$\qquad$ \#: $\qquad$
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) A car travels 95 km to the north at $70.0 \mathrm{~km} / \mathrm{h}$, then turns around and travels 21.9 km at $80.0 \mathrm{~km} / \mathrm{h}$. What is the difference between the average speed and the average velocity on this trip?
A) $24 \mathrm{~km} / \mathrm{h}$
B) $32 \mathrm{~km} / \mathrm{h}$
C) $19 \mathrm{~km} / \mathrm{h}$
D) $27 \mathrm{~km} / \mathrm{h}$
2) The following conversion equivalents are given:

$$
1 \mathrm{gal}=231 \mathrm{in}^{3} \quad 1 \mathrm{ft}=12 \mathrm{in} \quad 1 \mathrm{~min}=60 \mathrm{~s}
$$

A pipe delivers water at the rate of $95 \mathrm{gal} / \mathrm{min}$. The rate, $\mathrm{in}^{3} 3 / \mathrm{s}$, is closest to:
A) 0.15
B) 0.21
C) 0.19
D) 0.17
E) 0.14
3) A CD-ROM disk can store approximately 600.0 megabytes of information. If an average word requires 9.0 bytes of storage, how many words can be stored on one disk?
A) $5.4 \times 10^{9}$ words
B) $2.0 \times 10^{9}$ words
C) $2.1 \times 10^{7}$ words
D) $6.7 \times 10^{7}$ words
4) A train starts from rest and accelerates uniformly, until it has traveled 5.6 km and acquired a velocity of $42 \mathrm{~m} / \mathrm{s}$. The train then moves at a constant velocity of $42 \mathrm{~m} / \mathrm{s}$ for 420 s . The train then slows down uniformly at $0.065 \mathrm{~m} / \mathrm{s}^{2}$, until it is brought to a halt. The acceleration during the first 5.6 km of travel is closest to:
A) $0.19 \mathrm{~m} / \mathrm{s}^{2}$
B) $0.20 \mathrm{~m} / \mathrm{s}^{2}$
C) $0.14 \mathrm{~m} / \mathrm{s}^{2}$
D) $0.16 \mathrm{~m} / \mathrm{s}^{2}$
E) $0.17 \mathrm{~m} / \mathrm{s}^{2}$
5) An oak tree was planted 22 years ago. How many seconds does this correspond to? (Do not take leap days into account.)
A) $1.2 \times 10^{7}$
B) $6.9 \times 10^{8}$
C) $2.9 \times 10^{7}$
D) $2.8 \times 10^{8}$
6) Bob and Biff throw identical rocks off a tall building at the same time. Bob throws his rock straight downward. Biff throws his rock downward and outward such that the angle between the initial velocity of the rock and the horizon is 30 degrees. Biff throws the rock with a speed twice that of Bob's rock. Which rock hits the ground first (assume the ground near the building is flat)?
A) Bob's rock
B) They hit at the same time.
C) Biff's rock
D) Impossible to determine
7) Shown here are the velocity and acceleration vectors for an object in several different types of motion. In which case is the object's velocity changing while its speed is not changing?
A)

B)

C)

D)

E) None of these cases
8) A ball is projected upward at time $t=0.0 \mathrm{~s}$, from a point on a roof 60 m above the ground. The ball rises, then falls and strikes the ground. The initial velocity of the ball is $28.4 \mathrm{~m} / \mathrm{s}$. Consider all quantities as positive in the upward direction. At time $t=4.3 \mathrm{~s}$, the acceleration of the ball is closest to:
A) $+5 \mathrm{~m} / \mathrm{s}^{2}$
B) $+10 \mathrm{~m} / \mathrm{s}^{2}$
C) zero
D) $-5 \mathrm{~m} / \mathrm{s}^{2}$
E) $-10 \mathrm{~m} / \mathrm{s}^{2}$
9) The motions of a car and a truck along a straight road are represented by the velocity-time graphs below. The two vehicles are initially alongside each other at time $t=0$.


