PHYS 1110—Spring 2018
Exam 1

Name: ____________________________
Student ID: ____________________________

Start time of your Tutorial (circle one):
Time: 8am  9am  10am  11am  ❌12pm  1pm  2pm  3pm  4pm

Your TA's name (circle one):
TA: Geller  Alhejji  Valencia  Yan  Knaack  Maple  Ansari  Wang  Bellas  Jaron-Becker

TEST VERSION B

Please do not open the exam until you are asked to.

- Write in and bubble in your name and student ID number on the bubble sheet now.
- Bubble in the TEST VERSION (B) at the center of the bubble sheet now.
- For a missing or wrong student ID we subtract 2 points! Same goes for TEST VERSION!
- As you take the exam, show all your work on the exam and circle the correct answers on your exam. Your circled answers and bubbled answers must agree.

The exam consists of 25 multiple choice questions, worth 4 points each for a total of 100 points. When you are finished, turn in your bubble sheet AND your booklet.

Allowed material: Hand-written equation sheet (one side of one letter-sized piece of paper), pencils and erasers. Calculators are allowed, but cell phones are not and must be turned off.

By handing in this exam, you agree to the following statement: "On my honor, as a University of Colorado Student, I have neither given nor received unauthorized assistance on this work"

Signature ____________________________

Possibly useful information:

\[
\begin{align*}
\sqrt{2}, 45^\circ, 1 & \\
45^\circ, 1 & \\
2, 60^\circ, 1 & \\
\sqrt{3} & \\
\end{align*}
\]

\[g = 9.8 \text{ m/s}^2\]
1 in = 2.54 cm
1 mi = 5280 ft
1 hr = 3600 s
1. The postage stamp shown in the diagram has a length 32.0 mm and a width of 24.0 mm. Express the area of the stamp in standard units. (Hint for Exam 1 only: 1 mm = 1 \times 10^{-3} \text{ m}. For future exams we will expect you to have these prefixes memorized or on your formula sheet!)
   
   A. 768 mm
   B. 768 m²
   C. 5.6 \times 10^{-2} \text{ m}²
   D. 7.68 \times 10^{-4} \text{ m}²
   E. 1024 mm²

2. The diagram below shows a strobe photograph of a ball rolling up a ramp. The time interval between each photograph is the same.

   ![Diagram of a ball rolling up a ramp]

   Which option below correctly shows the acceleration of the ball at position 6 (the turnaround point)?
   
   A. A
   B. B
   C. C
   D. D
   E. The acceleration is zero

3. A car is backing straight out of its parking space. The car is currently slowing down and will soon come to rest. What are the signs of the velocity and the acceleration of the car at this moment? Take the convention that forward is the positive direction.

   A. \( v \) is positive and \( a \) is positive.
   B. \( v \) is positive and \( a \) is negative.
   C. \( v \) is negative and \( a \) is zero.
   D. \( v \) is negative and \( a \) is positive.
   E. \( v \) is negative and \( a \) is negative.
4. An object at an initial time $t_1$ has a velocity vector $\vec{v}_1$ as shown. At time $t_2$ the same object has velocity vector $\vec{v}_2$. What is the direction of the average acceleration vector over the time period $\Delta t = t_2 - t_1$?

A. A  
B. B  
C. C  
D. D  
E. None of these

5. A ball rolls along the inside of a metal ring on a horizontal surface and then exits the ring at the gap shown. The ball rolls with constant speed in the entire trajectory. At which of the labeled points is the magnitude of the ball’s acceleration zero?

A. 1 and 3 only  
B. 4 only  
C. 1, 2, 3 only  
D. 1, 2, 3, and 4 (i.e. always zero)  
E. Acceleration is never zero

6. A baseball player throws a ball in the trajectory shown. Ignore air resistance. Consider the following statements:

(i) At point 2 the acceleration is zero.  
(ii) At point 2 the speed is zero.  
(iii) The speed at point 1 is equal to the speed at point 3.  
(iv) At points 1 and 3 the acceleration is zero.

Which one or more of these statements is/are true?

