Q1.
The body mass index (BMI) of a person is calculated in SI units using the formula:

$$\text{BMI} = \text{weight (kg)} / \text{height}^2\ (\text{m}^2)$$

Find the BMI of a person (in SI units) whose weight is 160 lb (pound) and height is 70.0 inches. (1.00 inch = 2.54 cm, 1.00 lb = 454 g).

A) 23.0
B) 16.7
C) 5.45
D) 35.0
E) 45.2

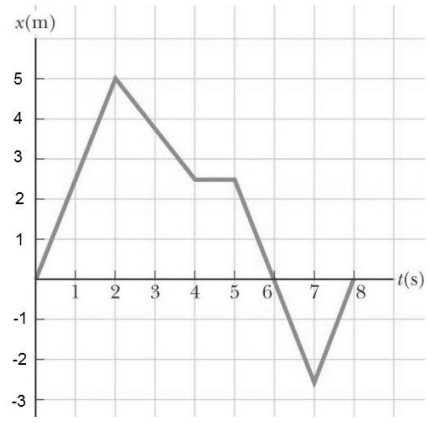
Q2.
It is observed that the frequency f (s^{-1}) of oscillations of a string depends upon its mass (M), length (L) and tension P (kg.m /s^2) as follows:

$$f = C\ P^a\ M^b\ L^c$$

where C is a dimensionless constant. Find the values of the constants a, b, and c (in this order)

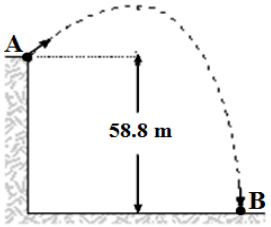
A) ½, -½, -½
B) ½, ½, -½
C) -½, ½, ½
D) ½, -½, ½
E) -½, -½, ½

Q3.
The position versus time for a certain particle moving along the x-axis is shown in **Figure 1**. The average velocity in the time interval 4.0 s to 7.0 s is:



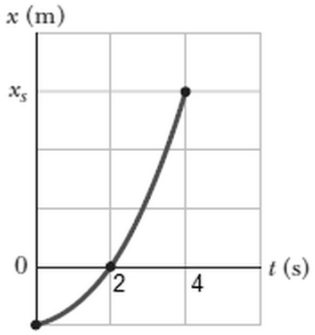
A) – 1.7 m/s
B) Zero
C) 1.7 m/s
D) 0.80 m/s
E) – 0.80 m/s

Q4.
A stone is thrown outward from point A at the top of a 58.8 m high cliff with an upward velocity component of 19.6 m/s (see **Figure 2**). Assume that it lands on the ground, at point B, below the cliff, and that the ground below the cliff is flat. How long was the stone in the air? [Neglect the air resistance].



A) 6.00 s
B) 5.00 s
C) 4.00 s
D) 7.00 s
E) 8.00 s

Q5.
Figure 3 illustrates the motion of a particle starting from rest and moving along an x-axis with a constant acceleration. The figure's vertical scaling is set by x_s = 12 m. The particle's acceleration is

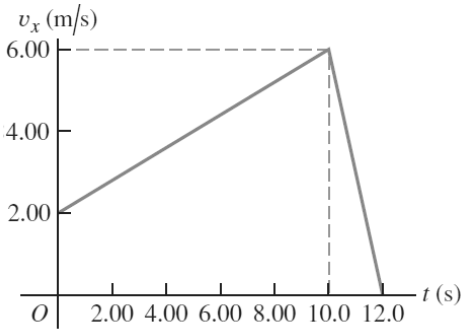


A) 2.0 m/s^2
B) 0.50 m/s^2
C) – 6.0 m/s^2
D) 6.0 m/s^2
E) –3.0 m/s^2

Q6.
A ball is thrown directly downward from a height of 30.0 m. It takes 1.79 s to reach the ground. Find the magnitude of the initial velocity.

