Exam 1

Name KEY

20 Questions

Select the one response that best answers each question.

1) Which of these could represent a unit vector that points from the origin to the point x=2, y=2, z=2?

A) $\hat{i}+\hat{j}+\hat{k}$

B) $\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})$

C) $2\hat{i}+2\hat{j}+2\hat{k}$

D) No such vector is possible, since unit vectors, by definition, must point along coordinate axes.

$\vec{A} = 2\hat{i}+2\hat{j}+2\hat{k}$ is in that direction, but $|\vec{A}| \neq 1$

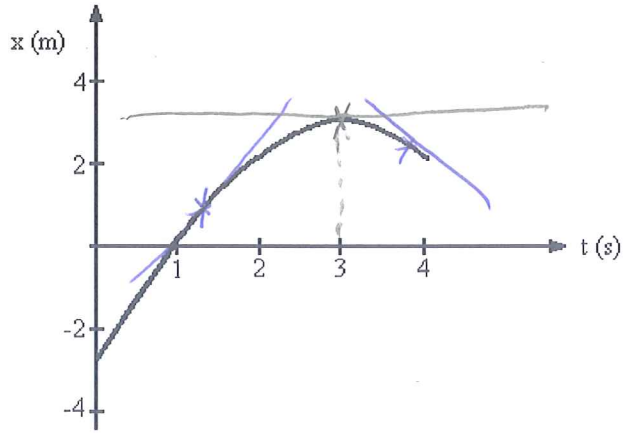
$\left(\frac{1}{\sqrt{12}}\vec{A}\right)$ has a magnitude of 1 but is not listed ☹

$\vec{B} = \frac{1}{2}\vec{A} = \hat{i}+\hat{j}+\hat{k}$ is ALSO in that direction. But $|\vec{B}| = \sqrt{3}$

So: $\frac{1}{\sqrt{3}}(\hat{i}+\hat{j}+\hat{k})$ is a unit vector in the correct direction.

An 'A' question ☺

FIGURE 2–11 (Two Questions refer to this figure)



2) Fig. 2–11 represents the position of a particle as it travels along the x–axis. At what time is the objects velocity zero?

A) 0 s

B) 1 s

C) 3 s ✓

D) never.

E) no way to tell

$v = \frac{dx}{dt} \Rightarrow$ slope of tangent line

3) Fig. 2–11 represents the position of a particle as it travels along the x–axis. At the time t = 3 seconds, the object's acceleration is _____.

A) no way to tell

B) zero

C) positive

D) negative ✓

E) 9.8 m/s^2

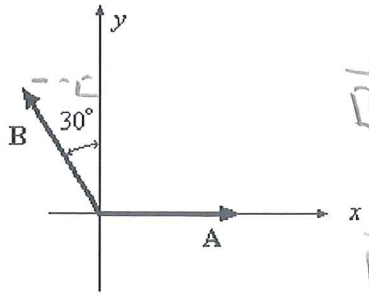
tangent lines @ earlier times indicate a positive velocity. At later times the velocity is negative. Acceleration must be negative @ t=3 for this to happen

4) Vector $\vec{A} = -3.00\,\hat{i} + 3.00\,\hat{j}$ and vector $\vec{B} = 3.00\,\hat{i} + 4.00\,\hat{j}$. What is the magnitude of the vector $\vec{C} = 2\vec{A} + \vec{B}$?

A) 7.00 B) 5.00 C) 33.5 D) 10.4 ✓ E) 4.47

$\vec{C} = (-6+3)\hat{i} + (6+4)\hat{j} = -3\hat{i} + 10\hat{j}$ || $|\vec{C}| = \sqrt{9+100} = 10.4$

FIGURE 3–1



5) If the vector $\vec{B}$ shown above has a magnitude of 50 units, it can be written in algebraic notation as _____.

A) $-25\,\hat{i} + 43.3\,\hat{j}$ ✓ B) $-43.3\,\hat{i} + 25\,\hat{j}$ C) $25\,\hat{i} - 25\,\hat{j}$ D) $-25\,\hat{i} + 25\,\hat{j}$ E) $x + y$

6) A boy throws a rock off of a cliff, giving it horizontal velocity of 15 m/s. Ignoring air resistance, during the flight the horizontal velocity _____.

A) increases and then decreases
B) continuously decreases.
C) remains a non-zero constant. ✓
D) continuously increases.
E) what happens depends on that angle at which the rock was thrown.

7) The vector **A** is 15 units at an angle of –30°. If $\mathbf{C} = \mathbf{A} + \mathbf{B}$, and $\mathbf{C} = 5\hat{i} + 2\hat{j}$, what is the magnitude of the vector **B** ?

