PHYS101 - MAJOR I, TERM 102
ZERO VERION
23-March-2011

Q1.
The position of a particle is given by $x = At^3 + (B/A)t^2$, where x is in meters and t is in seconds. The dimension of B is:

A) L^2T^{-5}
B) LT^{-4}
C) L^2T^2
D) LT^{-3}
E) T^{-3}

Q2.
A light-year is the distance traveled by light in one year (365 days). Express a light-year in kilometers if the speed of light is 3.0×10^8 m/s.

A) 9.5×10^{12} km
B) 7.5×10^{15} km
C) 1.6×10^{11} km
D) 3.9×10^{11} km
E) 3.9×10^{15} km

Q3.
A ball is dropped from a height of 100 m at $t = 0$. Later, at $t = 1.00$ s, a second ball is thrown downward with a speed of 19.8 m/s. At what time will the two balls be at the same height? (Neglect air resistance).

A) 1.49 s
B) 2.54 s
C) 4.95 s
D) 0.543 s
E) 0.982 s

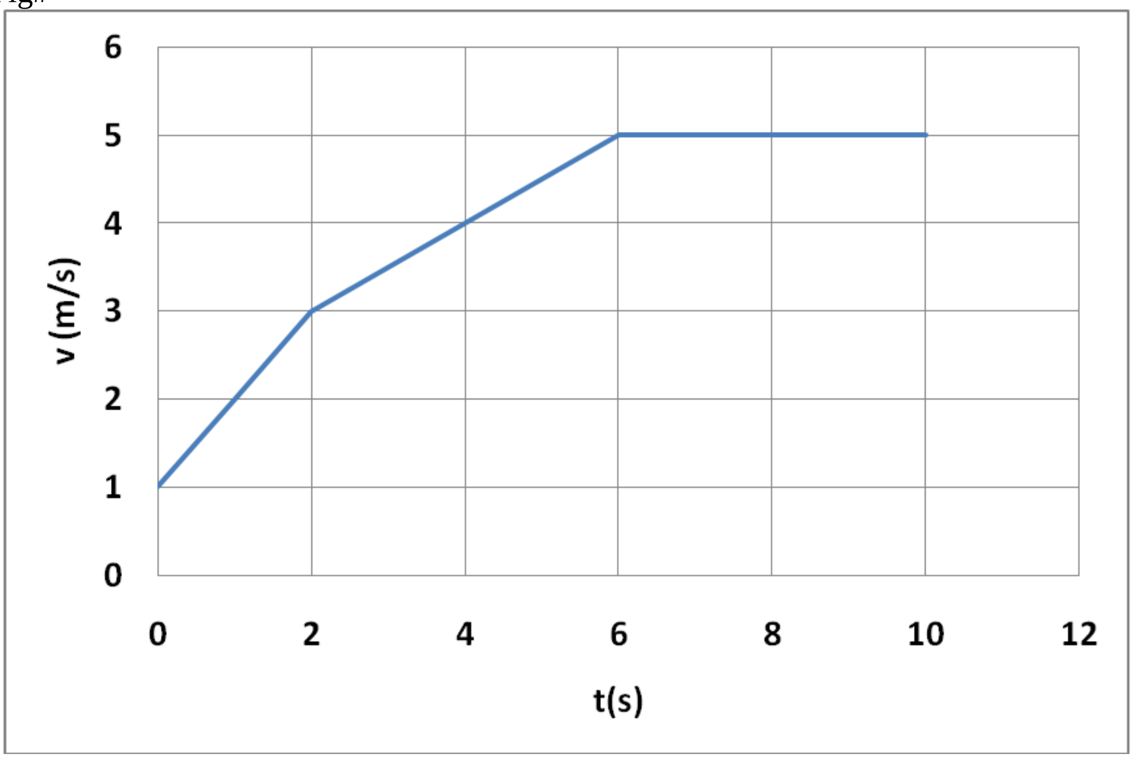
Q4.
A car starts from rest and accelerates at a constant rate of 2.0 m/s^2 in a straight line until it reaches a speed of 30 m/s. The car then slows down at a constant rate of 1.0 m/s^2 until it stops. How much time elapses (total time) from start to stop?
A) 45 s
B) 20 s
C) 15 s
D) 40 s
E) 30 s

Q5.

Which one of the following statements is always FALSE?

A) A body has constant velocity and variable acceleration.
B) A body has velocity eastward and acceleration eastward.
C) A body has velocity eastward and acceleration westward.
D) A body has zero instantaneous velocity but non-zero acceleration.
E) A body has constant acceleration and variable velocity.

