

# EXAM 1

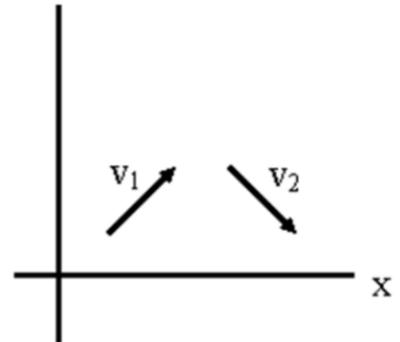
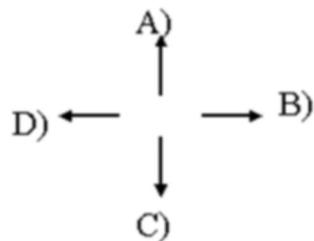
*MECHANICS*  
15% of the final grade

Winter 2018

Name: \_\_\_\_\_

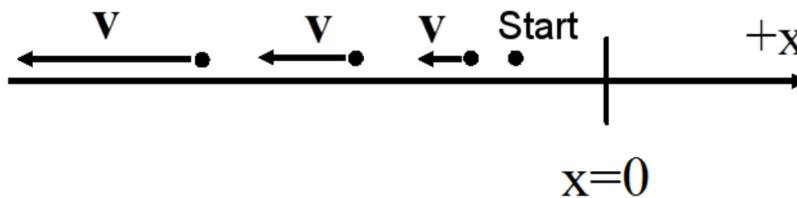
Each multiple-choice question is worth 3 marks.

1. In the figure, the velocity of an object at different times is shown ( $v_2$  is after  $v_1$ ). What is the direction of the average acceleration of the object?



E) None of these answers

2. A racecar moves as shown.

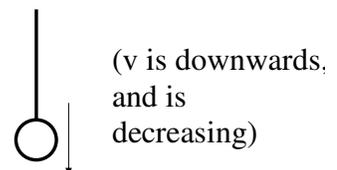


Complete the sentence with *positive*, *negative* or *zero*.

During this motion, the velocity is \_\_\_\_\_, and the acceleration is \_\_\_\_\_.

3. An object fixed at the end of a rope is going down with a decreasing speed. Thus, the tension of the rope is...

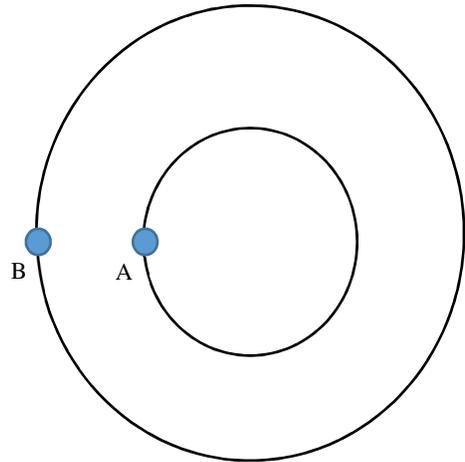
- larger than the weight of the object.
- equal to the weight of the object.
- smaller than the weight of the object.



4. These two objects are making a uniform circular motion.

Which of these objects has the greatest centripetal acceleration if they have the same period? \_\_\_\_\_

Which of these objects has the greatest centripetal acceleration if they have the same speed? \_\_\_\_\_



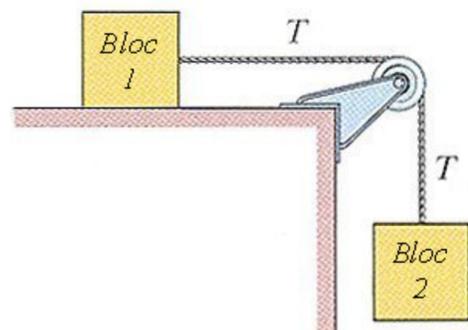
5. A sailboat, driven by the wind, moves at a constant speed on a lake. What is the direction of the net force acting on the boat?

- Towards the front of the boat
- Towards the back of the boat.
- There is no net force.
- Upwards (towards the sky).
- Downwards (towards the bottom of the lake).

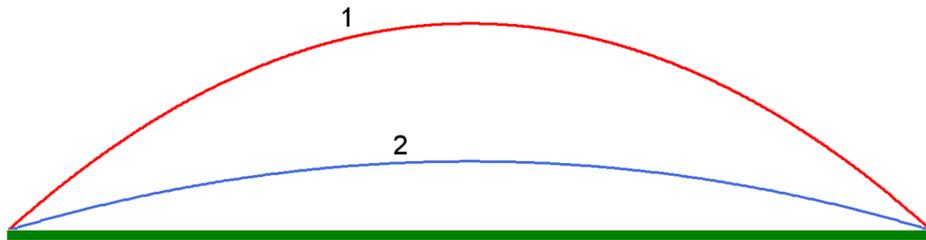


6. In the situation shown in the figure, there is no friction. The mass of block 1 is greater than the mass of block 2. On which blocks does the largest net force act?