A) 14.0 B) 12.4 ✓ C) –8.0 D) +8.0

8) An object has a position given by $\vec{r} = [2.0 + 3.00\,t]\,\hat{i} + [3.0\text{ m} - 2.00\,t^2]\,\hat{j}$. The units are SI. What is the speed of the object at time $t = 2.00$ s?

A) 11.0 m/s B) 5.00 m/s C) 4.65 m/s D) 5.50 m/s E) 8.54 m/s ✓

9) A rock is dropped from a vertical cliff. The rock takes 7.00 s to reach the ground below the cliff. What is the height of the cliff?

A) 26.2 m B) 100 m C) 481 m D) 80.1 m E) 240 m

10) An object is thrown upwards with a speed of 14 m/s. It goes up and then comes down. As it is coming down, let t_1 be the time at which it is 5.0 m above its starting point. What is t_1? Note that t=0 is the moment when the object was thrown.

A) 4.2 s B) 1.2 s C) 2.4 s ✓ D) 0.42 s E) 3.1 s

11) The velocity of an object moving along the x axis is given by the expression $v(t) = 3.00 + 2.00\ t^2$. The units are SI. Determine the position of the object as a function of time if it is located at $x = 1.00$ m at time $t = 0.00$ s.

A) $2.00\ t + 1.00$
B) $1.00 + 3.00\ t + 0.667\ t^3$
C) $2.00\ t$
D) 0.667
E) $3.00\ t + 0.667\ t^3$

$x(t) = \int v(t)\,dt = 3t + \frac{2t^3}{3} + \text{constant}$

$x|_{t=0} = 1 = \text{constant}$

$\therefore x(t) = 3t + \frac{2}{3}t^3 + 1$

12) Your mass is m and you ride on an elevator while standing on a bathroom scale. The elevator is moving with a constant upward acceleration. The reading on the scale is _____.

HINTS: You are moving with the same acceleration as the elevator. The scale is reading the Normal Force that is acting on you.

A) more than mg.
B) equal to mg.
C) less than mg.
D) could be more or less than mg, depending on the magnitude of the acceleration.

for me

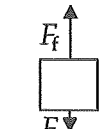
$\sum F_y = ma_y$ ← A positive #!

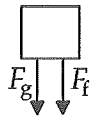
$+N - mg = ma_y$

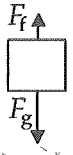
$N = +ma_y + mg$

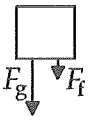
13) Which of the following free-body diagrams best represent the free-body diagram, with correct relative force magnitudes, of a person in an elevator that is traveling upward with a constant velocity? F_f is the force of the floor on the person and F_g is the force of gravity on the person.

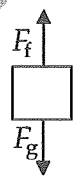
If $a = 0$, so net force must be zero

A)


B)


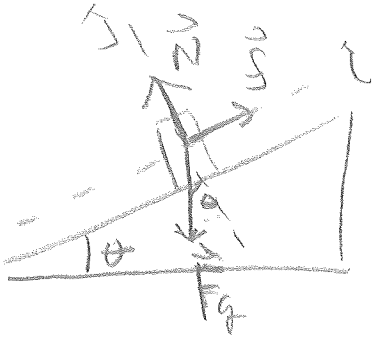
C)


D)


E)


14) An object rests on an inclined surface. If the inclination of the surface is made steeper, what happens to the magnitude of the normal force acting on the object?

A) increases
B) The normal force is always equal to mg.
C) decreases
D) stays the same
E) Cannot be determined without additional information.



2 NII

$\sum F_y = ma_y$

$+N - mg\cos\theta = ma_y$ (→ 0)

$N = mg\cos\theta$

As θ → larger, this get smaller,

for m_2

$\vec{T} = T\hat{j}$

$\vec{F}_g = -m_2 g\hat{j}$

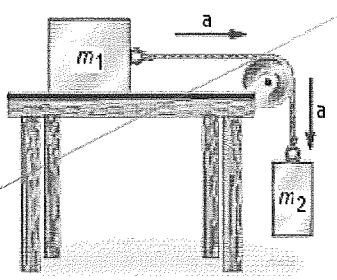
2nd: $\Sigma F_y = ma_y$

$T - m_2 g = ma_y$

$\therefore T = ma_y + m_2 g$

This is NEGATIVE (m_2 moves down)

FIGURE 4-4



15) Two masses, m_1 and m_2, are connected to each other as shown in Fig. 4-4. Mass m_1 slides without friction on the table surface. Both masses have acceleration of magnitude a as shown. How does the tension in the string compare to the weight, $m_2 g$, of mass m_2?
HINT: Consider a free body diagram for m_2 if it were at rest. Compare that to this situation.

