Solutions to

Exam I: Physics 117 F07 **VERSION A** James J. Griffin
September 28, 2007 Physics 2109/Tel.301-405-6118
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FOR VERSION B use

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PHYSICS 117 EXAM I
CONVERTING VERSION A TO VERSION B

To get version B of this exam from version A,
Make the following identifications

Version B#	is the same as	Version A #
#2		#3
#3		#2
#4		#7
#7		#4
#11		#13
#13		#11
#19		#22
#22		#19
#31		#32
#32		#31
#57		#58
#58		#57

NUMBER.

4) MAKE NO STRAY MARKS ON THE ANSWER SHEET AND ERASE CLEANLY IF NECESSARY.

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C) GENERAL ADVICE

Many students will not have time to finish this exam if they proceed at a leisurely pace. Therefore it is probably advantageous to earmark time-consuming items for later attention and skip forward to questions that can be answered more easily. No subtractions will be made for wrong answers, so that last minute best guessing is probably an advantageous strategy.

IF YOU NEED HELP, ASK!.....AND ASK EARLY RATHER THAN LATE.

ALSO FOR FAIRNESS' SAKE, PLEASE STOP WRITING WHEN THE EXAM ENDS. A **PENALTY OF 8% OF THE RAW SCORE** MAY BE IMPOSED UPON STUDENTS WHO TRY TO TAKE UNFAIR ADVANTAGE OF THE COLLECTION PROCESS BY CONTINUING TO WRITE AFTER THE END HAS BEEN ANNOUNCED.

MULTIPLE CHOICE: Choose the one most nearly correct and complete answer and insert its letter into your answer sheet. (Note that a table of ten matching questions comprises items #46 through #55 of this exam, and you may wish to sequence your work accordingly.)

1. Please enter the answer (A) or (B) into item 1 of your NCS sheet to answer question #1:
At the top line of this page on the left side it says:
   a) "This is Version A of the Exam"
   b) "This is Version B of the Exam"

2. A cyclist covers 160 miles between 2 PM and 6 AM. What was his instantaneous speed at the halfway point?
   a. 10 mph
   b. 20 mph
   c. 40 mph
   d. 80 mph
   e. Not enough information is given to be able to say.

3. On a trip to Philadelphia, you start your parked car, drive to Baltimore, stop for a one hour coffee break and arrive and park in Philadelphia exactly two hours after leaving College Park. If it is 120 miles to Philadelphia, your average speed would be 60 mph. Which of the following statements about this trip is correct?
   a. To average 60 mph the car, having started and ended at rest, must have exceeded 120 mph for some portion of the trip. T
   b. The instantaneous speed was certainly equal to 60 mph at some point during this trip. T
   c. It is possible to average 60 mph even if the speed is zero for one half of the trip's duration. T
   d. Since the car speeds up after each stop and slows down before each stop, it certain that the car traveled faster than 120 mph at some point in the trip T
   e. All of the above statements are correct.
   f. None of the above statements is correct.

4. What average speed, most nearly, is required to run a hundred yards in 10 seconds?
   a. 1 m/s
   b. 5 m/s
   c. 10 m/sec
   d. 30 m/s
   e. 60.0m/s
   f. 100.0 m/s

$\frac{100\,yd}{10\,sec} \times \frac{3\,ft}{1\,yd} \times \frac{12\,in}{1\,ft} \times \frac{2.54\,cm}{1\,in} \times \frac{1\,m}{100\,cm} = \frac{9.1\,m}{sec}$

OR (Quicker) $1\,m \approx 1\,yd$ $\frac{100\,yds}{10\,sec} \approx \frac{100\,m}{10\,sec} \approx 10\,m/s.$

5. The acceleration of an object at a time, t, during a trip of duration, T, is defined to be :
   a. one half of the sum of the maximum and the minimum velocities divided by T. F
   b. the average velocity divided by T. F
   c. the total trip distance divided by T^2, on dimensional grounds. F
   d. the difference between the final velocity and the initial velocity divided by T. F
   e. the value of the velocity at the midpoint of the time interval divided by T F
   f. None of the above.

6. Which of the following quantities could specify an acceleration vector
   a. 5 m/s^2
   b. 5 m/s^2 downward
   c. 5 m/s North
   d. 5 m/s West
   e. 5-m/s^2 East
   f. None of the above could possibly specify a physical acceleration.