A. Only statement (i)  
B. Only statement (ii)  
C. Only statement (iii)  
D. Only statement (iv)  
E. More than one statement is true

Version B
7. Two runners are warming up in adjacent lanes of a straight 100m track. Their motion is described in the plot of velocity shown. The runners are at the same location along the track at the start of the plot (t=0).

Which of the following statements is CORRECT?

A. At time E, the runners are at the same location.
B. At time E the runners are moving in the same direction and runner 2 is ahead of runner 1.
C. Runner 1 moves in the same direction throughout the time of the plot.
D. Runner 1 is never stationary.
E. Runner 2 does not accelerate throughout the time of the plot.

8. A car is traveling clockwise around the circular track shown below. As it passes point P, it is slowing down. Which of the vector options best represents the acceleration of the car as it passes point P?

Version B
9. In a re-enactment of a historical battle, a cannon ball is fired with a speed of 32 m/s at an angle of 25 degrees above the horizontal. It is fired from ground level and lands at ground level somewhat short of its intended target. How far is the landing spot from the cannon?

A. 80 m  
B. 209 m  
C. 37 m  
D. 88 m  
E. 41 m

10. What could be done to increase the range of the cannon in the previous problem, so that the cannon ball reaches its target? Consider the following options:

(i) Increase the launch angle (relative to the horizontal) up to 45 degrees.
(ii) Increase the launch angle (relative to the horizontal) as much as possible.
(iii) Increase the launch speed.
(iv) Decrease the launch speed.
(v) Raise the cannon above ground level for launch.

Which one or more of these options should the operator choose?

A. iii only  
B. iii and v  
C. ii, iii and v  
D. i, iii and v  
E. ii and iii

11. Which of the following correctly expresses the components of $\vec{f} - \vec{e} - \vec{d}$? [Take positive $x$ to be to the right, and positive $y$ to be up.]

A. $(\vec{f} - \vec{e} + \vec{d})_x = -2$, $(\vec{f} - \vec{e} + \vec{d})_y = 4$
B. $(\vec{f} - \vec{e} + \vec{d})_x = -\sqrt{5}$, $(\vec{f} - \vec{e} + \vec{d})_y = \sqrt{5}$
C. $(\vec{f} - \vec{e} + \vec{d})_x = 0$, $(\vec{f} - \vec{e} + \vec{d})_y = 4$
D. $(\vec{f} - \vec{e} + \vec{d})_x = -2$, $(\vec{f} - \vec{e} + \vec{d})_y = 0$
E. $(\vec{f} - \vec{e} + \vec{d})_x = 1$, $(\vec{f} - \vec{e} + \vec{d})_y = 2
12. Under what condition is \(|\mathbf{A} + \mathbf{B}| = |\mathbf{A}| - |\mathbf{B}|\)?
   A. The statement is always true.
   B. The statement is never true.
   C. Vectors \(\mathbf{A}\) and \(\mathbf{B}\) point in perpendicular directions.
   D. Vectors \(\mathbf{A}\) and \(\mathbf{B}\) point in the same direction.
   E. Vectors \(\mathbf{A}\) and \(\mathbf{B}\) point in opposite directions.

13. An object's velocity vs. time graph is shown. Which situation produces this kind of motion? [Take "up" and "right" as positive.]
   A. A rock is thrown straight up and then falls
   B. A rock is dropped from rest
   C. A rock is thrown straight down
   D. A book slides to the right and comes to rest
   E. More than one of the above

14. A train car moves along a long, straight track. The graph shows the position versus time for the train. The graph shows that, during the time interval from \(t_1\) to \(t_2\), the train...
   A. speeds up all the time.
   B. slows down all the time.
   C. speeds up part of the time and slows down part of the time.
   D. moves at constant velocity.
   E. None of these statements are true.

15. I attach a support wire to my tree to stop it from being blown over. The top of the support wire is attached to the trunk a distance of 2.4 m above the ground. The other end of the support wire is attached to a stake at ground level. The angle between the trunk and the wire, \(\theta\), is 40 degrees. What is the length of the support wire?
   A. 2.4 m
   B. 1.4 m
   C. 1.8 m
   D. 3.7 m
   E. 3.1 m
16. Students are given information about the velocity of an object (as shown in the top diagram) and asked to sketch in corresponding acceleration and position versus time plots. Which student (A through D) below is correct?

