Closed book. No work needs to be shown for multiple-choice questions.

1. Density is the ratio of mass to volume. The element mercury has a density of 1.36×10^{4} kg/m^3. What is the density of mercury in units of g/cm^3?

a. 1.36×10^{3} g/cm^3.
b. 0.735 g/cm^3.
c. 1.36×10^{5} g/cm^3.
d. 3.45×10^{6} g/cm^3.
e. 13.6 g/cm^3.

2. A motorist makes a trip of 300 miles. For the first 220 miles she drives at a constant speed of 55 mph. At what constant speed must she drive the remaining distance if her average speed for the total trip is to be 50 mph?

a. 55 mph.
b. 52.5 mph.
c. 50 mph.
d. 45 mph.
e. 40 mph.

3. A projectile is shot vertically upward with a given initial velocity. It reaches a maximum height of 100 m. Neglect air resistance. If, on a second shot, the initial velocity is doubled then the projectile will reach a maximum height of:

a. 70.7 m.
b. 141 m.
c. 200 m.
d. 241 m.
e. 400 m.

4. A cheetah can run approximately 100 km/hr and a gazelle at 80 km/hr. If both animals are running at full speed, with the gazelle 70 m ahead, how long before the cheetah hits its prey?

a. 25.2 s.
b. 12.6 s.
c. 6.3 s.
d. 10.7 s.
e. 21.2 s.

5. A basketball player can jump 1.6 m off the hardwood floor. With what upward velocity did he leave the floor?

a. 5.6 m/s.
b. 1.4 m/s.
c. 4.2 m/s.
d. 2.8 m/s.
e. 3.3 m/s.

6. A ship sets sail from port and follows a bearing of 30º (i.e., N 30º E) for 15 km and then alters course to a bearing of 90 º (i.e., due E) for 30 km. At this point a crew member has a serious accident and the captain requests a helicopter from the port to fly the person to hospital. He also anchors the ship. What distance and along what bearing must the helicopter fly?

a. 23.4 km at 269 º.
b. 39.7 km at 300 º.
c. 44.8 km at 60 º.
d. 23.4 km at 78 º.
e. 51.0 km at 87 º.

7. Use the method of components to add the following vectors. The angles are defined with respect to the X-axis of conventional rectangular axes. **A** = 8 units, 20°**B** = 12 units, 300° and **C** = 5 units, 60°. The resulting vector has a magnitude of

a. 15.3 units
b. 25.0 units
c. 16.0 units
d. 3.3 units
e. 16. 4 units

8. A 2.0 kg stone is thrown horizontally from a cliff with an initial speed of 10 m/s. The stone hits the bottom of the cliff 4.3 seconds after it is thrown. What is the height of the cliff? Neglect air resistance and remember that only velocities in the vertical affect vertical displacements.

a. 22 m.
b. 43 m.
c. 69 m.
d. 91 m.
e. 48 m.

Equations and constants:

$$\begin{Bmatrix} x = r\cos\theta \\ y = r\sin\theta \end{Bmatrix};\quad \begin{Bmatrix} r = \sqrt{x^2 + y^2} \\ \theta = \tan^{-1}\left(\dfrac{y}{x}\right) \end{Bmatrix};\quad \begin{Bmatrix} v_x = v_{ox} + a_x t \\ \Delta x = \frac{1}{2}\left(v_{ox} + v_x\right)t \\ \Delta x = v_{ox}t + \frac{1}{2}a_x t^2 \\ v_x^2 = \left(v_{ox}\right)^2 + 2a_x\Delta x \end{Bmatrix};\quad \begin{Bmatrix} v_y = v_{oy} + a_y t \\ \Delta y = \frac{1}{2}\left(v_{oy} + v_y\right)t \\ \Delta y = v_{oy}t + \frac{1}{2}a_y t^2 \\ v_y^2 = \left(v_{oy}\right)^2 + 2a_y\Delta y \end{Bmatrix};\quad \begin{Bmatrix} \Delta x = x_f - x_i \\ \\ speed_{avg} = \dfrac{d}{\Delta t} \end{Bmatrix};$$

$$\begin{Bmatrix} a_{avg} = \dfrac{\Delta v}{\Delta t} \\ \\ v_{avg} = \dfrac{\Delta x}{\Delta t} \end{Bmatrix};\quad \begin{Bmatrix} a = \lim\limits_{\Delta t \to 0}\dfrac{\Delta v}{\Delta t} \\ \\ v = \lim\limits_{\Delta t \to 0}\dfrac{\Delta x}{\Delta t} \end{Bmatrix};\quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a};\quad \vec{\mathrm{v}}_{\mathrm{AC}} = \vec{\mathrm{v}}_{\mathrm{AB}} + \vec{\mathrm{v}}_{\mathrm{BC}};\quad g = 9.80\ \mathrm{m/s^2};$$

$60\ \mathrm{s} = 1\ \mathrm{min};\ 60\ \mathrm{min} = 1\ \mathrm{hr};\ 24\ \mathrm{hr} = 1\ \mathrm{day};\ 365.24\ \mathrm{days} = 1\ \mathrm{yr};\ 2.54\ \mathrm{cm} = 1\ \mathrm{in};\ 12\ \mathrm{in} = 1\ \mathrm{ft};$

$5{,}280\ \mathrm{ft} = 1\ \mathrm{mi};\ 1{,}609\ \mathrm{m} = 1\ \mathrm{mi};\ 0.3048\ \mathrm{m} = 1\ \mathrm{ft}.$