Practice Problems
Physics 111 Common Exam 1, Spring 2025
Chapters 1, 2 and 3

1. 2 mm^3 is equivalent to:

A) $2 \cdot 10^{-3}$ m^3
B) $2 \cdot 10^{-6}$ m^3
C) $\mathbf{2 \cdot 10^{-9}}$ $\mathbf{m^3}$
D) $2 \cdot 10^{-12}$ m^3
E) $2 \cdot 10^{-15}$ m^3

For the following 3 problems use the vectors:
$\vec{A} = 1\hat{i} + 2\hat{j} + 0\hat{k}$ and $\vec{B} = 2\hat{i} + 2\hat{j} + 0\hat{k}$

2. Find the magnitude of $\vec{A} + \vec{B}$. Select the closest answer.

A) 1
B) 2
C) 3
D) 4
E) **5**

3. Find the dot product $\vec{A} \cdot \vec{B}$ and the angle between vectors:

A) 4, 33^0
B) 12, 38^0
C) 6, $\mathbf{18^0}$
D) 3, 48^0
E) 9, 23^0

4. At t = 0, a particle leaves the origin with a velocity of 8 m/s in the positive y direction and moves in the xy plane with a constant acceleration of $\left(-2.0\hat{\mathbf{i}} + 4.0\hat{\mathbf{j}}\right)$ m/s^2. How far from the origin is the particle 10 sec later?

A) 100 m
B) 210 m
C) 297 m
D) 424 m
E) 345 m

5. A body is projected vertically upward from the surface of the earth with a speed of 10.0 m/s. What is its speed (in m/s) when it is at ½ of its maximum height?

A) 0
B) 2.5
C) 5.0
D) 7.0
E) 10.0

6. A body moves from A to B along a straight line a distance of 100 m in 10 sec. Stops at B for 20 sec. and then returns to A at an average speed of 5 m/s. The average speed (in m/s) from A to B is:

A) 0
B) -2
C) 3
D) 4
E) 5

7. An Apache helicopter during vertical takeoff releases a package when it is at 39.2 m high and its speed is 9.80 m/s. How long (in seconds) does it take the package to reach the ground?

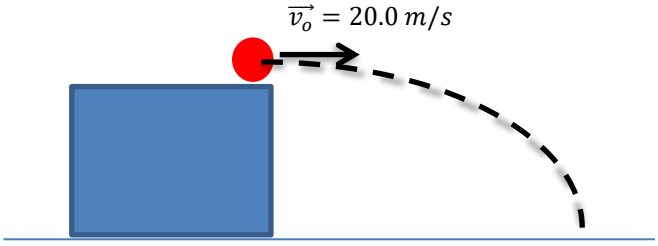
A) 1
B) 2.8
C) 3
D) 4
E) 5.2

8. The displacement of a body $x(t) = 10\ (m) + 20\ \left(\frac{m}{s}\right) t - 5\left(\frac{m}{s^2}\right) t^2$. Find the average velocity for the period between t=0 and t=5s.

A) 0
B) -1
C) 1
D) -2
E) -5

9. A ball is thrown off a 100 meters high cliff with an initial horizontal velocity of 20 m/s. How long does it take for it to hit the ground?

A) 4.5 s
B) 20.0
C) 2.0 s
D) 3.2 s
E) 12 s



10. A particle starts from the origin with velocity $5\hat{\imath}$ m/s and t=0 and moves in the xy plane with a constant acceleration of $6\hat{\jmath}$. Determine the position of the particle after 5 s:

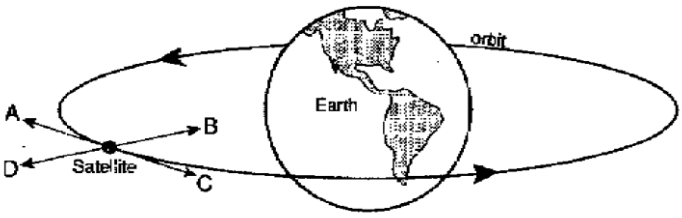
A) $\vec{r} = \mathbf{25\,\hat{\imath} + 75\,\hat{\jmath}}$
B) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$
C) $\vec{r} = 30\,\hat{\imath} + 15\,\hat{\jmath}$
D) $\vec{r} = 20\,\hat{\imath} + 30\,\hat{\jmath}$
E) $\vec{r} = 5\,\hat{\imath} + 25\,\hat{\jmath}$

11. A projectile is fired from the ground with a velocity of 110.0 m/s at an angle of 40.0 degrees above the horizontal. What will be the range (the horizontal displacement) of this projectile?

A) 125 m
B) 2350 m
C) 532 m
D) 1215 m
E) 752 m

12. The diagram shows a satellite orbiting the earth. The centripetal acceleration and velocity of the satellite, respectively, point to the following letters:

A) A and B
B) B and D
C) A and C
D) B and D
E) B and C

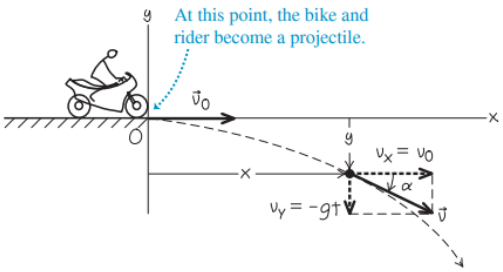


13. A firefighter, a distance d=5 meters from a burning building directs a stream of water from a fire hose at angle $\boldsymbol{\theta = 40^0}$ above the horizontal. If the initial speed of the stream is $\boldsymbol{v_i = 10}$ **m/s,** at what height h does the water strike the building?