At time $T$, what is true of the distances traveled by the vehicles since time $t=0$ ?
A) The car will have traveled farther than the truck.
B) The truck will not have moved.
C) The truck will have traveled farther than the car.
D) They will have traveled the same distance.
10) Add 3685 g and 66.8 kg and express your answer in milligrams (mg).
A) $7.05 \times 10^{7} \mathrm{mg}$
B) $7.05 \times 10^{5} \mathrm{mg}$
C) $7.05 \times 10^{6} \mathrm{mg}$
D) $7.05 \times 10^{4} \mathrm{mg}$
11) A dragster travels $1 / 4 \mathrm{mi}$ in 6.7 s . Assuming that acceleration is constant and the dragster is initially at rest, what is its velocity when it crosses the finish line?
A) $188 \mathrm{mi} / \mathrm{h}$
B) $296 \mathrm{mi} / \mathrm{h}$
C) $135 \mathrm{mi} / \mathrm{h}$
D) $269 \mathrm{mi} / \mathrm{h}$
12) Karim rides his bike with velocity $\overrightarrow{\mathrm{v}}=\left(8.4 \mathrm{~m} / \mathrm{s}, 25^{\circ}\right.$ north of east) for 10 minutes. How far to the north of his starting position does Karim end up?
A) 2100 m
B) 4600 m
C) 36 m
D) 76 m
13) A rescue plane spots a survivor 132 m directly below and releases an emergency kit with a parachute. If the package descends at a constant vertical acceleration of $6.89 \mathrm{~m} / \mathrm{s}^{2}$ and the initial plane horizontal speed was $68.9 \mathrm{~m} / \mathrm{s}$, how far away from the survivor will it hit the waves?
A) 2.64 km
B) 426 m
C) 446 m
D) 301 m
14) Shown here are the velocity and acceleration vectors for an object in several different types of motion. In which case is the object slowing down and turning to its left?
A)

B)
C)

D)

E)

15) A stone is thrown vertically upwards, reaches a highest point, and returns to the ground. When the stone is at the top of its path, its acceleration
$\mathrm{A})$ is directed downwards.
B) changes direction from upwards to downwards.
C) is zero.
D) is directed upwards.
16) What is the maximum distance we can shoot a dart, provided our toy dart gun gives a maximum initial velocity of $2.78 \mathrm{~m} / \mathrm{s}$ ?
A) 0.79 m
B) 1.39 m
C) 1.58 m
D) More information needed

17) A projectile is fired from the origin (at $\mathrm{y}=0 \mathrm{~m}$ ) as shown in the figure. The initial velocity components are $\mathrm{v}_{\mathrm{ox}}=940 \mathrm{~m} / \mathrm{s}$ and $\mathrm{v}_{\mathrm{oy}}=96 \mathrm{~m} / \mathrm{s}$. The projectile reaches maximum height at point P , then it falls and strikes the ground at point Q . In the figure, the y -coordinate of point P is closest to:
A) 470 m
B) $90,160 \mathrm{~m}$
C) $45,080 \mathrm{~m}$
D) 940 m
E) $45,550 \mathrm{~m}$
18) The plot below shows the position of an object as a function of time. The letters H-L represent particular moments of time. At which moment in time is the speed of the object equal to zero?