A) 7.99 m/s
B) 1.66 m/s
C) 10.0 m/s
D) 2.00 m/s
E) 3.75 m/s

Q7.
A man is running in a straight line (along the x-axis). The graph in **Figure 4** shows the man's velocity as a function of time. During the first 12.0 s, the total distance traveled is



A) 46.0 m
B) Zero
C) 40.0 m
D) 8.00 m
E) 72.0 m

Q8.
If $\vec{A} = \hat{i} - \hat{j}$ and $\vec{B} = 3.0\,\hat{i} + 2.0\,\hat{j}$, what is the angle between the two vectors? [$\hat{i}$, $\hat{j}$ and $\hat{k}$ are the unit vectors in the x, y and z-direction, respectively]

A) 79°
B) 41°
C) 90°
D) 19°
E) 26°

Q9.
A boat is sailing due East at a speed of 6.0 m/s relative to the water of a river. The water is moving due south at a speed of 5.0 m/s relative to the ground. What is the velocity of the boat relative to the ground in unit vectors? See **Figure 5**. [$\hat{i}$, $\hat{j}$ and $\hat{k}$ are the unit vectors in the x, y and z-direction, respectively]

(North)

$\hat{j}$

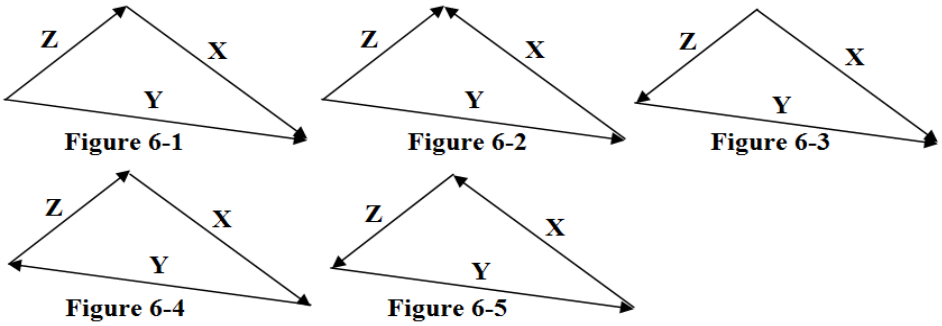
$\uparrow\rightarrow\hat{i}$ **(East)**

A) $\vec{V}_{bg} = 6.0\,\hat{i} - 5.0\,\hat{j}$
B) $\vec{V}_{bg} = 3.0\,\hat{i} - 4.0\,\hat{j}$
C) $\vec{V}_{bg} = 8.0\,\hat{i} - 5.0\,\hat{j}$
D) $\vec{V}_{bg} = 6.0\,\hat{i} - 8.0\,\hat{j}$
E) $\vec{V}_{bg} = 5.0\,\hat{i} - 4.0\,\hat{j}$

Q10.
A vector in the *xy* plane has a magnitude of 25 and the magnitude of its *x*-component is 12. The angle this vector makes with the positive *y*-axis is:

A) 64°
B) 29°
C) 61°
D) 24°
E) 41°

Q11.
The vectors **X**, **Y**, and **Z** are related by **Z - Y + X = 0**. Which diagram in **Figure 6** illustrates this relationship?



A) Figure 6-1
B) Figure 6-2
C) Figure 6-3
D) Figure 6-4
E) Figure 6-5

Q12.
The result of $(\hat{j}\times\hat{k})\times(\hat{k}\times\hat{i})$ is:
[$\hat{i}$, $\hat{j}$ and $\hat{k}$ are the unit vectors in the x, y and z-direction, respectively]

A) $\hat{k}$
B) 0
C) $\hat{i}$
D) $\hat{j}$
E) $-\hat{k}$

Q13.

A particle undergoes a displacement, $\Delta\vec{r} = 2.0\hat{i} - 3.0\hat{j} + 6.0\hat{k}$, ending with the position vector, $\vec{r} = 3.0\hat{j} - 4.0\hat{k}$ in meters. What was the particle's initial position vector? [$\hat{i}$, $\hat{j}$ and $\hat{k}$ are the unit vectors in the x, y and z-direction, respectively]

A) $-2.0\hat{i} + 6.0\hat{j} - 10\hat{k}$

B) $6.0\hat{j} + 10\hat{k}$

C) $2.0\hat{i} + 3.0\hat{k}$

D) $2.0\hat{k}$

E) $-2.0\hat{i} + 3.0\hat{j} - 9.0\hat{k}$

Q14.

A stone is tied to a string and rotated in a circle of radius 4 m at a constant speed. If the magnitude of its acceleration is 16 m/s^2, what is the period of the motion?

A) π s
B) 2π s
C) 3π s
D) $\pi/2$ s
E) 4π s

Q15.

The minimum speed of a projectile during the whole flight is 5.0 m/s. It takes 4.0 s to reach its horizontal range. What is the range of the projectile?

A) 20 m
B) 30 m
C) 40 m
D) 50 m
E) 10 m