A) The tension is larger than $m_2 g$.
B) The tension is smaller than $m_2 g$. ✓
C) The tension is equal to $m_2 g$.
D) It depends on m_1 being smaller than m_2.
E) It depends on m_1 being larger than m_2.

Did something similar in class :)

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16) The following four forces act on a 4.00 kg object:

$\vec{F}_1$ = 300 newtons, east = $300\hat{i}$
$\vec{F}_2$ = 700 newtons, north = $700\hat{j}$
$\vec{F}_3$ = 500 newtons, west = $-500\hat{i}$
$\vec{F}_4$ = 600 newotns, south = $-600\hat{j}$

$\Sigma \vec{F} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4 = -200\hat{i} + 100\hat{j}$

Let $\hat{i}$ be east and $\hat{j}$ be north. Just to be clear, "30 degrees north of west" is a direction that makes an angle of 150° with the +x axis.

What is the acceleration of the object?

A) 75.0 m/s^2 in a direction 63.4° north of west
B) 525 m/s^2 in a direction 26.6° north of west
C) 55.9 m/s^2 in a direction 26.6° north of west ✓
D) 55.9 m/s^2 in a direction 63.4° north of west
E) 75.0 m/s^2 in a direction 26.6° north of west

2nd law: $\Sigma \vec{F} = m\vec{a}$

$\therefore \vec{a} = \frac{1}{m}(\Sigma \vec{F}) = -50\hat{i} + 25\hat{j}$

$|\vec{a}| = 55.9\ m/s^2$

$\theta = \tan^{-1}\left(\frac{25}{50}\right) = 26.6°$

17) Starting from rest and moving with a constant acceleration, a 4.0-kg body reaches a speed of 8.0 m/s in 2.0 s. What is the net force acting on the body?

A) 1.0 N B) 32 N C) 4.0 N D) 16 N ✓ E) 8.0 N

$t = 0$, $x_0 = 0$, $v_0 = 0$, $a = ?$

$t_1 = 2$, $v_1 = 8$

(1) $x(t) = \frac{1}{2}at^2$
(2) $v(t) = at$

(2) $t_1 = 2$, $v_1 = 8$

(2) $\Rightarrow 8 = a(2)$ $\therefore a = 4\ m/s^2$

HAVE What Need

2nd $\Rightarrow F = ma = 16\ N$

18) A hockey player kicks a hockey puck across the ice, giving it an initial velocity of 50m/s. Ignore the air and assume that there is no friction. How many forces are acting on the puck at the instant when it is 15 meters away from the hockey player?

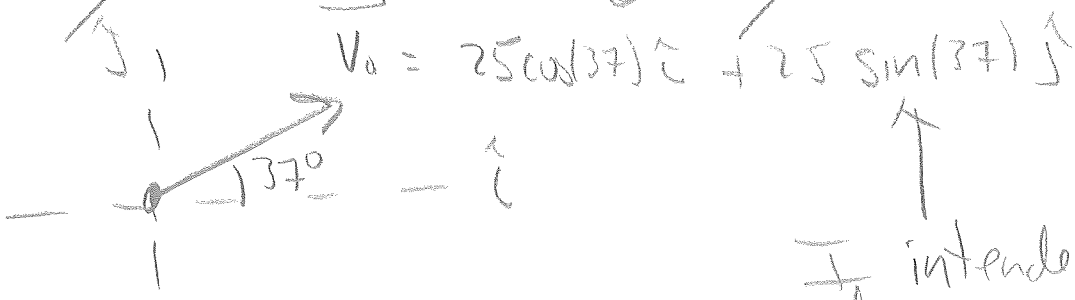
A) 2 B) 3 C) 4 D) 0

19) A basketball is dropped from the top of a building. As it falls, the air exerts a force on the ball opposing its fall, the 'drag force'. The vertical acceleration for the basketball is _____.

A) always 9.8 m/s^2
B) less than 9.8 m/s^2
C) greater than 9.8 m/s^2
D) nothing can be said about the acceleration.

20) A girl stands at the top of a cliff 100 meters tall. She throws a rock with an initial speed of 25 m/s at an angle of 37° above the horizontal. If the origin of the coordinate system is taken to be at the top of the cliff, with down being chosen as the $+\hat{j}$ direction, which of these is the correct equation for motion in the vertical direction?

A) $y(t) = 100 + 25\cos(37)t - 4.9t^2$
B) $y(t) = 100 - 25\cos(37)t + 4.9t^2$
C) $y(t) = 25\cos(37)t - 4.9t^2$
D) $y(t) = -25\cos(37)t + 4.9t^2$



+ intended all of these answers have sin(37).

No correct answer listed, Everyone gets credit.