A) I
B) H
C) J
D) K
E) L
19) A ball is thrown straight upward with a velocity of $39 \mathrm{~m} / \mathrm{s}$. How much time passes before the ball strikes the ground? (Disregard air resistance.)
A) 4.0 s
B) 1.2 s
C) 2.4 s
D) 8.0 s
20) Acceleration is sometimes expressed in multiples of $g$, where $g=9.8 \mathrm{~m} / \mathrm{s}^{2}$ is the acceleration due to the earth's gravity. In a car crash, the car's velocity may go from $26 \mathrm{~m} / \mathrm{s}$ to $0 \mathrm{~m} / \mathrm{s}$ in 0.15 s . How many g's are experienced, on average, by the driver?
A) 22 g
B) 18 g
C) 13 g
D) 23 g
21) Which of the following ideas is true about projectile motion with no air drag?
A) $v_{x}^{2}+v_{\mathrm{y}}^{2}=$ constant.
B) The velocity of the object is zero at the point of maximum elevation.
C) The horizontal motion is independent of the vertical motion.
D) The acceleration is +g when the object is rising and -g when falling.
E) The trajectory will depend on the object's mass as well as its initial velocity and launch angle.
22) Which of the following situations is impossible?
A) An object has velocity directed east and acceleration directed east.
B) An object has velocity directed east and acceleration directed west.
C) An object has zero velocity but non-zero acceleration.
D) An object has constant non-zero acceleration and changing velocity.
E) An object has constant non-zero velocity and changing acceleration.
23) The following conversion equivalents are given:

$$
1 \mathrm{~kg}=1000 \mathrm{~g} \quad 11=1000 \mathrm{~cm}^{3} \quad 11=0.0353 \mathrm{ft}^{3}
$$

The density of a liquid is $0.83 \mathrm{~g} / \mathrm{cm}^{3}$. The density of the liquid, in $\mathrm{kg} / \mathrm{ft}^{3}$, is closest to:
A) 28
B) 21
C) 26
D) 19
E) 24
24) You are taking a turn at $23.0 \mathrm{~m} / \mathrm{s}$ on a ramp of radius 39.0 m . What is your acceleration?
A) $0.590 \mathrm{~m} / \mathrm{s}^{2}$
B) $13.6 \mathrm{~m} / \mathrm{s}^{2}$
C) $66.1 \mathrm{~m} / \mathrm{s}^{2}$
D) $1.70 \mathrm{~m} / \mathrm{s}^{2}$
25) A racquetball strikes a wall with a speed of $30 \mathrm{~m} / \mathrm{s}$ and rebounds with a speed of $26 \mathrm{~m} / \mathrm{s}$. The collision takes 20 ms . What is the average acceleration of the ball during the collision?
A) $2800 \mathrm{~m} / \mathrm{s}^{2}$
B) $200 \mathrm{~m} / \mathrm{s}^{2}$
C) $1300 \mathrm{~m} / \mathrm{s}^{2}$
D) $1500 \mathrm{~m} / \mathrm{s}^{2}$
E) zero
26) An airplane needs to reach a velocity of $203.0 \mathrm{~km} / \mathrm{h}$ to take off. On a 2000 m runway, what is the minimum acceleration necessary for the plane to take flight?
A) $0.95 \mathrm{~m} / \mathrm{s}^{2}$
B) $0.87 \mathrm{~m} / \mathrm{s}^{2}$
C) $0.79 \mathrm{~m} / \mathrm{s}^{2}$
D) $1.0 \mathrm{~m} / \mathrm{s}^{2}$
27) The wavelength of a certain laser is 0.66 microns, where 1 micron $=1 \times 10^{-6} \mathrm{~m}$. What is this wavelength in nanometers? $\left(1 \mathrm{~nm}=10^{-9} \mathrm{~m}\right)$
A) $6.6 \times 10^{1} \mathrm{~nm}$
B) $6.6 \times 10^{4} \mathrm{~nm}$
C) $6.6 \times 10^{2} \mathrm{~nm}$
D) $6.6 \times 10^{3} \mathrm{~nm}$
28) A car accelerates from $5.0 \mathrm{~m} / \mathrm{s}$ to $21 \mathrm{~m} / \mathrm{s}$ at a rate of $3.0 \mathrm{~m} / \mathrm{s}^{2}$. How far does it travel while accelerating?
A) 41 m
B) 207 m
C) 69 m
D) 117 m
29) Human reaction times are worsened by alcohol. How much farther would a drunk driver's car travel before he hits the brakes than a sober driver's car? Assume both cars are initially traveling at $49.0 \mathrm{mi} / \mathrm{h}$, the sober driver takes .33 s and the drunk driver takes 1.0 s to hit the brakes in a crisis.
A) 58 ft
B) 53 ft
C) 48 ft
D) 34 ft
30) A child is sitting on the outer edge of a merry-go-round that is 18 m in diameter. If the merry-go-round makes $8.3 \mathrm{rev} / \mathrm{min}$, what is the velocity of the child in $\mathrm{m} / \mathrm{s}$ ?
A) $15.6 \mathrm{~m} / \mathrm{s}$
B) $7.8 \mathrm{~m} / \mathrm{s}$
C) $1.2 \mathrm{~m} / \mathrm{s}$
D) $5.5 \mathrm{~m} / \mathrm{s}$
31) Two bullets are fired simultaneously parallel to a horizontal plane. The bullets have different masses and different initial velocities. Which one will strike the plane first?
A) the fastest one
B) the lightest one
C) the heaviest one
D) the slowest one
E) They strike the plane at the same time.
32) You walk 55 m to the north, then turn $60^{\circ}$ to your right and walk another 45 m . How far are you from where you originally started?
A) 87 m
B) 94 m
C) 50 m
D) 46 m
33) A ball is thrown vertically upward and then comes back down. During the ball's flight up and down, its velocity and acceleration vectors are
A) always in opposite directions.
B) always in the same direction.
C) first in the same direction and then in opposite directions.
D) first in opposite directions and then in the same direction.
34) The following conversion equivalents are given:

