Name: ________________________________________

# PHYS 1110-02 Exam 1

Standards 1–18

Calculators of any type are permitted. Using scratch paper is recommended and encouraged. All of the questions are multiple choice: select the one best answer from the choices provided.

1. Tor completes a 5 km run in 20 min 14 s. What is his average speed in meters per second?

   a. 2.43 b. 13.5 c. 4.12 d. 9.21

2. The world record for the mile run is under four minutes. My personal record for the mile run is 5:40. What is the average speed of my fastest mile, in meters per second?

   a. 4.74 b. 2.98 c. 15.5 d. 5.02

3. How many seconds are in a year?

   a. $3.15 \times 10^7$ b. 86,400 c. $3.6 \times 10^8$ d. 525,600

4. The world land speed record of 632 mi/h was set by Lt. Col. Paul Stapp in a rocket sled on Dec 10, 1954. He came up to this speed in five seconds, and then endured an acceleration of magnitude $46.2g$ in coming to a stop. ($g$ is the magnitude of acceleration due to gravity; $g = 9.8\ \text{m/s}^2$.)

   A. What was the magnitude of Col. Stapp's stopping acceleration in meters per second per second?

   a. 64.5 b. 453 c. 127 d. 152

   B. What was Col. Stapp's top speed in meters per second?

   a. 64.48 b. 282.53 c. 1016.9 d. 203.38

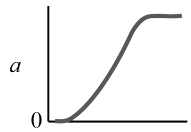
   C. If Col. Stapp's acceleration was constant as he came to a stop from rest, how far did he travel while stopping?

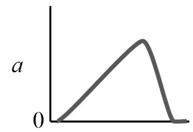
   a. 708 m b. 176 m c. 88.2 m d. 231 m

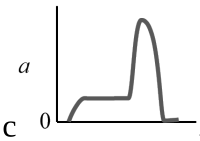
   D. How much time did it take for the rocket sled to brake from top speed to a stop?

   a. 0.625 s b. 6.73 s c. 1.39 s d. 13.6 s

E. Which of the following would represent an acceleration-time graph of Col. Stapp's record ride?

a. 

b. 

c 

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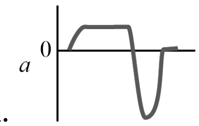
d. 


F. If we consider the forward direction to be positive, was Col. Stapp's velocity or acceleration ever negative during his ride?

a. Neither acceleration nor velocity were ever negative.

b. Velocity was sometimes negative, but acceleration was never negative.

c. Velocity was never negative, but acceleration was sometimes negative.

d. Velocity was sometimes negative, and acceleration was also sometimes negative.

5. The instantaneous velocity of an object at some time is shown graphically as the ___________________ the object's position-time graph at that time.

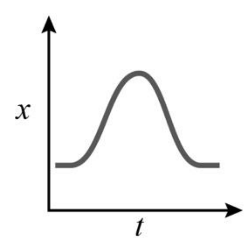
a. curvature of

b. area under

c. slope of a line tangent to

d. value of

6. The position-time graph to the right matches which description below?




a. An object moving forward, reversing to travel past the starting point in the opposite direction, then reversing again to approach the starting point while coming to a halt.

b. An object moving forward, turning around, and returning to where it began.

c. An object accelerating quickly, then easing up to a constant cruising speed.

d. An object starting from rest, speeding up, and then slowing down to a stop.

7. _________ is the rate of change of ___________, which is the rate of change of ________.

a. velocity, acceleration, position

b. position, velocity, acceleration

c. acceleration, velocity, position

d. velocity, position, acceleration.

8. Which phrase describes the position-time graph of an object moving at constant velocity?
   a. curved concave upward
   b. a straight line
   c. curved concave downward
   d. a horizontal line

9. Billy leaves his house to walk to school in the morning. It takes him 15.0 minutes to walk there at his steady speed of 1.32 m/s. At 2.5 minutes after he leaves the house, his mother notices that his lunch is on the counter. She carries the lunch to Billy's school. At what steady speed must his mother walk to reach Billy just as he arrives at school?

   a. 7.92 m/s b. 1.58 m/s c. 1.10 m/s d. 6.60 m/s

10 A physics student drops a hard rubber ball from his dormitory room window onto the concrete sidewalk below. The ball takes 2.45 s to reach the ground. The ball bounces straight up, and rises to half its initial height before falling back down. How much time after hitting the sidewalk does it take for the ball to reach its greatest height on the rebound?

   a. 4.90 s b. 1.73 s c. 1.23 s d. 0.817 s

11 Adrianna walked 2.20 km at a compass bearing (east of north) of 25°, and then 3.40 km at a compass bearing of 100° (10° south of east) before stopping for lunch, in a total time of 1 h 24 min.