Q6.
The velocity-time graph of an object moving in a straight line is shown in **Figure 1**. What is the average speed of the object for the first 6.0 s?
Fig#



A) 3.3 m/s
B) 3.0 m/s
C) 1.8 m/s
D) 1.3 m/s
E) 0.83 m/s

Q7.
A man leaves his house and makes **three** successive displacements. The first displacement is **D1** (10.0 km, 60.0°), the second displacement **D2** is unknown, and the third displacement **D3** is (10.0 km, 240°). Find the second displacement **D2** if his resultant displacement is (20.0 km, 90.0°). All angles are measured counter clockwise with respect to the positive x-axis.

A) (20.0 km, 90.0°)
B) (40.0 km, 270°)
C) (40.0 km, 90.0°)
D) (60.0 km, 60.0°)
E) (20.0 km, 60.0°)

Q8.
Two vectors are given as: $\vec{A} = 3.0\,\hat{i} + 4.0\,\hat{j} + 5.0\,\hat{k}$ and $\vec{B} = 5.0\,\hat{i} + 4.0\,\hat{j} + 3.0\,\hat{k}$. Find the angle between the vectors $\vec{A}$ and $\vec{B}$.

A) 23°
B) 28°
C) 33°
D) 38°
E) 45°

Q9.
Three vectors are given by $\vec{A} = 3.0\,\hat{i} + 3.0\,\hat{j}$, $\vec{B} = -1.0\,\hat{i} - 4.0\,\hat{j}$ and $\vec{C} = 2.0\,\hat{i} + 2.0\,\hat{j}$. Find $\vec{A} \cdot (\vec{B} \times \vec{C})$.

A) 0
B) −21
C) +26
D) −26
E) +5.0

Q10.
A particle moves in a circular path of radius 0.400 m with constant speed. If the particle makes five revolutions in each second of its motion, find the magnitude of its acceleration.

A) 395 m/s^2
B) 220 m/s^2
C) 98.0 m/s^2
D) 532 m/s^2
E) 450 m/s^2

Q11.
At t = 0, a particle is moving in the *x*-*y* plane with a velocity of $(5.0\,\hat{j})$ m/s and a constant acceleration of $(2.0\,\hat{i} + 3.0\,\hat{j})$ m/s^2. Find the velocity of the particle at t = 5.0 s.

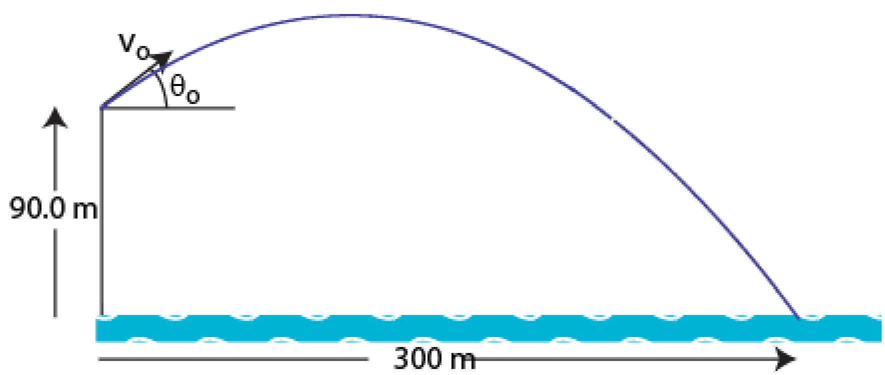
A) $(10\,\hat{i} + 20\,\hat{j})$ m/s
B) $(10\,\hat{i} + 5.0\,\hat{j})$ m/s

C) $\left(5.0\,\hat{i} + 10\,\hat{j}\right)$ m/s
D) $\left(20\,\hat{i} + 12\,\hat{j}\right)$ m/s
E) $\left(15\,\hat{i} + 15\,\hat{j}\right)$ m/s

Q12.
Car A is moving with a speed of 70.0 km/hr in a direction making an angle of 45.0° with the positive *x*-axis. Car B is moving with a speed of 70.0 km/hr in a direction making an angle of 135° with the positive *x*-axis. Find the velocity of Car A with respect to Car B in unit vector notation. (All angles are measured counterclockwise with respect to positive *x*-axis).

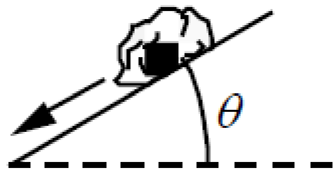
A) $\left(99.0\,\hat{i}\right)$ km/hr
B) $\left(99.0\,\hat{j}\right)$ km/hr
C) $\left(49.5\,\hat{i} + 49.5\,\hat{j}\right)$ km/hr
D) $\left(-49.5\,\hat{i} + 49.5\,\hat{j}\right)$ km/hr
E) $\left(49.5\,\hat{i} - 49.5\,\hat{j}\right)$ km/hr

Q13.
A ball is thrown from the top of a cliff as shown in **Figure 2**. The ball lands 10.0 seconds later in water 300 m from the base of the cliff. The height of the cliff is 90.0 m. Neglect the air resistance and find the initial speed v_o of the ball.
Fig#



A) 50.0 m/s
B) 40.6 m/s
C) 60.5 m/s
D) 90.0 m/s
E) 30.4 m/s

Q14.
As shown in **Figure 3**, a 2.0-N rock slides down on a frictionless inclined plane. Which one of the following statements is TRUE concerning the magnitude of the normal force that the plane exerts on the rock?
Fig#



A) The normal force is less than 2.0 N.
B) The normal force is zero.
C) The normal force is 2.0 N.
D) The normal force is greater than 2.0 N.
E) The normal force *increases* as the angle of inclination, θ, is *increased*.