![Diagram of motion graphs]

A. Student A  
B. Student B  
C. Student C  
D. Student D  
E. None of these

17. A rock is dropped off a cliff and it takes a time $t$ for the rock to strike the ground, far below. Now, a second rock, with four times the mass of the first rock, is dropped off the same cliff. How long will it take for the second rock to strike the ground? Ignore air resistance.

A. $t/16$  
B. $t/4$  
C. $t/2$  
D. $t$  
E. $2t$
18. A block of mass 2 kg is acted on by only two forces: 1 N (directed to the left) and 1 N (directed to the right). Consider the following statements:
   (i) It could be accelerating to the left or to the right.
   (ii) It cannot be accelerating, but it might be moving.
   (iii) It cannot be moving.

Which statements are TRUE?
A. (i) only
B. (ii) only
C. (iii) only
D. (i) and (iii)
E. None of the statements are true.

19. The diagram below shows a block with 2 (and only 2) steady forces being exerted on it. The length of the arrows accurately represent the magnitudes of the forces. Which of the plots could describe the motion of the block?

A. A
B. B
C. C
D. D
E. E
20. Two books are sitting on a bench. A strong, negligibly thin thread is tied around the upper book ONLY. I pull the string gently in the vertically upwards direction. The books remain in contact with each other and the lower book remains in contact with the bench. Which is the correct free body diagram for the lower book in this situation? (Note that we are using the same force notation as in tutorials: $F_{12}$ is the force ON object 1, exerted BY object 2).

21. We now place the same 2 books (no string) on the floor of an elevator as shown. The elevator and the books accelerate upwards. The same subscript notation is used as in the previous question, with the addition of $F = \text{Floor}$. Which statement below correctly explains why the upper book accelerates upwards in this situation?

A. Because $W_{UB} < N_{UL}$ in this situation
B. Because $W_{UB} = N_{UL}$ in this situation
C. Because $W_{UB}$ decreases when the elevator accelerates upwards
D. Because $W_{LE} < N_{UL}$ in this situation
E. Because $W_{RE} < N_{UL}$ in this situation
22. In experiment 1, a force of magnitude \( F \) acts on a mass \( m_1 \) resulting in acceleration \( a \). In experiment 2, a force of magnitude \( 2F \) acts on a mass \( m_2 \) and results in the same acceleration, \( a \), as experiment 1.

Now imagine experiment 3, in which \( m_1 \) and \( m_2 \) are glued together and a force of magnitude \( F \) acts on this combination.

What is the resulting acceleration?
A. \( 3a \)
B. \( 2a \)
C. \( a/3 \)
D. \( a/2 \)
E. \( 2a/3 \)

23. Those survivors are still stuck on the desert island, and so a plane is delivering supplies (again!). At the instant that the plane drops the parcel, it is flying horizontally at a speed of 520 km/hr and is a horizontal distance of 967 m in front of the landing zone. Air resistance may be ignored. You may assume that the landing zone is at sea level. What is the altitude of the plane, if the package hits the landing zone? [Note: 1 km = 1000 m]
A. 33 m
B. 17 m
C. 220 m
D. 1080 m
E. 752 m
24. Vector \( \mathbf{A} \) points in the \(+y\)-direction and has length 3. Vector \( \mathbf{B} \) points in the \(+x\)-direction and has length 2. Find the direction of \( \mathbf{C} = \mathbf{A} + \mathbf{B} \) measured counterclockwise from the \(+x\)-direction.

A. 15°
B. 22°
C. 30°
D. 34°
E. 56°

25. You’re driving along a straight road at a speed \( v \) when you spot a stationary moose on the road, a distance \( d \) ahead of you. You immediately step on the brakes. The brakes result in a steady, net horizontal braking force \( F \) being exerted on the car. The combined mass of you and the car is \( m \). You come to a stop with your front fender just touching the moose (he is OK!). What is the stopping distance, \( d \)?

A. \( \frac{mv}{2F} \)
B. \( \frac{mv^2}{2F} \)
C. \( \frac{2mv^2}{F} \)
D. \( \frac{Fv^2}{2m} \)
E. \( \frac{mv^2}{F} \)