Physics 151 MT1 (practice) Name: Spire ID:

A formula sheet similar to this will be provided with the exam.

You may detach this page from the test booklet*

PLEASE READ THESE INSTRUCTIONS CAREFULLY

- **Allowed:** Calculator and an 8.5"×11" reference sheet with handwritten notes on both sides
- **Not Allowed:** phones, laptops, tablets, headphones, music players, cameras, anything with internet connectivity. Put these away while the exam is in progress.
- **PRINT YOUR NAME AND SPIRE ID ON THE EXAM BOOKLET AND ANSWER SHEET**
- **>>> USE #2 PENCIL TO FILL IN THE CIRCLES ON ANSWER SHEET WITH YOUR NAME (last name first) and SPIRE ID. <<<**
- Please go to the restroom before the midterm starts.
- Unless friction or air resistance are mentioned, you can assume that they are negligible.
- Use #2 Pencil to fill the circles with your answers in spaces 1 through 27. Each question is worth 1 point. Only bubble in one circle per answer, or you may not receive credit. Erase pencil marks cleanly.
- When done, hand in ANSWER SHEET, EXAM BOOKLET, and show your UMass ID.
- There are 27 questions but the exam will be graded out of 25. This means you can get one question incorrect and still get a perfect score.

Math

$\frac{d}{dx}(x^n) = nx^{n-1}$

$\int x^n dx = \frac{x^{n+1}}{n+1} + C$

$ax^2 + bx + c = 0$

$\Rightarrow x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

Angular Motion

$a = v^2/r = \omega^2 r$

$v = \omega r$

$\omega = 2\pi/T$

$L = r\theta;\ v = r\omega;\ a = r\alpha$

$\theta(t) = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$

$\omega(t) = \omega_0 + \alpha t$

$\omega^2 = \omega_0{}^2 + 2\alpha\Delta\theta$

1D Kinematics

$x(t) = x_0 + v_0 t + \frac{1}{2}at^2$

$v(t) = v_0 + at$

$\Delta x = \frac{v_1{}^2 - v_0{}^2}{2a}$

Projectile Motion

Range: $D = \frac{v_0^2 \sin(2\theta)}{g}$

[Same initial/final height only]

Dynamics

$\sum \vec{F}_{ext} = m\vec{a}$

Conversion Factors and Constants

$1\ minute = 60s$

$1\ hour = 3600s$

$1\ mile = 1.60934\ km$

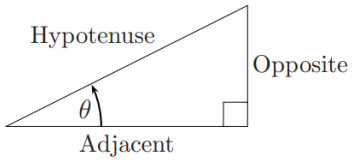
$1\ mile = 5280\ feet$

$1\ foot = 0.3048\ meters$

$1\ foot = 12\ inches$

$1\ inch = 2.54\ cm$

$g = 9.8\ m/s^2$



$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$

$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$

$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$

This document contains practice problems for the upcoming exam. Some of these are test questions from previous exams. These will not exactly represent the questions on the test, but they will be of a similar scope and content to the test questions. Probably they will be harder than the exam questions. Answers are on the last page of the document.

1. One of the below answers corresponds to your test version. Select the answer choice highlighted in bold below. **PLEASE SELECT THE CORRECT ANSWER OR YOU MAY LOSE ALL CREDIT FOR THE EXAM.**

   A) **[SELECT THIS ONE PLEASE]**

   B) ---

   C) ---

   D) ---

   E) ---

2. The period of a ball suspended on a spring is the time it takes the ball to move up and down once through a complete cycle. The period may or may not depend on the acceleration due to gravity g, ball mass m, and the so-called spring constant, K, measured in kg/s^2 (kilograms over square seconds). Which of these combinations of g,m, and K could the period be proportional to?