Q15.
As shown in **Figure 4**, a 4.0-kg block and a 2.0-kg block move on a horizontal frictionless surface while being accelerated by a 12-N force. In unit vector notation, determine the force that the 2.0-kg block exerts on the 4.0-kg block.
Fig#

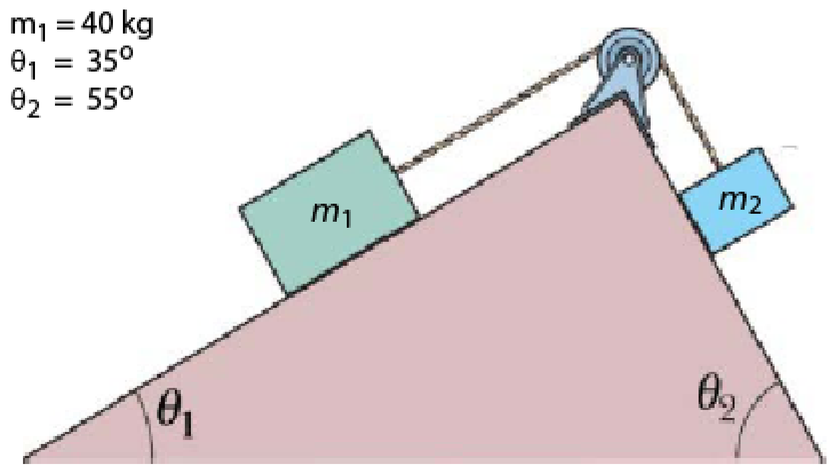
A) $-\left(4.0\,\hat{i}\right)$ N
B) 0
C) $\left(+8.0\,\hat{i}\right)$ N
D) $\left(-12\,\hat{i}\right)$ N
E) $\left(+4.0\,\hat{i}\right)$ N

Q16.
With what force will the feet of a person of mass 60.0 kg press downward on an elevator floor when the elevator has an upward acceleration of 1.20 m/s^2?

A) 660 N
B) 600 N
C) 516 N
D) 588 N
E) 980 N

Q17.

As shown in **Figure 5**, two masses rest on opposite sides of a frictionless pulley on frictionless inclines. What is the mass m_2 if the system remains at rest?
Fig#

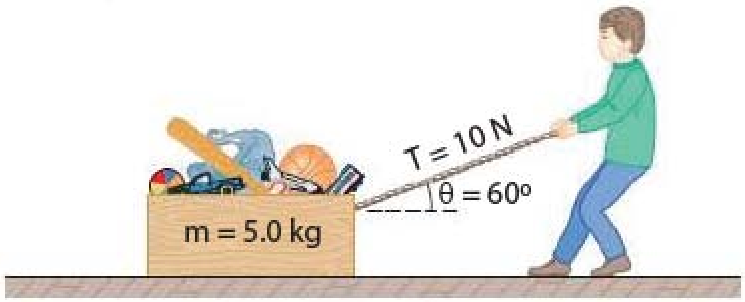


A) 28 kg
B) 25 kg
C) 63 kg
D) 57 kg
E) 46 kg

Q18.
A box rests on the flatbed of a truck that is initially traveling at 15 m/s on a level road. The driver applies the brakes and the truck is brought to a stop in a distance of 38 m. If the deceleration of the truck is constant, what is the minimum coefficient of static friction between the box and the flatbed of the truck that is required to keep the box from sliding?

A) 0.30
B) 0.20
C) 0.10
D) 0.59
E) 0.49

Q19.
As shown in **Figure 6**, a boy pulls a box of total mass m = 5.0 kg with a rope that makes an angle of 60° with the horizontal. The boy pulls on the rope with a force of 10 N; and the box moves with constant velocity. What is the coefficient of kinetic friction between the box and the surface?
Fig#



A) 0.12
B) 0.090
C) 0.060
D) 0.18
E) 0.24

Q20.
A 0.250-kg ball attached to a string is rotating in a vertical circle of radius 0.500 m. Find the magnitude of the tension in the string at the bottom of the circle where its speed is 4.00 m/s.

A) 10.4 N
B) 7.34 N
C) 2.50 N
D) 5.65 N
E) 15.4 N