PHY 2053 – Review Test I

Show all work in the spaces provided where appropriate. Label answer with its unit when appropriate.

1. Today, the *standard unit of mass* is defined in terms of:

__________________________________________________________________________________
__________________________________________________________________________________

2. The surface of a circular lake has an area of 15.5 km$^2$. (a) What is the area of the lake in mi$^2$? (b) What is the radius of the lake in mi?

(a) __________________________ mi$^2$

(b) __________________________ mi

3. Consider the equation $v = \frac{1}{3} z x t^2$. The dimension (in SI units) of the variables are:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x$</td>
<td>m</td>
</tr>
<tr>
<td>$v$</td>
<td>m/s</td>
</tr>
<tr>
<td>$t$</td>
<td>s</td>
</tr>
</tbody>
</table>

What is the dimension (in SI units) of the variable $z$ so that both sides of the equation are dimensionally equal?

________________________
4. Using the units given for the variables in the table, determine which of the following equations is dimensionally correct:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>1/s</td>
</tr>
<tr>
<td>l</td>
<td>m</td>
</tr>
<tr>
<td>g</td>
<td>m/s²</td>
</tr>
</tbody>
</table>

(a) \[ f = \frac{g}{2\pi l} \]
(b) \[ 2\pi f = \sqrt{\frac{l}{g}} \]
(c) \[ f = 2\pi l g \]
(d) \[ f = 2\pi \sqrt{\frac{g}{l}} \]

5. Which of the following expression may be used to express the angle \( \theta \) shown in the drawing?

a. \( \theta = \cos^{-1} \left( \frac{2}{5} \right) \)

b. \( \theta = \sin^{-1} \left( \frac{2}{5} \right) \)

c. \( \theta = \tan^{-1} \left( \frac{5}{2} \right) \)

d. \( \theta = \tan^{-1} \left( \frac{2}{5} \right) \)

6. A 3.00 m ladder leans against a wall and makes an angle of 32.0° with the wall as shown. What is the height \( h \) above the floor where the ladder makes contact with the wall?
7. A cruise ship leaves the home port (origin) and makes the following displacements in this sequence:

- **A** = 50.0 m, east (1\textsuperscript{st} displacement)
- **B** = 10.0 m, 22° south of east (2\textsuperscript{nd} displacement)
- **C** = 30.0 m, 46° south of west (3\textsuperscript{rd} displacement)

Draw a diagram (to an approximate scale) showing the head to tail addition of the three displacements made by the ship, in their order. Also indicate the resultant displacement (from the home port to the 3\textsuperscript{rd} displacement)

Use the component method to obtain the following {Be sure to indicate the appropriate sign of the components}:

- \(A_x = \) _________________________  \(A_y = \) _________________________
- \(B_x = \) _________________________  \(B_y = \) _________________________
- \(C_x = \) _________________________  \(C_y = \) _________________________
- \(|R| = \) _________________________  \(\theta = \) _________________________° (ccw from + x axis)
8. In which of the following situations does a car have a westward acceleration?

a. the car travels westward at constant speed 
   b. the car travels eastward and speeds up 
   c. the car travels westward and slows down 
   d. the car travels eastward and slows down 

9. A ball is thrown vertically upward from the surface of the earth. Consider the following quantities:

   (1) velocity of the ball  
   (2) acceleration of the ball

Which of these is (are) zero when the ball reaches maximum height?

a. 1  
   b. 2  
   c. 1 and 2  
   d. none of the above

10. A bug is moving along a straight line in the positive x direction. The graph shows its position from the starting point as a function of time with various segments of the path labeled A, B, C, and D.

   a. What is the velocity of the bug at \( t = 8 \text{ s} \)?

   ___________________________

   b. What is the average velocity of the bug in segment D?

   ___________________________

c. What is the total distance covered by the bug (from start to finish)?

   ___________________________

d. What is the total displacement of the bug (from start to finish)?

   ___________________________

e. What is the total average velocity of the object (from start to finish)?

   ___________________________
11. A driver in a car is traveling at 30.0 m/s when he notices a boulder blocking the road up ahead. He
slams on the brakes (the instant he sees it) and the car decelerates uniformly at 5.00 m/s².

a. What is the stopping distance of the car, as measured from the point where the driver first notices
the boulder?

_________________________

b. Assume that the boulder is located from the car at the distance found above (part a.) when the
driver sees it, but now his reaction time is 0.500 s (time it takes before the driver to react and apply
the brakes). At what speed will the driver hit the boulder?

