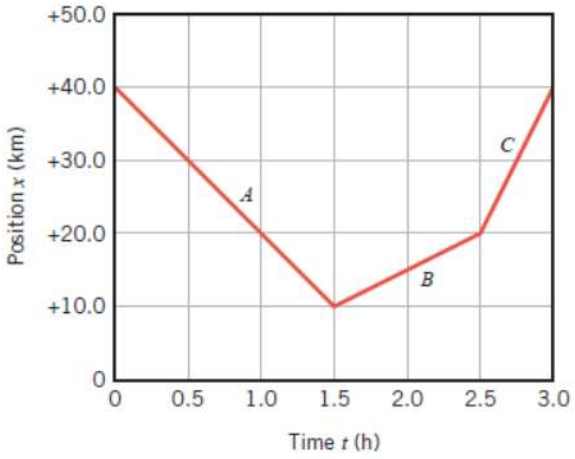
103 Phys. Homework-1

1) Express the speed limit of 65 miles/hour in terms of meters/second.
2) In which of the following equations are the units on the left side of the equals sign consistent with the units on the right side?

(a) $x = vt$
(b) $x = vt + \frac{1}{2}at^2$
(c) $v = at$
(d) $v = at + \frac{1}{2}at^3$
(e) $v^3 = 2ax^2$
(f) $t = \sqrt{\frac{2x}{a}}$

3) A bus makes a trip according to the position–time graph shown in the figure. What is the average velocity (magnitude and direction) of the bus during each of the segments A, B, and C? Express your answers in km/h.



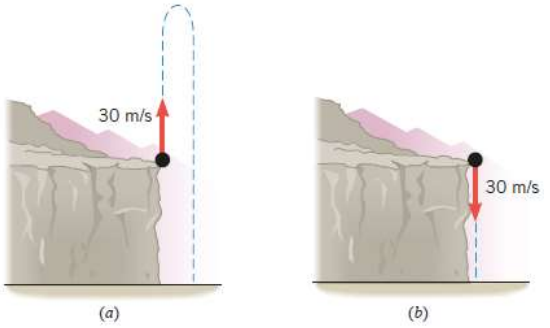
4) A race car driver begins slowing down when $t_0 = 9.0$ s and the car's velocity is v_0=28 m/s. When t=12.0 s, the velocity has been reduced to v=13 m/s. What is the average acceleration of the car?

5) A whale swims due east for a distance of 6.9 km, turns around and goes due west for 1.8 km, and finally turns around again and heads 3.7 km due east. **a)** What is the total distance traveled by the whale? **b)** What are the magnitude and direction of the displacement of the whale?

6) **a)** Suppose that a race car is moving to the right with a constant velocity of +82 m/s. What is the average acceleration of the car? **b)** Twelve seconds later, the car is halfway around the track and traveling in the opposite direction with the same speed. What is the average acceleration of the car?

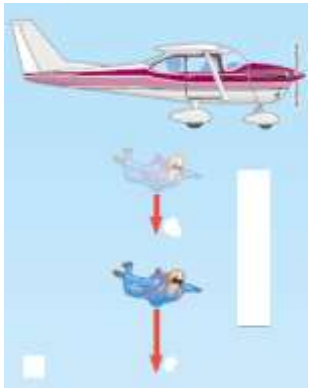
7) A jet is taking off from the deck of an aircraft carrier, as shown in the Figure. Starting from rest, the jet is catapulted with a constant acceleration of 31 m/s^2 along a straight line and reaches a velocity of 62 m/s. Find the displacement of the jet.

8) Figure (a) shows a pellet that has been fired straight upward from a gun at the edge of a cliff. The initial speed of the pellet is 30 m/s. It goes up and then falls back down, eventually hitting the ground beneath the cliff. In Figure (b) the pellet has been fired straight downward at the same initial speed. In the absence of air resistance, would the pellet in Figure (b) strike the ground with



a) a smaller speed than the pellet in Figure (a)
b) the same speed as the pellet in Figure (a)
c) a greater speed than the pellet in Figure (a)

9) A skydiver is falling straight down, along the negative *y* direction. During the initial part of the fall, his speed increases from 16 to 28 m/s in 1.5 s as shown in the figure. Determine the magnitude and direction of his average acceleration.



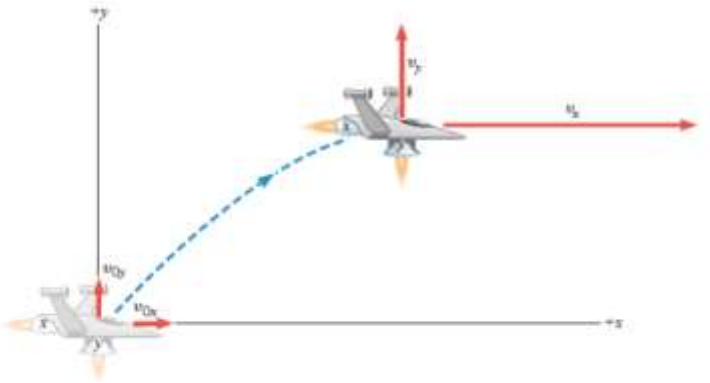
10) Two vectors **A** and **B** are added together to give a resultant vector: **R**= **A**+**B**. The magnitudes of **A** and **B** are 3m and 8m, respectively, but the vectors can have any orientation. What is
a) the maximum possible value for the magnitude of **R**?
b) the minimum possible value for the magnitude of **R**?

