

EXAM 2

MECHANICS
15% of the final grade

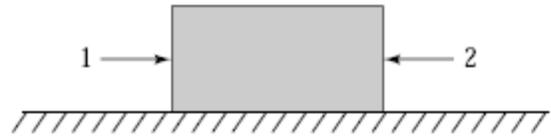
Winter 2018

Name: _____

Each multiple-choice question is worth 3 marks.

1. Two opposing forces are exerted on a block. Which of the following statements is true if the block moves 5 m to the right?

- The work done by both forces is positive.
- The work done by force 1 is positive and the work done by force 2 is negative.
- The work done by force 1 is negative and the work done by force 2 is positive.
- The work done by both forces is negative.

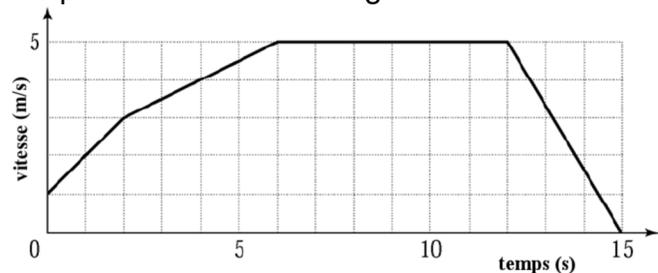


2. Abdelbrahim wants to climb to the top of a mountain on a bike, and he has a choice between two trails. Trail B is twice as long as trail A. If air friction and the friction in the mechanisms of the bike are neglected, the average force needed to climb trail B is...

- four times smaller than the average force needed to climb trail A.
- three times smaller than the average force needed to climb trail A.
- two times smaller than the average force needed to climb trail A.
- the same as the average force needed to climb trail A.

3. A variable force is applied to an object so that the speed of the object is given by the following graph. When is the instantaneous power of this force negative?

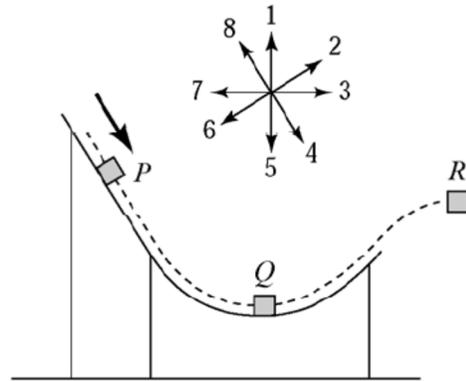
- Between $t = 0$ s and $t = 5$ s
- Between $t = 5$ s and $t = 12$ s
- Between $t = 12$ s and $t = 15$ s
- It is never negative.



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4. The following diagram shows a cube sliding down a ski-jump ramp. If there is no friction, in which direction is the apparent weight of the cube when it is at position R?

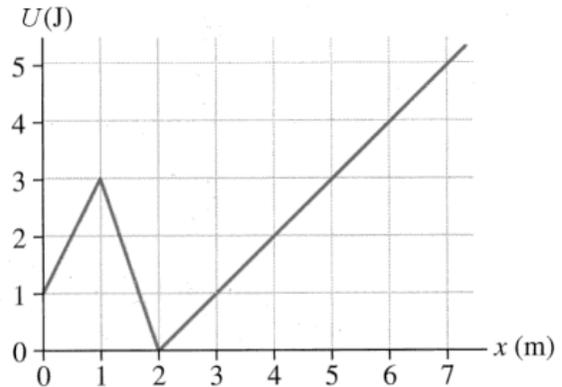
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- The apparent weight is zero



5. The graph shows the potential energy as a function of the position. The 2 kg object has a mechanical energy of 5 J.

What is the speed of the object when its position is $x = 3$ m?

What is the acceleration of the object (magnitude and direction) when its position is $x = 3$ m?



6. An object is thrown from the top of a cliff with a speed of 10 m/s. If there is no friction, in which case is the kinetic energy of the object the largest when it hits the ground?

- When the object is thrown upwards.
- When the object is thrown horizontally.
- When the object is thrown downwards.
- The kinetic energy will be the same, regardless of the direction of the throw.

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7. Two identical boxes (A and B) are on a horizontal surface. There is friction between the boxes and the ground. Box A moves with a constant speed of 3 m/s when it is pushed with a force F_A , and box B moves with a constant speed of 6 m/s when it is pushed with force F_B . Which of these forces is the largest?

- F_A
- F_B
- The force is the same for both boxes.