- On block 1
- On block 2
- The magnitude of the net force is the same for both blocks.



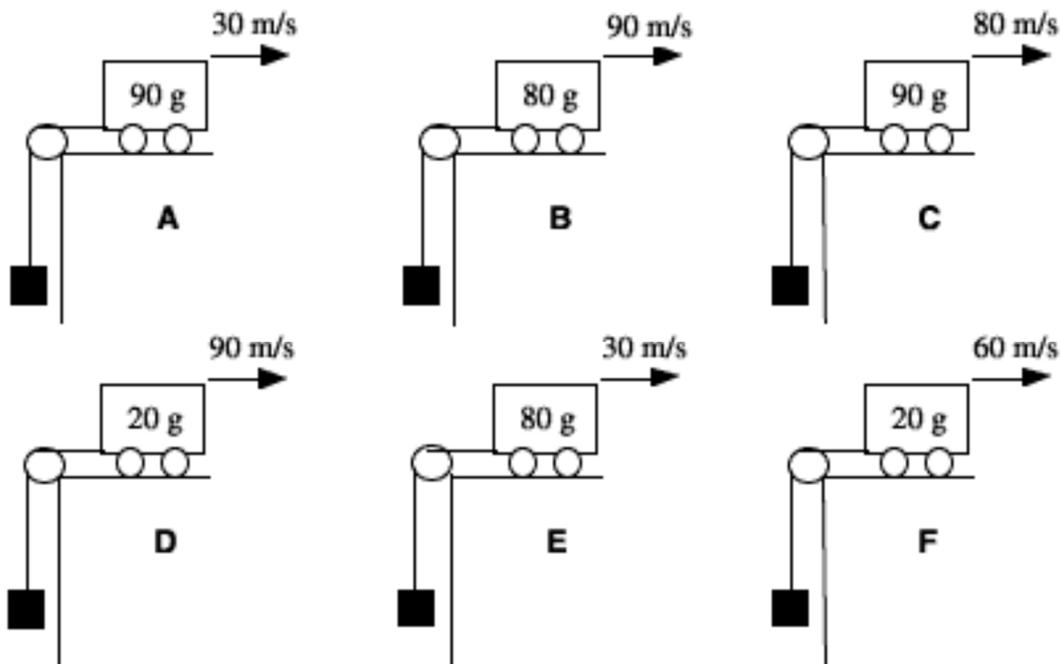
7. This is the trajectory of 2 projectiles having the same range. There is no friction.



Which of these projectiles has the largest horizontal speed ( $v_x$ )?

- Projectile 1
- Projectile 2
- The horizontal speed is the same for both projectiles.

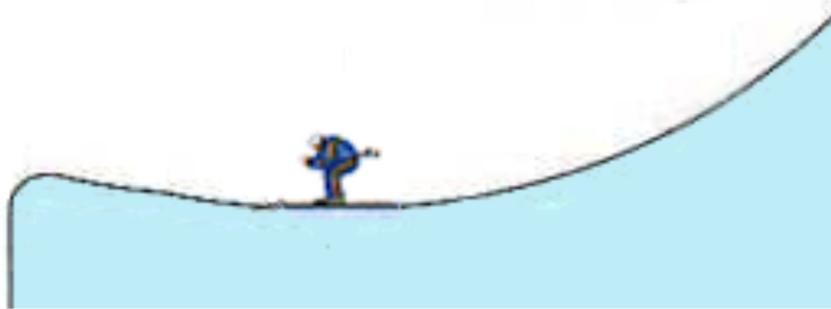
8. In the situations shown here, there is no friction and the pulley has no mass. For which situation the tension of the rope is the largest? (Circle the correct answer. If there are several situations that have the greatest tension, you must circle them all.)



