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nagytibo@msu

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Nagy,

Tibor

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Keep this exam **CLOSED** until advised by the instructor.

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50 minute long closed book exam.

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Fill out the bubble sheet: last name, first initial, **student number**. Leave the section, code and form areas empty.

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A two-sided handwritten 8.5 by 11 help sheet is allowed.

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When done, hand in your **test** and your **bubble sheet**.

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Thank you and good luck!

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Possibly useful constant:

- $g = 9.81 \text{ m/s}^2$

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Please, sit in row C.

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1 pt Are you sitting in the seat assigned?

1.A  Yes, I am.

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**4 pt** An apple, a brick and a hammer are all dropped from the second floor of a building at the same time. Which object(s) will hit the ground first?

**2.A**  Without knowing the masses of the objects, we cannot tell which one hits the ground first.

**B**  The hammer and the apple will hit the ground first in a tie.

**C**  The hammer will hit first.

**D**  They will all hit the ground at the same time.

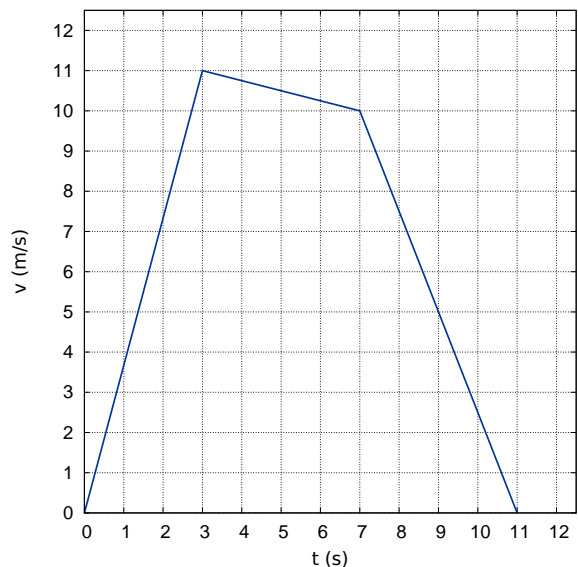
**E**  The apple and the brick will hit the ground first in a tie.

**F**  The brick and the hammer will hit the ground first in a tie.

**G**  The brick will hit first.

**H**  The apple will hit first.

A car is waiting at an intersection. When the traffic light turns green, the car starts moving. After some time the car comes to rest at another traffic light. The figure below shows the velocity of the car as a function of time.



One can clearly identify three different stages of this motion.

**3 pt** What is the acceleration of the car during the second stage of the motion?  
(in  $\text{m/s}^2$ )

- 3.** **A**  -0.500    **B**  -0.333    **C**  -0.250    **D**  -0.200  
**E**  0.167    **F**  0.200    **G**  0.250    **H**  0.500

**3 pt** What is the total distance travelled by the car between the two traffic lights?  
(in m)

- 4.** **A**  44.4    **B**  59.0    **C**  78.5    **D**  104  
**E**  139    **F**  185    **G**  246    **H**  327

**4 pt** On a car trip you drive for 2 hours and 34 minutes on a highway at a speed of 125.0 km/h. Then you stop at a gas station to fill up your tank. You also eat a quick lunch. The whole break lasts 31 minutes. After the break you start your engine up and you switch to a state road. You drive for another 3 hours and 30 minutes at a speed of 72.0 km/h before you arrive to your destination. What was your average speed for the whole trip with the lunchbreak included?  
(in km/h)

5.    **A**   $2.85 \times 10^1$     **B**   $3.56 \times 10^1$     **C**   $4.46 \times 10^1$   
       **D**   $5.57 \times 10^1$     **E**   $6.96 \times 10^1$     **F**   $8.70 \times 10^1$   
       **G**   $1.09 \times 10^2$     **H**   $1.36 \times 10^2$

**4 pt** A boat crossing a 258.0 m wide river is directed so that it will cross the river and land on the opposite shore directly across from the starting point.  
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The boat has a speed of 5.00 m/s in still water and the river flows uniformly at 2.70 m/s. Calculate the time required for the boat to reach the opposite shore.  
(in s)

6.    **A**   $2.04 \times 10^1$     **B**   $2.39 \times 10^1$     **C**   $2.80 \times 10^1$   
       **D**   $3.27 \times 10^1$     **E**   $3.83 \times 10^1$     **F**   $4.48 \times 10^1$   
       **G**   $5.24 \times 10^1$     **H**   $6.13 \times 10^1$

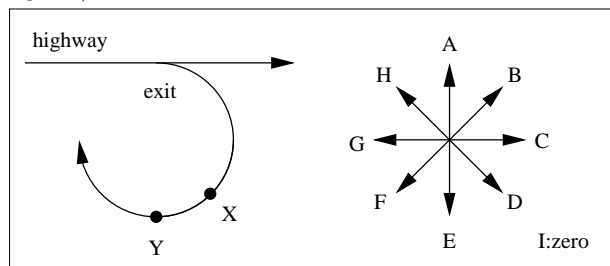
**3 pt** An artillery shell is launched on a flat, horizontal field at an angle of  $\alpha = 31.8^\circ$  with respect to the horizontal and with an initial speed of  $v_0 = 280$  m/s. What is the horizontal velocity of the shell after 20.35 s of flight? (Neglect air friction. Use the coordinate system where the x-axis is horizontal and points to the right; and the y-axis is vertical and points up.)  
(in m/s)