_______________________________
12. A ball is thrown vertically upward from the surface of the Earth with an initial speed of 8.0 m/s. Neglect any effects due to air resistance. (Consider ± sign of vector quantities)

a. What is the ball's displacement from the starting point after 1 second has passed?

____________________________

b. What maximum height will the ball reach?

____________________________

c. What is the velocity of the ball 1.5 seconds after it is thrown?

____________________________

d. How much time is the ball in flight? (from its initial throw to its return to the original launch position)?

____________________________
13. A prankster on the 3rd floor of the science building which is 20.0 m above the ground, drops a balloon from rest. A chemistry student is running at a constant velocity on the ground at a horizontal distance of 25.0 m from the base of the building.

a. How long does it take for the balloon to drop down to the ground?

___________________________

b. At what (constant) speed should the chemistry student (from his horizontal distance of 25.0 m) be running toward the base of the building if he is to catch the balloon at ground level?

___________________________
14. A tennis ball is thrown upward at an angle from point $A$. At the instant shown, the ball is at point $B$. Point $C$ represents the maximum height of the ball above the ground. Point $D$ represents the instant the ball strikes the ground.

a. At which point is the speed of the ball equal to the speed that the ball had initially (at point $A$)?
   (a) $B$
   (b) $C$
   (c) $D$
   (d) none of the above

b. At which point is the vertical velocity of the ball zero?
   (a) $A$
   (b) $B$
   (c) $C$
   (d) $D$
   (e) none of the above

c. At which point is the horizontal velocity of the ball zero?
   (a) $A$
   (b) $B$
   (c) $C$
   (d) $D$
   (e) none of the above
15. A football is kicked from the ground with an initial velocity $v_0 = 20.0 \text{ m/s}$, $55.0^\circ$ above the horizontal. Neglect air resistance.

   a. How long is the football in the air before it returns to the ground?

   ______________________________

   b. How far does the football travel \textit{horizontally} before it hits the ground?

   ______________________________
16. A shell is fired from a gun (at ground level) and has an initial velocity of components: 
$v_{ox} = 30.0 \, \text{m/s}, \text{ and } v_{oy} = 40.0 \, \text{m/s}$.

a. What is the magnitude of the shell’s initial velocity? 

_______________________

b. At what angle above the horizontal is the shell initially fired from? 

_______________________

c. How long does it take the shell to reach maximum height? 

_______________________

d. What is the x-component of the shell’s velocity when it reaches maximum height? 

_______________________

e. What are the x and y components of shell’s acceleration when it reaches maximum height? 

_______________________   _______________________

f. What is the magnitude of the shell’s final velocity? (at the instant of impact with the ground) 

$v = ________________________$
17. This time the shell is fired with only an *initial horizontal velocity* \((v_{oy} = 0)\) but instead of ground level, it is fired from the top of an 80.0 m high cliff. The shell strikes the ground at a horizontal distance of 1,330 m from the base of the cliff.

a. How long is the shell in the air?

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b. What are the *x and y components of the shell’s final velocity*?

____________________________   _______________________

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1. The standard unit of mass in the SI system is the kilogram. The kilogram is defined as the mass contained in a platinum-iridium cylinder kept at the Bureau of Weights and Measures in Sevres, France.

2. (a) 5.99 mi²  (b) 1.38 mi

3. 1/s³

4. (d)

5. c.

6. 2.54 m

7. \[ A_x = 50.0 \text{ m}, \quad A_y = 0, \]
   \[ B_x = 9.27 \text{ m}, \quad B_y = -3.75 \text{ m}, \]
   \[ C_x = -20.8 \text{ m}, \quad C_y = -21.6 \text{ m}, \]
   \[ |R| = 46.1 \text{ m}, \quad \theta = 327° \]

8. d.

9. a.

10. a. 0, b. 1 m/s, c. 35 m, d. 0, e. 0

11. a. 90.0 m, b. 12.2 m/s

12. a. 3.10 m, b. 3.27 m, c. -6.70 m/s, d. 1.63 s

13. a. 2.02 s, b. 12.4 m/s

14. a. (c) D, b. (c) C, c. (e) none of the above

15. a. 3.34 s, b. 38.3 m

16. a. 50.0 m/s, b. 53.1°, c. 4.08 s, d. 30.0 m/s, e. 0, -9.8 m/s², f. 50.0 m/s

17. a. 4.04 s, b. 329 m/s, -40.0 m/s