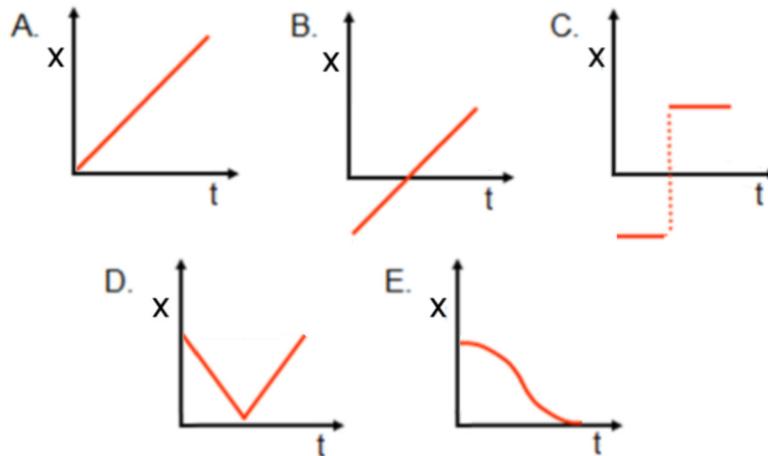
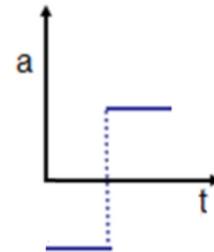
G) The tension is always the same.

**Exam 1 - Mechanics**

9. A skier arrives at the bottom of a small dip. At this instant, the speed of the skier is decreasing. What is the direction of the net force acting on the skier at that moment? (Draw a vector representing the net force on the figure.)



10. Which of these graphs of the position goes with this graph of the acceleration (circle the correct answer)?



Answers: 1c 2 negative, negative 3a 4 B,A 5c 6a 7b 8 A,C  
9 10e

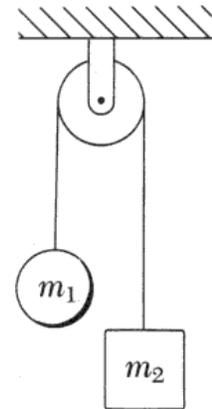


**11.** (15 marks)

Two masses ( $m_1 = 35 \text{ kg}$  and  $m_2 = 30 \text{ kg}$ ) are suspended vertically and connected by a rope passing through a pulley as shown.

- a) What is the acceleration of the blocks (magnitude and direction)?
- b) What is the tension of the rope?

Neglect friction and the mass of the pulley.



Answers: a)  $0,7538 \text{ m/s}^2$  (downwards for the 35 kg block)    b)  $316,6 \text{ N}$

**12.** (15 marks)

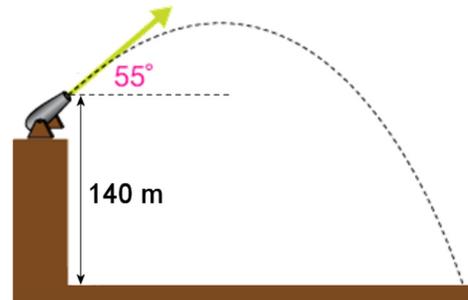
Rosalie decides to try to beat the drag-racing world record. To beat it, she has to travel 400 m with her racing car in less than 4.441 s, starting from rest. Initially, her racecar has a constant acceleration of  $44 \text{ m/s}^2$ . This acceleration stops when the racecar reaches its maximum speed, which is  $554,4 \text{ km/h}$ . How much time does it take for Rosalie to reach the finish line?

Answer:  $4.347 \text{ s}$

## 13. (20 marks)

Colonel Bozon is in charge of a cannon firing shells at a speed of 600 m/s at an angle of  $55^\circ$  from the horizontal. The cannon is placed on top of a cliff so that the end of the barrel is 140 m high.

- What is the time of flight of the shell?
- What is the range of the shell?
- What is the maximum height reached by the shell (measured from the bottom of the cliff)?



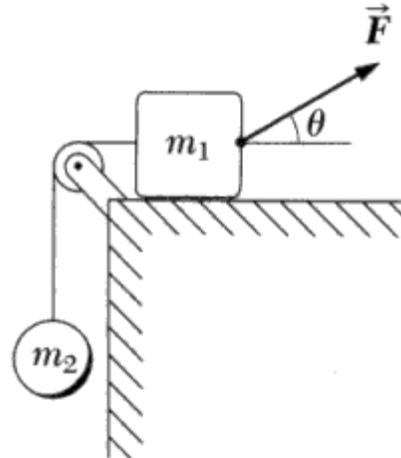
(The drawing is not to scale.)

Answers: a) 100.6 s    b) 34,617 m    c) 12,464 m

## 14. (20 marks)

A force  $F = 15$  N is exerted with an angle of  $\theta = 30^\circ$  on a mass  $m_1 = 7$  kg. This mass is connected by a rope to a mass  $m_2 = 3$  kg as shown in the figure.

- What is the acceleration (magnitude and direction) of the blocks?
- What is the tension of the rope?
- What is the normal force exerted on the 7 kg block?



There is no friction in this problem.

Answers: a)  $1.641 \text{ m/s}^2$  (downwards for the 3 kg block)    b) 24.48 N    c) 61.1 N