A) g/K

B) gmK

C) gK

D) $\sqrt{m/K}$

E) $\sqrt{K/m}$

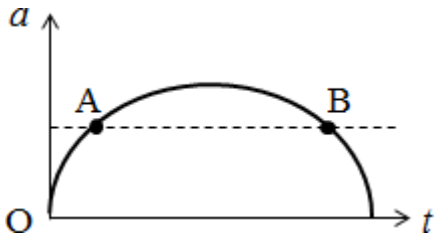
3. An object moves in the positive x-direction at a speed of 40 m/s. As it passes through the origin, it starts to experience a constant acceleration of 3.5 m/s^2 in the negative x-direction. How much time elapses before the object returns to the origin?
   A) 11 s
   B) 15 s
   C) 19 s
   D) 23 s
   E) 27 s

4. A water balloon is thrown vertically downwards at a speed of 14 m/s from the top of a tall building. Assuming the water balloon does not bang into anything or burst, how fast is it moving 1.8 s after it was thrown?
   A) 3.6 m/s
   B) 12 m/s
   C) 18 m/s
   D) 24 m/s
   E) 32 m/s

5. A rock is thrown with a velocity of 30.0 m/s at a 37º angle of elevation (up from the horizontal) off the top of a building. At what other time will the rock have the same speed as it does 2.50 s after being thrown?
   A) 1.2 s after being thrown
   B) 1.8 s after being thrown
   C) 3.1 s after being thrown
   D) 3.7 s after being thrown
   E) 5.0 s after being thrown

6. Two particles, A and B, are in uniform circular motion about a common center. The acceleration of particle A is 8.5 times that of particle B. The period of particle B is 2.0 times the period of particle A. The ratio of the radius of the motion of particle A to that of particle B is closest to
   A) $r_A/r_B=18$
   B) $r_A/r_B= 2.1$
   C) $r_A/r_B=17$
   D) $r_A/r_B=4.3$
   E) $r_A/r_B=0.24$

7. The graph shows the acceleration versus time for the motion of a car in the *x*-direction. Which of the following best describes the motion of the car at A and B?



   A) At *both* A and B the car's velocity is increasing.
   B) At A the car's velocity is increasing, *but* at B the car's velocity is decreasing.
   C) At *both* A and B the car is moving with the same velocity.
   D) At A the car is moving in the positive *x*-direction, *but* at B the car is moving in the negative *x*-direction.
   E) At *both* A and B the car is moving in the positive *x*-direction.

8. As an elevator is coming to a stop at the top floor of a building, which of the following is true?
   A) The elevator's acceleration and velocity are in the same direction.
   B) The elevator's velocity is constant.
   C) The elevator's acceleration is directed towards the ground.
   D) The elevator has zero acceleration.
   E) The elevator's speed is increasing.

9. Consider an object that has a constant zero acceleration. Which of the following could NOT be an accurate statement concerning its motion?

   A) If the object is moving, it will slow to zero velocity.

   B) The object will move with constant velocity.

   C) The object will not move.

   D) The velocity versus time graph of this object would look like a horizontal line.

   E) The position versus time graph of this object would look like a straight or horizontal line.

10. Pablo and Ambika are throwing watermelons straight up from the ground. (They're making fruit salad.) Pablo throws his watermelon at speed v and it spends time t in the air before smashing into the ground. Not to be outdone, Ambika then throws her watermelon at speed $2v$. How long is Ambika's watermelon in the air before it smashes back into the ground?

    A) $0.5t$

    B) t

    C) $2t$

    D) $4t$

    E) t^2

11. Professor Hamilton is straining to lift a large crate without success because it is too heavy. We denote the forces on the crate as follows: P is the upward force he exerts on the crate, C is the vertical contact force exerted on the crate by the floor, and W is the weight of the crate. How are the magnitudes of these forces related while your instructor is trying unsuccessfully to lift the crate?