$$
1 \mathrm{~m}=100 \mathrm{~cm} \quad 1 \mathrm{in}=2.54 \mathrm{~cm} \quad 1 \mathrm{ft}=12 \mathrm{in}
$$

A bin has a volume of $1.5 \mathrm{~m}^{3}$. The volume of the bin, in $\mathrm{ft}^{3}$, is closest to:
A) 59
B) 41
C) 47
D) 53
E) 35
35) A person in a car is driving down a straight road. The instantaneous acceleration is decreasing with time, but is directed in the direction of the car's motion. The speed of the car is
A) decreasing with time.
B) constant.
C) increasing with time.
36) Estimate the number of times an average person's heart beats in a lifetime. Assume the average heart rate is 69 beats $/ \mathrm{min}$ and a life span of 75 yr .
A) $3 \times 10^{8}$ beats
B) $3 \times 10^{10}$ beats
C) $3 \times 10^{7}$ beats
D) $3 \times 10^{9}$ beats
37) A child standing on a bridge throws a rock straight down. The rock leaves the child's hand at $t=0$. Which of the graphs shown here best represents the velocity of the stone as a function of time?
A)

B)

C)

D)

E)

38) The plot below shows the position of an object as a function of time. The letters $\mathrm{H}-\mathrm{L}$ represent particular moments of time. At which moment in time is the speed of the object the highest?

A) J
B) H
C) I
D) K
E) L
39) A racing car accelerates uniformly from rest along a straight track. This track has markers spaced at equal distances along it from the start, as shown below. The car reaches a speed of $140 \mathrm{~km} / \mathrm{h}$ as it passes marker 2 .


Whereabouts on the track was the car when it was travelling at half this speed, i.e. at $70 \mathrm{~km} / \mathrm{h}$ ?
A) before marker 1
B) at marker 1
C) between marker 1 and marker 2
40) Shown here are the velocity and acceleration vectors for an object in several different types of motion. In which case is the object slowing down and turning to its right?
A)
$\stackrel{\mathrm{V}}{\longrightarrow} \mathrm{a}$
B)

D)

E)


Answer Key
Testname: AP CH 1-3 11

1) $D$
2) $B$
3) $D$
4) $D$
5) $B$
6) $B$
7) $D$
8) E
9) C
10) A
11) D
12) A
13) B
14) B
15) A
16) $A$
17) $A$
18) $A$
19) $D$
20) B
21) C
22) E
23) E
24) B
25) A
26) C
27) C
28) C
29) C
30) B
31) E
32) A
33) D
34) D
35) C
36) D
37) E
38) A
39) A
40) D