   A. What was Adrianna's average speed?

      a. 0.89 m/s b. 0.68 m/s c. 0.44 m/s d. 1.11 m/s

   B. How far from where Adrianna started (actual distance, not distance along the path) did she stop for lunch?

      a. 4.50 km b. 1.20 km c. 5.60 km d. 5.20 km

   C. What is the compass heading (degrees clockwise of north) from where she started to where she stopped for lunch?

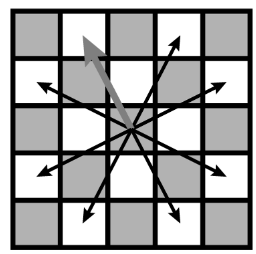
      a. 72° b. 59° c. –60° d. 18°

12. The quantity momentum is defined as mass multiplied by velocity. This has the same units as the result of what other operation?
   a. Force multiplied by acceleration
   b. Force multiplied by mass
   c. Force multiplied by time
   d. Force multiplied by distance

13. Acceleration multiplied by time gives the same units as what other operation?
    a. Force divided by mass
    b. Distance divided by time
    c. Velocity divided by distance
    d. Force divided by distance

14. A crow places a chicken bone on the roof of a house. The bone rolls off the roof, leaving the roof at a speed of 1.60 m/s at an angle of 40° below horizontal.
    A. What is the vertical component of the bone's velocity as it leaves the roof? Assume that upward is positive.
       a. 1.60 m/s  b. –1.03 m/s  c. 1.22 m/s  d. 1.03 m/s
    B. What is the horizontal component of the bone's velocity as it leaves the roof? Assume that away from the roof is the positive horizontal direction.
       a. 1.22 m/s  b. 1.60 m/s  c. 1.03 m/s  d. –1.60 m/s

15. A knight in a chess game can change position only to another square that is (±1, ±2) or (±2, ±1) squares away, as shown by the arrows in the diagram. A knight on a chessboard whose squares are of length *a* makes the move indicated by the gray arrow.



    A. What is the length of the knight's move?
       a. $2a$  b. $\sqrt{2}a$  c. $\sqrt{5}a$  d. $3a$
    B. What is the direction of the knight's move, expressed as an angle counterclockwise of a ray to the right (→)?
       a. 26.6°  b. 243.4°  c. 63.4°  d. 116.6°

16. A car tire is launched from a hobbyist's catapult at a speed of $v_0$ = 20.0 m/s at an angle of $\theta$ = 50° above horizontal from a height of $h$ = 2.50 m above the ground. For this problem, the positive $y$ direction is vertically upward, and the positive $x$ direction is forward.
    A. What is the formula for the time $t_L$ elapsed until the tire lands on the ground?
       a. $\frac{v_{0y}}{g} + \sqrt{\left(\frac{v_{0y}}{g}\right)^2 + 2h/g}$
       b. $2h/g - 2v_{0y}/g$
       c. $h + v_{0y} - \frac{1}{2}g$
       d. $2h/g + \sqrt{v_{0y}/g - v_{0y}^2}$

B. What is the formula for the horizontal distance traveled by the tire when it lands on the ground?

a. $v_{0x}t_L$ b. $v_{0y}t_L$ c. $h - ½\, g t_L^2$ d. $v_0^2 \sin(2\theta)/g$

17. A 2500-kg elevator suspended by a steel cable accelerates upward at a rate of 1.20 $m/s^2$.

A. What is the magnitude of the net force acting on the elevator?

a. 3,000 N b. 21,500 N c. 27,500 N d. 24,500 N

B. What is the weight of the elevator?

a. 3,000 N b. 21,500 N c. 27,500 N d. 24,500 N

C. What is the tension in the elevator's cable?

a. 3,000 N b. 21,500 N c. 27,500 N d. 24,500 N

18. A cantaloupe weighing 15 N sits on a table. From this, we know that

A. ____________ exerts a downward force of 15 N on the cantaloupe.

a. The Earth b. The table c. The cantaloupe d. Gravity

B. ____________ exerts an upward force of 15 N on the cantaloupe.

a. The Earth b. The table c. The cantaloupe d. Gravity

C. The cantaloupe exerts a downward force of 15 N on ____________.

a. the Earth b. the table c. the cantaloupe d. gravity

D. The cantaloupe exerts an upward force of 15 N on ______________.

a. the Earth b. the table c. the cantaloupe d. gravity

19. What sort of quantity is a force?

a. Force is a scalar.

b. Force is a pure number.

c. Force is a mathematical operator.

d. Force is a vector.

20. Two security guards push an 80-kg physics teacher, each with a force of magnitude 10 newtons. What do we know about the net force acting on the teacher?

    a. The net force is zero.

    b. The net force has a magnitude of 200 newtons.

    c. The magnitude of the net force is between zero and 200 newtons.

    d. None of these.

21. A physics student walks with a constant speed up the steps of the Classroom building, at an angle of 40° above horizontal. What is the direction of the net force acting on the student?

    a. Straight upwards.

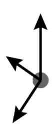
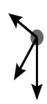
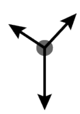
    b. 40° above horizontal.

    c. 40° below horizontal.

    d. No direction: the net force is zero.

22. A 16.0-kg chair slides down the deck of the sinking cruise ship *Costa Concordia*, which is inclined at an angle of 35° below horizontal. As it slides, it speeds up at a rate of 0.644 m/s$^2$.

    A. Which is the correct free body diagram for the chair?

    a.  b.  c.  d. 

    B. What is the weight of the chair, in newtons?

    a. 157 b. 128 c. 16 d. 90

    C. What is the magnitude of the normal force acting on the chair, in newtons?

    a. 128 b. 11.2 c. 90 d. 157

    D. What is the coefficient of kinetic friction between the chair and the deck?

    a. 1.4 b. 0.57 c. 0.70 d. 0.62