Mathematics.

1. Another equation describing linear motion in the *x*-direction is given by

$$v = v_o + at.$$

Solve this equation for *t*.

2. How did the trial and subsequent house arrest of Galileo Galilei affect the Scientific Revolution in Italy? Why didn't Isaac Newton undergo the same treatment by the Church of England (which also held with a geocentric view of the universe)?

3. After collecting your $4 million winnings from the Michigan Lottery™, you hurriedly catch a flight from Detroit to Burkina Faso (where the United States does not have an extradition treaty for tax evasion). At the airport, you encounter a conveyor walkway that is 75 m long and has a speed of 2.25 m/s relative to the ground. If it takes you 72 s to cover 75 m when walking on the ground, how long will it take you to cover the same distance on the conveyor? Assume you walk with the same speed on the walkway as you do on the ground.

4. Approximately how many *bb*'s can fit in the physics classroom at the Center?

5. A killer whale comes to the surface of the ocean to breathe, then dives at an angle of 15º below the horizontal. If the orca continues in a straight line for 150 m, (a) how deep is it and (b) how far has it traveled horizontally?

6. Why was Johannes Kepler's use of the ellipse to describe the orbits of planets around the Sun so controversial and difficult to accept?

7. You are sailing in a boat, with the wind pushing you along at 12.5 knots. You are moving away from the shoreline at an angle of 22º. What is your velocity relative to the beach?

8. Given vectors ***A*** = (33 m/s, 57º) and ***B*** = (18 m/s, 192º), (a) what is the magnitude of the resultant vector in the *x*-direction? (b) What is the magnitude of the resultant vector in the *y*-direction? (c) What is the direction of the resultant vector? (d) What is the magnitude of the resultant vector?

9. A chessboard square is $3\frac{1}{2}$ cm on a side. A player moves a knight from **g**8 to **f**6, then to **h**5, and finally to **g**3. What is the resultant vector of the knight? Hint: you may need to research the format of chessboard "axes" before attempting to solve this problem.

10. Given $x = x_o + v_o t + \frac{1}{2}at^2$ and $v = v_o + at$, use these two equations to show that

$$v^2 = v_o^2 + 2a(x - x_o).$$

11. Given vectors ***M*** = (15 N, 37º), ***N*** = (18 N, 298º), and ***O*** = (22 N, 112º), (a) what is the magnitude of the resultant vector in the *x*-direction? (b) What is the magnitude of the resultant vector in the *y*-direction? (c) What is the direction of the resultant vector? (d) What is the magnitude of the resultant vector?

12. It takes light approximately $1\frac{1}{3}$ s for light reflected from the surface of the Moon to reach the Earth. How far is the Moon from the Earth?

13. Galileo Galilei once wrote "The book of nature is written in mathematical symbols". What does that mean?

14. The period T for one orbit of a planet at a distance a about a star with mass M is given by

$$T^2 = \frac{4\pi^2}{GM} a^3.$$

Find the units that G must have in order for this equation to be dimensionally correct.

15. How many graduates of The Ohio State University (*Go Bucks!*) live in Michigan?

16. An astronaut "floats" through space along a velocity vector of $\boldsymbol{V}$ = (15 m/s, 25º) relative to the long axis on the International Space Station. If she fires a personal maneuvering unit so it adds a velocity of $\boldsymbol{v}$ = (3.5 m/s, 45º), what is her resultant velocity vector?

17. Given vectors $\boldsymbol{A}$ = (174 N, 157º) and $\boldsymbol{B}$ = (198 N, 92º), (a) what is the magnitude of the resultant vector in the x-direction? (b) What is the magnitude of the resultant vector in the y-direction? (c) What is the direction of the resultant vector? (d) What is the magnitude of the resultant vector?

18. Given vectors $\boldsymbol{R}$ = (72 mi/h, 127º), $\boldsymbol{S}$ = (70.4 ft/s, 78º), and $\boldsymbol{T}$ = (1,760 yd/min, 112º), (a) what is the magnitude of the resultant vector in the x-direction? (b) What is the magnitude of the resultant vector in the y-direction? (c) What is the direction of the resultant vector? (d) What is the magnitude of the resultant vector?

19. Given vectors $\boldsymbol{M}$ = (66 km/h, 292º), $\boldsymbol{N}$ = (12.6 m/s, 178º), and $\boldsymbol{O}$ = (1.24×10^5 cm/min, 202º), (a) what is the magnitude of the resultant vector in the x-direction? (b) What is the magnitude of the resultant vector in the y-direction? (c) What is the direction of the resultant vector? (d) What is the magnitude of the resultant vector?

20. What was the Tychonic solar system? How did it differ from the Ptolemaic and Copernican systems?

21. You are flying an ultralight airplane with an airspeed of 44 km/h with a headwind pushing against you at 1.22 m/s. If you are rising upwards at an angle of 6º relative to the ground, (a) what is your groundspeed? (b) If you change direction so now you have a tailwind pushing you, what is your new groundspeed?

22. Which of Galileo Galilei's two major works, *A Dialogue Concerning the Two Chief World Systems* or *Discourses and Demonstrations Relating to Two New Sciences*, was the most important? Why?

23. A U.S. Marine Sikorsky SH-3A Sea Stallion rescue helicopter is preparing to land on the deck of the USS *Gerald R. Ford* aircraft carrier. The ship is moving at 14 knots due west with respect to the water, which is flowing $6\frac{1}{2}$ knots north. The helicopter is moving at 78 knots south while the wind is blowing due east at 16 knots, both with respect to the aircraft carrier. (a) What is the speed and direction of the ship's motion relative to the helicopter? (b) What is the speed and direction of the helicopter's motion relative to the ship?

24. Approximately how many Snickers™ candy bars can fit in a VW Beetle?