A) P = C

B) P + C = W

C) P + C > W

D) P + C < W

12. According to the diagram, which of the following best describes vector $\vec{C}$?

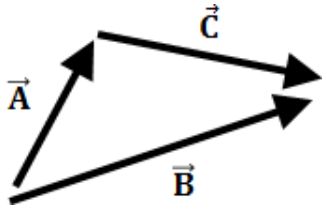
A) $\vec{C} = \vec{A} + \vec{B}$

B) $\vec{C} = -\vec{A} - \vec{B}$

C) $\vec{C} = \vec{B} - \vec{A}$

D) $\vec{C} = -\vec{B} - \vec{A}$

E) $\vec{C} = \vec{A} - \vec{B}$

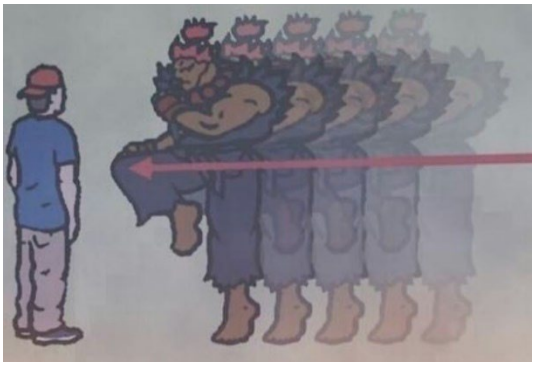


13. Grandma is screaming down the highway in her Ferrari Enzo at 138 m/s (310 mi/hr) when she passes a police car hidden behind a bush. As she passes, the police car pulls out and begins to accelerate at a steady 2 m/s^2. About how long does it take for the police car to catch up with grandma?
    A) 1 minute
    B) 2 minutes
    C) 3 minutes
    D) 4 minutes
    E) 5 minutes

14. The figure shows two forces, each of magnitude 4.6 N, acting on an object. The angle between these forces is 40°, and they make equal angles above and below the horizontal. What third force will cause the object to be in equilibrium (acceleration equals zero)?

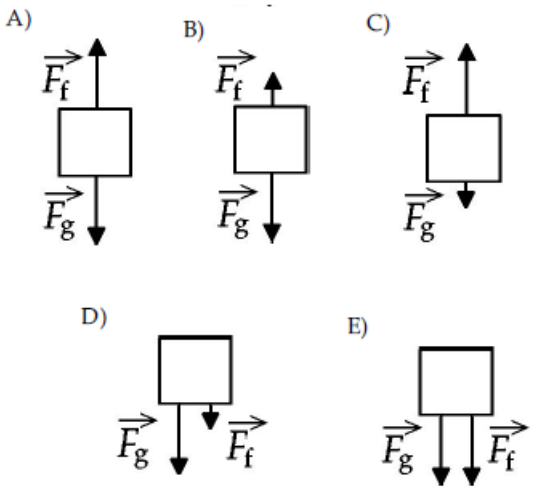
    A) 7.0 N pointing to the right
    B) 4.3N pointing to the right
    C) 8.6N pointing to the right
    D) 3.5N pointing to the right

15. In this motion diagram, Akuma is pictured traveling to the left at equal time intervals toward the stationary child. What does this imply about his acceleration?



    A) His acceleration is to the left.
    B) He is not accelerating.
    C) It is to the right.
    D) He is accelerating upward.
    E) All of the above.

16. Which one of the following free-body diagrams best represents the free-body diagram, with correct relative force magnitudes, of a person in an elevator that is traveling upward but is gradually slowing down at a rate of 9 m/s^2? F_f is the force of the floor on the person and F_g is the force of gravity on the person.



17. An irresponsible tourist stands at the top of the Empire State Building (381 m high) and throws a penny straight down with an initial speed of 22 m/s. Neglecting air friction, about how long should it take the penny to reach the ground?
    A) 6 s
    B) 7 s
    C) 9 s
    D) 10 s
    E) 11 s

18. A ball is tied to the end of a cable of negligible mass. The ball is spun in a circle with a radius 2.00 m making 7.00 revolutions every 10.0 seconds. What is the magnitude of the angular velocity of the ball?
    A) 7 rad/s
    B) zero
    C) 0.7 rad/s
    D) 2.2 rad/s
    E) 4.4 rad/s

19. An arrow has an initial launch speed of 18 m/s. If it must strike a target 31m away at the same elevation, which of the following launch angles will do the job?
    A) 10º
    B) 25º
    C) 40º
    D) 55º
    E) 65º

20. A lunar module falls vertically on the Moon's surface. At a distance h from the surface the speed of the module is v, and the module starts to decelerate. Assuming the acceleration to be constant, which value for the magnitude of the deceleration corresponds to a smooth landing? (A smooth landing is a landing at zero velocity.)
    A) $a = 0.25v / h$
    B) $a = 4v^2 / h$
    C) $a = 0.5v^2 / h$
    D) $a = 2v^2 / h$
    E) $a = 0.5v / h$