11) Vectors **A**, **B**, and **C** satisfy the vector equation **A**+**B**= **C**, and their magnitudes are related by the scalar equation A + B = C. How is vector **A** oriented with respect to vector **B**?

12) Which of the following displacement vectors (if any) are equal?

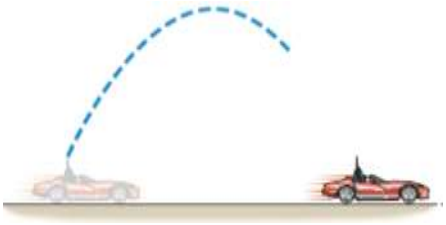
Variable	Magnitude	Direction
$\vec{A}$	100 m	30° north of east
$\vec{B}$	100 m	30° south of west
$\vec{C}$	50 m	30° south of west
$\vec{D}$	100 m	60° east of north

13) As shown in the figure, In the x direction, the spacecraft has an initial velocity component of v_{0x}=22 m/s and an acceleration component of a_x=24 m/s^2. In the y direction, the analogous quantities are v_{0y}=14 m/s and a_y = 12 m/s^2. At a time of t = 7.0 s, Find the magnitude and direction of the spacecraft's final velocity

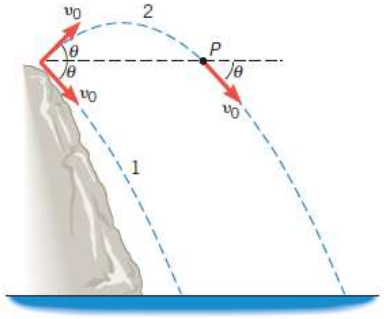


14) A power boat, starting from rest, maintains a constant acceleration. After a certain time, t, its displacement and velocity are **r** and **v**. At time 2t, what would be its displacement and velocity, assuming the acceleration remains the same?
a) 2**r** and 2**v** b) 2**r** and 4**v**
c) 4**r** and 2**v** d) 4**r** and 4**v**

15) As shown in the Figure, you point a rifle straight upward and fire it. In the absence of air resistance, would the bullet land
(a) behind you,
(b) ahead of you,
(c) in the barrel of the rifle?

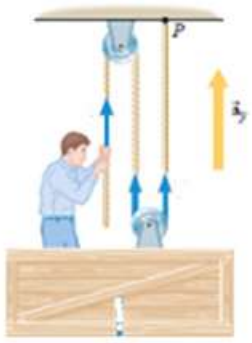


16) From the top of a cliff overlooking a lake, a person throws two stones. The stones have identical initial speeds v_0, but stone 1 is thrown downward at an angle below the horizontal, while stone 2 is thrown upward at the same angle above the horizontal, as shown in the Figure. Neglect air resistance and decide which stone, if either, strikes the water with the greater velocity:
a) both stones strike the water with the same velocity,
b) stone 1 strikes with the greater velocity,
c) stone 2 strikes with the greater velocity.

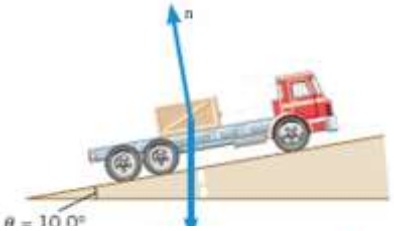


17) Which of the following statements can be explained by Newton's first law? (A); When your car suddenly comes to a halt, you lunge forward. (B); When your car rapidly accelerates, you are pressed backward against the seat.
a) Neither A nor B b) Both A and B
c) A but not B d) B but not A

18) A window washer on a scaffold is hoisting the scaffold up the side of a building by pulling downward on a rope, as shown in the Figure. The magnitude of the pulling force is 540 N, and the combined mass of the worker and the scaffold is 155 kg. Find the upward acceleration of the unit.



19) A flatbed truck is carrying a crate up a 10.0° hill, as shown in the Figure. The coefficient of static friction between the truck bed and the crate is 0.350. Find the maximum acceleration that the truck can attain before the crate begins to slip backward relative to the truck.



20) A supertanker of mass $m = 1.50 \times 10^8$ kg is being towed by two tugboats, as shown in the Figure. The tensions in the towing cables apply the forces $\mathbf{T_1}$ and $\mathbf{T_2}$ at equal angles of 30.0°with respect to the tanker's axis. In addition, the tanker's engines produce a forward drive force **D**, whose magnitude is $\boldsymbol{D} = 75.0 \times 10^3$ N. Moreover, the water applies an opposing force **R**, whose magnitude is $\boldsymbol{R} = 40.0 \times 10^3$ N. The tanker moves forward with an acceleration that points along the tanker's axis and has a magnitude of 2×10^{-3} m/s^2. Find the magnitudes of the tensions $\mathbf{T_1}$ and $\mathbf{T_2}$