

WLHS AP Physics  
Practice for the Final Exam, 2022  
No calculators or other electronic devices.

Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

TA: \_\_\_\_\_

Date: \_\_\_\_\_

Exam, Form: A

**Units, dimensions, and scaling:** The volume of an object as a function of time is given by  $V = At^3 + B/t$ , where  $t$  is time measured in seconds and  $V$  is volume measured in cubic meters.

1. What are the dimensions of  $A$  and  $B$ ?

2. What are the units  $A$  and  $B$ ?

**Race:** In a 100 meter race, Bill and Ted cross the finish line at the same moment, both taking 11 seconds. Accelerating uniformly, Bill takes 2 s and Ted takes 4 s to attain maximum speed, which they maintain for the rest of the race.

3. What are their respective maximum speeds?

4. What is the acceleration of each sprinter?

5. Which sprinter is ahead at the 6 second mark? By how much?

**Vectors:** Consider two vectors  $\vec{A} = 3\hat{x} - 2\hat{y}$  and  $\vec{B} = -\hat{x} - 4\hat{y}$

6. Compute  $\vec{A} + \vec{B}$

7. Compute  $\vec{A} - \vec{B}$

8. Compute the magnitude and direction of  $|\vec{A} + \vec{B}|$

**Projectiles (Just use a calculator on this practice problem):** A cannonball is fired at an angle of 30 degrees above a flat surface with a speed of 40 m/s.

9. What are the horizontal and vertical components of its initial velocity?

10. What is the maximum height achieved by the cannonball?

11. What is the range of the cannonball?

12. What is the velocity of the cannonball when it strikes the ground?

**Ice skater:** An ice skater moving at 10 m/s coasts to a halt in 100 m on an ice surface.

13. What is the coefficient of friction between ice and skates? You can use a calculator on this practice problem.

**Swing:** A 30 kg child sits on a swing supported by two chains, each 3 m long. The tension in each chain at the lowest point is 350 N.

14. Find the child's speed at the lowest point.

**Collision:** A 10 kg mass approaches a stationary 5 kg mass at a speed of 2 m/s. After colliding, the 10 kg mass has slowed to a speed of 1 m/s.

15. What is the speed of the 5 kg mass after the collision?

16. What is the total kinetic energy before and after the collision? Is it conserved?

**Rotation:** A 1 meter diameter solid disk of mass 10 kg spins around once per second.

17. What is the angular momentum of the disk?

18. What constant torque must be applied to bring the disk to a stop in 5 seconds?

**Fluid:** A fluid filled cylinder with two openings, each with a movable piston. The large opening has a radius of 1 cm. The small opening has a radius of 0.5 cm.

19. If the piston in the small end is moved in at 1 cm/second, at what speed does the large piston move out?

20. If the small piston is pushed with a force of 1 pound, what is the force exerted by the large piston ?