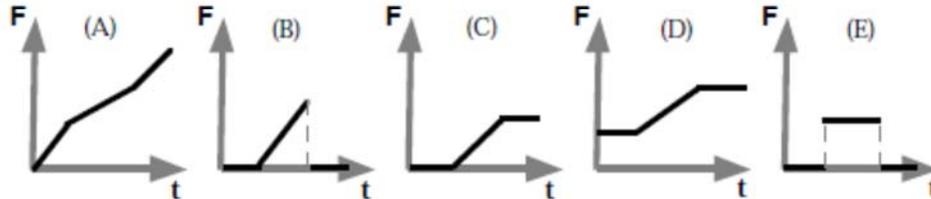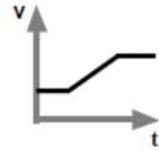
(A)   (B)   (C)   (D)   (E)

❑ A   ❑ B   ❑ C   ❑ D   ❑ E

7. A force is applied downwards on an object at rest on the ground. Then, the net force acting on the object is…
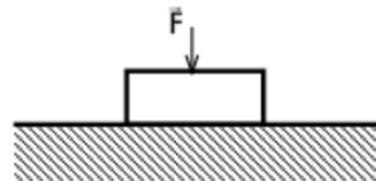
❑ zero.
❑ downwards.
❑ upwards.
❑ downwards or upwards, it depends on if the applied force is larger or smaller than the weight.

8. A rollercoaster car goes into a loop. There is no engine on the car, which means that its speed is not constant. Draw a vector that shows the direction of the acceleration of the car when it is at the position shown in the figure.
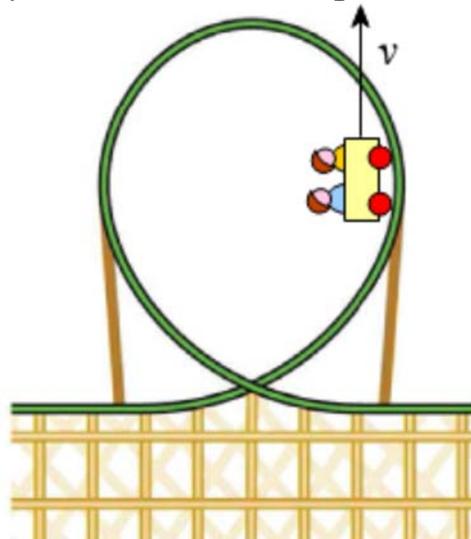
9. A person pulls a block across a rough horizontal surface at a constant speed by applying a force F. The arrows in the diagram correctly indicate the directions, but not necessarily the magnitudes of the various forces on the block.
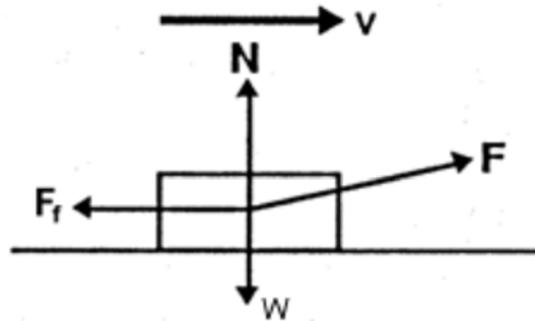
Then, F _____ F_f and N _____ w

(Use the symbols >, <, or =. You can use the same symbol twice if you want.)

10. If force **F** of the previous problem suddenly disappears, then the block…

- ❑   stops immediately.
- ❑   continues to move at a constant speed for a while, and then stops suddenly.
- ❑   slows down gradually.
- ❑   continues to move at a constant speed.
- ❑   increases its speed for a very short time, and then slows down gradually.
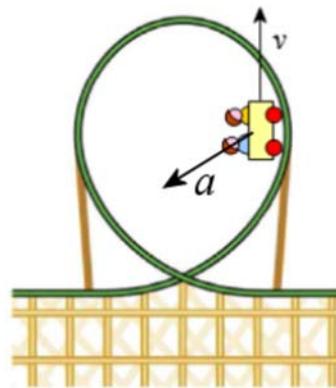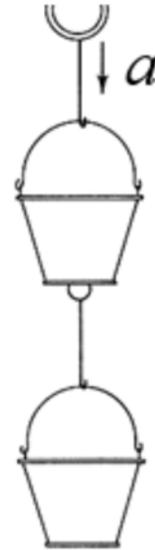
Ans. 1 3.33 m/s   2 2   3a   4c   5b   6e   7a   8
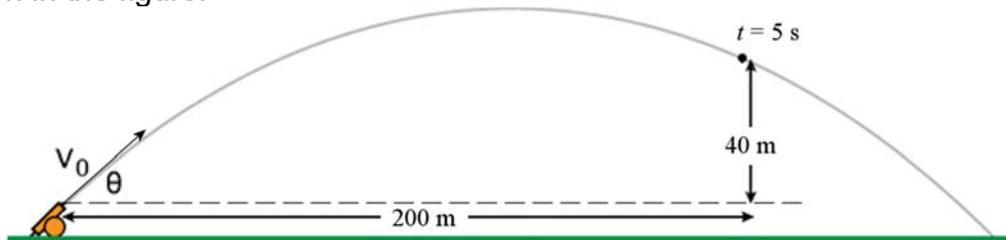
9 F > F_f et N < w   10c

11. (15 marks)

Two buckets, each having a mass of 5 kg, are connected together by a rope. Both are moving upwards, but with a speed that decreases at a rate of 1.5 m/s per second. Calculate the tension of each rope.

Ans. top rope: 41.5 N   bottom rope: 83 N

12. (20 marks)

A projectile is launched by a canon. 5 seconds later, the shell is at the position shown in the figure.

a) What was the initial speed of the shell?
b) What was the launch angle of the shell?
c) How far from the gun will the shell fall if the end of the barrel is 2 m above the ground?
d) What was the maximum height reached by the shell (measured from the ground)?
e) How long will the flight of this shell last?

Ans : 51.54 m/s   b) 39.09°   c) 267.7 m   d) 55.89 m   e) 6.694 s

13. (15 marks)

Everybody knows the famous St-Henri sled race. To defend the honor of her village, Julia designed a sled with a jet engine powered by pork slurry that can exert 6,000 N of force. The mass of the sled, including Julia, is 200 kg, and the motor can run for 5 seconds. The frictional force opposing the motion of the sled has a magnitude of 800 N. There's no brake. Once the motor stops, the sled eventually comes to a halt thanks to the frictional force.
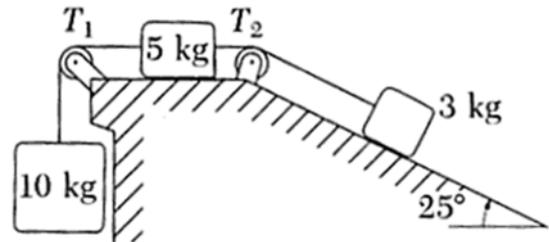
a) What is the total distance travelled by the sled before stopping?
b) How long was the sled moving for?

Ans. a) 2437.5 m   b) 37.5 s

14. (20 marks)

Three blocks are connected by ropes as shown in the figure.

a) What is the acceleration of the blocks? (Specify the direction of the acceleration.)
b) What is the tension of each rope?

Note: There's no friction in this problem.

Ans. a) 4.754 m/s² (The 10 kg block is accelerating downwards)
      b) T_1 = 50.46 N T_2 = 26.69 N