A) 2.1 m
B) 5.1 m
C) 1.2 m
D) 1.7 m
E) 3.4 m

14. A motorcycle stunt rider rides off the edge of a cliff. Just at the edge his velocity is horizontal, with magnitude 9.0 m/s. Find the motorcycle's position, distance from the edge of the cliff, and velocity 0.50 s after it leaves the edge of the cliff. Ignore air resistance.

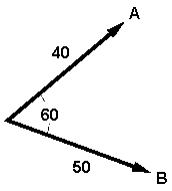
Ans. $\boldsymbol{\vec{r} = (4.5m)\hat{\imath} - (1.2\ m)\hat{\jmath}}$**;** $\boldsymbol{|\vec{r}|}$**= 4.7 m;**
v= 10.2 m/ s in a direction 29° below the horizontal.



15. A race car moving with a constant speed of 60 m/s completes one lap around a circular track in 50 s. What is the magnitude of the acceleration of the race car?

a. 8.8 m/s^2
b. 7.5 m/s^2
c. 9.4 m/s^2
d. 6.3 m/s^2
e. 5.3 m/s^2

16. Vectors $\vec{A}$ and $\vec{B}$ are shown. What is the magnitude of a vector $\vec{C} = \vec{A} - \vec{B}$?



Ans. 46

17. A web page designer creates an animation in which a dot on a computer screen has position:

$$\vec{r} = [4.0\text{ cm} + (2.5\text{ cm/s}^2)t^2]\hat{i} + (5.0\text{ cm/s})t\hat{j}$$

(a) Find the magnitude and direction of the dot's average velocity between $t = 0$ and $t = 2.0$ s. (b) Find the magnitude and direction of the instantaneous velocity at $t = 0$

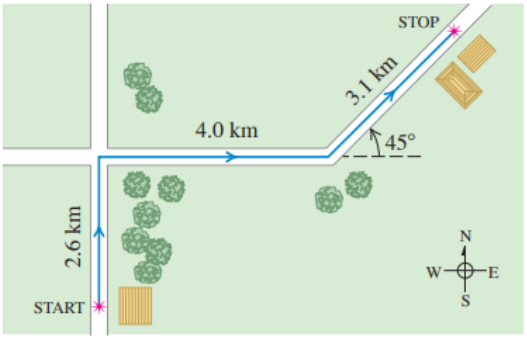
Ans. A) v_{av}=7.1cm/s, θ= 45°
B) v= 5m/s, θ= 90°

18. An object moves in a horizontal circle at constant speed v (in units of m/s). It takes the object T seconds to complete one revolution. Derive an expression that gives the radial acceleration of the ball in terms of v and T, but not r. (a) If the speed doubles, by what factor must the period T change if a_{rad} is to remain unchanged?

Ans.
if the speed doubles, T must also double to keep a_{rad} the same

19. A postal employee drives a delivery truck over the route shown in Figure. Use the method of components to determine the magnitude and direction of her resultant displacement.

Ans. 7.8 km, 38º

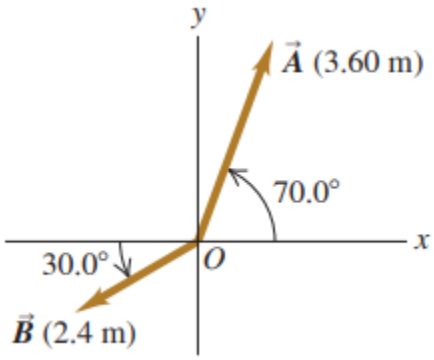


20. A disoriented physics professor drives 3.25 km north, then 2.20 km west, and then 1.50 km south. Find the magnitude and direction of the resultant displacement, using the method of components.

Ans. 2.81 km, 141.5°

21. Write each vector in figure below in terms of the unit vectors $\hat{\imath}$ and $\hat{\jmath}$. (b) Use unit vectors to express vector $\vec{C}$, where $\vec{C} = 3.00\vec{A} - 4.00\vec{B}$. (c) Find the magnitude and direction of $\vec{C}$.

Ans. (c) 19.7 m, 51.2°



22. The density of gold is 19.3 g/cm^3. What is this value in kilograms per cubic meter?

Ans. 1.93 x 10^4 kg/m^3

23. The wheel of a stationary exercise bicycle at your gym makes one rotation in 0.670 s. Consider point P on this wheel positioned 10.0 cm from the rotation axis. Find the speed of point P on the spinning wheel and the centripetal acceleration of this point.

Ans. 0.938 m/s, 8.79 m/s^2

24. A robotic vehicle, or rover, is exploring the surface of Mars. The stationary Mars lander is the origin of coordinates, and the surrounding Martian surface lies in the xy-plane. The rover, which we represent as a point, has x- and y-coordinates that vary with time:

$$x = 2.0\ \text{m} - (0.25\ \text{m/s}^2)t^2$$
$$y = (1.0\ \text{m/s})t + (0.025\ \text{m/s}^3)t^3$$

(a) Find the rover's coordinates and distance from the lander at t = 2.0 s. Ans. 2.2 m; 2.4 m
(b) Find the rover's displacement and average velocity vectors for the interval t = 0.0 s to t = 2.0 s.
(c) Find a general expression for the rover's instantaneous velocity vector $\vec{v}$. Express $\vec{v}$ at t = 2.0 s in component form and in terms of magnitude and direction.