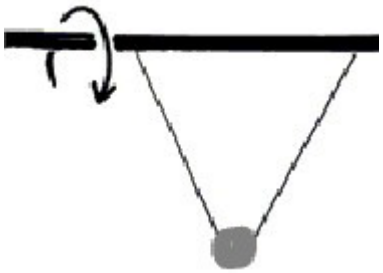
21. Leonardo travels from his home in Pisa 30 mi north and 50 mi west to Genoa, where he stops for lunch with his former teacher Verrocchio. After lunch, he travels 40 mi north and 110 mi east to Venice, where he meets Antonello for dinner. What is the length of his displacement from Pisa to Venice?
    A) 60 mi
    B) 90 mi
    C) 130 mi
    D) 175 mi
    E) 200 mi

22. A professor holds a $1,000,000 bill above the hand of a student who is poised to catch the bill as it falls between his fingers. After the release is made, the student catches the bill when it has fallen 11 cm. For how long was the bill falling? [For this problem assume the existence of $1,000,000 bills.]
    A) 0.02 s
    B) 0.13 s
    C) 0.15 s
    D) 0.18 s
    E) 0.20 s

23. Joe Newton can bring his fully loaded 18-wheel Mac truck smoothly from 25 m/s to a complete stop in a distance of 97 meters. What would Joe's stopping distance be in meters if his starting speed were 30 m/s? You may pretend that Joe's reaction time is negligible for this problem and that his (steady) deceleration is the same in both cases.
    A) 97 m
    B) 103 m
    C) 120 m
    D) 130 m
    E) 140 m

24. Two people are on a flat rooftop. At the same instant, they each throw a snowball with the **same initial speed**, but in different directions. One person throws his snowball downward at 40º below horizontal; the other person throwsher snowball upward at 40º above horizontal. Which of the following is true?
    A) Both snowballs hit the ground with the same speed.
    B) The initial velocities of each snowball are the same.
    C) The snowball thrown downward hits the ground with a greater speed than the upward one.
    D) Both snowballs hit the ground at the same time.
    E) None of the above is true.

25. A ball is connected by two massless strings to a horizontal, rotating rod, and moves in a vertical circle. The strings are tied to the rod, are taut, and form two sides of an equilateral triangle. A "photograph" of the system is taken at moment t_0 and shown in the figure. At t_0 the centripetal acceleration of the ball



A) is vertical and points upward.
B) is vertical and points downward.
C) is horizontal and points left.
D) is horizontal and points right.
E) does not depend on the speed of rotation.

26. A farmer pulls an apple cart down a straight road at a steady speed of 2 m/s. Behind the cart, on the same road, a horse is trotting in the same direction at a steady 8 m/s. Initially, the horse is 120 m behind the cart. (Note that we are putting the cart before the horse.) About how long does it take before the horse catches up to the cart to replace the farmer?
A) 10 s
B) 20 s
C) 30 s
D) 50 s
E) 70 s

27. A ball rolls around the rim of a roulette wheel at constant speed, experiencing a centripetal acceleration a=0.1g. It takes time t for the ball to make one complete circle. What is the speed of the ball?

A) 0.2π gt
B) $0.1gt/\pi$
C) 0.1π gt
D) $0.05gt/\pi$
E) 0.05π gt

28. A speed skater is sliding across the ice at a speed of 19 m/s when she encounters a rough patch of ice that is 2.0 m wide. As she coasts out of the rough patch, she is moving with a speed of 18 m/s. Assuming her deceleration to be constant, roughly what is the magnitude of that deceleration?

A) 0.5 m/s^2
B) 1 m/s^2
C) 2 m/s^2
D) 5 m/s^2
E) 10 m/s^2

Answers

1	A
2	D
3	D
4	E
5	D
6	B
7	A
8	C
9	A
10	C
11	B
12	C
13	B
14	C
15	B
16	B
17	B
18	E
19	D
20	C
21	B
22	C
23	E
24	E
25	A
26	B
27	D
28	E