7.    **A**   $1.65 \times 10^2$     **B**   $1.86 \times 10^2$     **C**   $2.11 \times 10^2$   
       **D**   $2.38 \times 10^2$     **E**   $2.69 \times 10^2$     **F**   $3.04 \times 10^2$   
       **G**   $3.43 \times 10^2$     **H**   $3.88 \times 10^2$

**3 pt** What is the vertical velocity of the shell at this moment?  
(in m/s)

8.    **A**   $-1.30 \times 10^2$     **B**   $-1.04 \times 10^2$     **C**   $-5.21 \times 10^1$   
       **D**   $-2.61 \times 10^1$     **E**   $2.61 \times 10^1$     **F**   $5.21 \times 10^1$   
       **G**   $1.04 \times 10^2$     **H**   $1.30 \times 10^2$

A car is exiting the highway on a circular exit ramp. (See figure.)



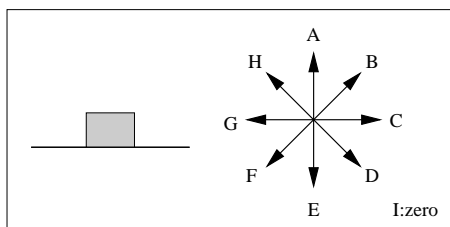
3 pt The driver slows the car down to the posted speed limit, enters the exit ramp and then maintains a constant speed. When the car is at point X on the ramp, which vector best represents the direction of the car's acceleration?

9.  A.  B.  C.  D.  E.  F.  G.  H.  I: the acceleration is zero.

3 pt After passing point X but before reaching point Y the driver starts to push the brake pedal and applies the brakes for the rest of the exit ramp. Which vector best represents the direction of the car's acceleration when the car is at point Y?

10.  A.  B.  C.  D.  E.  F.  G.  H.  I: the acceleration is zero.

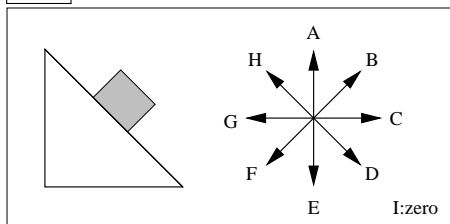
4 pt A block is at rest on a horizontal surface. (See figure.)



Which vector best represents the direction of the force exerted by the surface on the block?

11.  A.  B.  C.  D.  E.  F.  G.  H.  I: the force is zero.

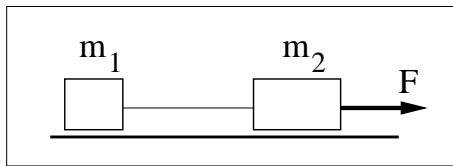
4 pt A block is at rest on a frictional incline. (See figure.)



Which vector best represents the direction of the force exerted by the surface on the block?

12.  A.  B.  C.  D.  E.  F.  G.  H.  I: the force is zero.

Two masses,  $m_1 = 2.15$  kg and  $m_2 = 6.67$  kg are on a horizontal frictionless surface and they are connected together with a rope as shown in the figure.



**3 pt** The rope will snap if the tension in it exceeds 50.0 N. What is the maximum value of the force  $\mathbf{F}$  which can be applied?

(in N)

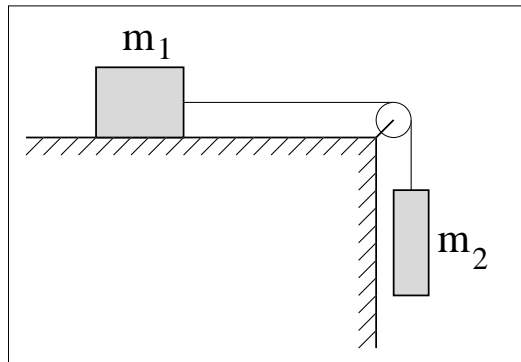
13. A   $8.72 \times 10^1$     B   $9.85 \times 10^1$     C   $1.11 \times 10^2$   
 D   $1.26 \times 10^2$     E   $1.42 \times 10^2$     F   $1.61 \times 10^2$   
 G   $1.82 \times 10^2$     H   $2.05 \times 10^2$

**3 pt** What is the acceleration of the whole system, when this maximum force is applied?

(in  $\text{m/s}^2$ )

14. A   $2.06 \times 10^1$     B   $2.33 \times 10^1$     C   $2.63 \times 10^1$   
 D   $2.97 \times 10^1$     E   $3.36 \times 10^1$     F   $3.79 \times 10^1$   
 G   $4.28 \times 10^1$     H   $4.84 \times 10^1$

**5 pt** Mass  $m_1 = 13.3$  kg is on a horizontal table. Mass  $m_2 = 5.19$  kg hangs on a rope which is attached to the first mass using a pulley. (See figure.)



The pulley is massless and frictionless. The system is observed to move with constant speed. Determine  $\mu_k$ , the coefficient of kinetic friction between mass  $m_1$  and the surface of the table.

15. A  0.239    B  0.270    C  0.306    D  0.345  
 E  0.390    F  0.441    G  0.498    H  0.563