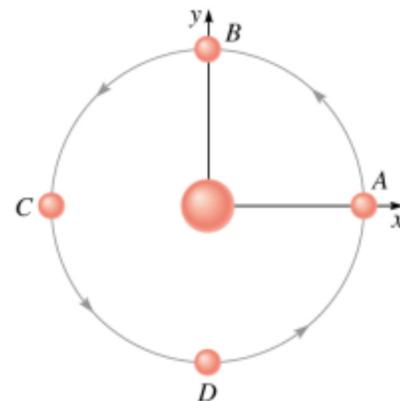
8. Luc and Audrey are in a tug-of-war competition and, until now, nobody is winning even if Luc's mass is twice as great as Audrey's. What is the relation between the magnitude of the force of friction exerted on Luc's feet (f_L) and the force of friction exerted on Audrey's feet (f_A)?



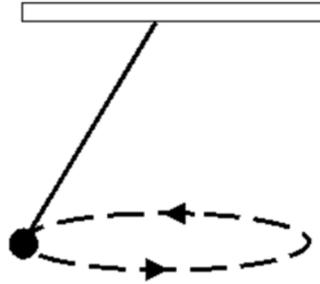
- $f_L > f_A$
- $f_L = f_A$
- $f_L < f_A$

9. A small planet orbits around a more massive planet. Where is the small planet when its acceleration is directed toward the positive y-axis (according to the axes shown in the figure)?

- A
- B
- C
- D
- The acceleration is never towards the positive y-axis for these 4 positions.



10. An object is rotating as shown.



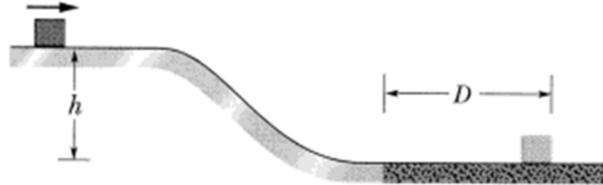
Which force is the centripetal force?

- The total weight.
- The total tension force.
- The vertical component of the weight.
- The horizontal component of the weight.
- The vertical component of the tension force.
- The horizontal component of the tension force.

Answers: 1b 2c 3c 4 zero 5: 2 m/s and -0.5 m/s^2 6d 7c 8b 9d 10f

11. (16 points)

A 2 kg block at a speed of 15 m/s slides on a horizontal frictionless surface. The block then comes to a slope and descends 10 m (h in the figure). There is still no friction on the slope. At the bottom of the slope, the block comes to a region where the coefficient of kinetic friction is 0.4.

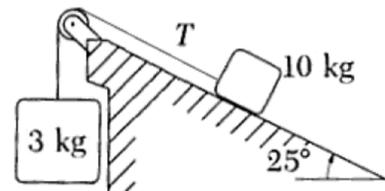


- What will the speed of the block be at the bottom of the slope, just before coming to the region where there is friction?
- What is the work done by gravity during the descent?
- What will the distance travelled by the block (D) be before stopping in the region where there is friction?
- What is the work done by friction during the stopping phase?

Answers: a) 20.52 m/s b) 196 J c) 53.7 m d) -421 J

12. (18 points)

A 10 kg block on 25° slope is connected to a 3 kg block by a string as shown in the diagram. The coefficient of static friction between the 10 kg block and the slope is 0.25 and the coefficient of kinetic friction between the 10 kg block and the slope is 0.2.



- What is the acceleration of the blocks if the 10 kg block is initially moving uphill?
- Will this system start to move if the blocks are initially at rest?

Answers: a) 2.29 m/s^2 downhill for the 10 kg block
 b) Since 12.02 N is smaller than 22.20 N, they remain at rest.

13.(18 points)

Mathilde, who has a mass of 50 kg, goes bungee-jumping. She attaches her feet to a 15 m long elastic rope (when it is not stretched), and jumps off a bridge. The constant of the rope is 200 N/m. She is free falling for 15 m and then the cable starts to stretch. Neglect air friction.

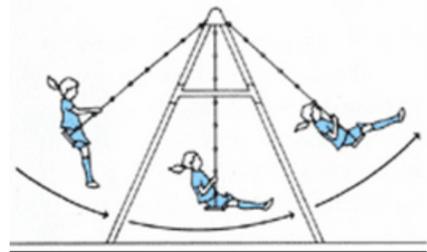
- a) What is the total fall distance?
- b) What is the magnitude of the maximum force exerted by the rope?
- c) What is the work done by the rope?
- d) What is the number of g experienced by Mathilde at the lowest point?

N.B. The rope acts exactly like a spring.

Answers: a) 26.37 m b) 2273 N c) -12,920 J d) 4.639

14.(18 points)

On a beautiful summer day, Allison, who has a mass of 50 kg, is having fun on a swing. As she passes at the lowest point of the motion, the tension of the rope is 600 N. The rope is 5 m long.



- a) What is Allison's speed at the lowest point?
- b) What is Allison's speed when the angle is 30° ?
- c) What is the maximum angle reached during this motion?
- d) What is the tension of the rope at the highest point of this motion?
- e) What is the number of g experienced by Allison at the lowest point?

Answers: a) 3.317 m/s b) She does not reach 30° c) 27.4° d) 435 N
e) 1.2245