7. An object is accelerating
   a. only when its speed changes.
   b. only when its direction changes.
   c. when either its speed or direction changes.
   d. if its velocity is large.
   e. whenever no net force is acting upon it, by Newton's II Law.
   f. In none of the above cases.

8. If a go-cart requires 30 seconds to accelerate from 0 to 90 km per hour, its average acceleration is, most nearly,
   a. 80 m/ sec^2
   b. 8.0 m/ sec^2
   c. 0.8 m/sec^2
   d. 3 m/sec^2
   e. 30 m/sec^2

(Conversion factors = 1 !)

$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{90-0}{30-0} = \frac{90\ km}{30\ sec} \times \frac{10^3\ m}{1\ km} \times \frac{1\ hr}{3600\ sec}$

$= 0.833\ m/sec^2$

9. In the strobe diagram below the ball is moving from left to right. Which statement best describes the motion? The ball is

   ...o o o o o o....

   a. not accelerating.
   b. speeding up.
   c. slowing down.
   d. moving with a constant speed.
   e. none of the above.

10. A pitcher requires about 0.2 second to throw a baseball. If the ball leaves his hand with a speed of 40 m/s how large is its average acceleration during the throw?
    a. 20m/ s
    b. 20 m/s^2
    c. 200 m/s^2
    d. 200 m/s
    e. None of the above is both dimensionally correct and within 10% of the true answer.

$\bar{a} = \frac{40}{0.2} = 200\ m/s.$

11. When we said that light objects and heavy objects fall at the same rate, what assumption(s) were we making?
    a. They have the same shape.
    b. They have the same size.
    c. They have surfaces with similar air resistances
    d. They are falling in a vacuum.
    e. They are made of the same material.
    f. All of the above assumptions are required to make them fall at the same rate.
    g. None of the above assumptions (a through e) suffices to yield the same rates

12. The motion of a block sliding down a frictionless ramp can be described as motion with
    a. a constant acceleration less than 10 m/s^2
    b. a constant speed that depends on the slope of the ramp.
    c. an acceleration which increases as the block continues sliding.
    d. a constant acceleration which is negative (i.e., slows the object down) due to friction.
    e. a constant speed, independent of the slope of the ramp.
    f. None of the above.

$a = g \sin\theta < g = 10\ m/sec^2$

13. If a ball is dropped from rest, it will fall 5 m during the first second. How far will it fall during the sixth second, most nearly ?
    a. 15 m
    b. 25 m
    c. 45 m
    d. 55 m
    e. 65 m
    f. None of the above is correct within 10%.

$d = g/2\, t^2$ $\quad d(6) - d(5) = \frac{10}{2}(36-25) = 55\,m$

14. A ball with a mass of 1.5 kg is thrown vertically upward with a speed of 35 m/s. What are its speed and direction 5 seconds later?
    a. 15 m/s upward
    b. 5 m/s upward
    c. zero
    d. 5 m/s downward
    e. 15 m/s downward
    f. None of the above is within 10% of the correct answer

$v = v_0 - gt = +35 - 10\cdot 5 = -15\,m/sec$ (i.e downward)

15. If we use plus and minus signs to indicate the directions of velocity and acceleration in one dimension, in which of the following situations does the object speed up?
    a. negative velocity and negative acceleration.
    b. positive velocity and positive acceleration.
    c. zero velocity and positive acceleration.
    d. zero velocity and negative acceleration.
    e. In all of the above cases the object speeds up.
    f. In none of the cases, a through d above, does the object speeds up.

16. The Center of Mass Point of a solid body
    a. Is a definite fixed point in a coordinate system fixed to the body itself.
    b. moves as though all of the forces applied to the body were applied at its location.
    c. moves as though the entire mass of the body were concentrated at its location.
    d. may be located outside the physical extension of the body.
    e. All of the above remarks (a through d) are true of the Center of Mass Point.
    f. None of the above answers is true and correct.

17. A car initially traveling north at 20 m/s has a constant acceleration of 0.5 m/s^2 Northward. How far does the car travel in the first 10 s, most nearly?
    a. 25 m
    b. 50 m
    c. 125 m
    d. 150 m
    e. 225 m
    f. 250 m
    g. None of the above is within 10% of the correct answer.

$d(t) = v_0 t + \frac{1}{2} a t^2$
$= 20\cdot 10 + \frac{1}{2}(0.5)100 = 225\,m$

18. A circus clown plans to launch a ball vertically from a gun which gives it an initial upward speed of 30 m/s. His partner is placed so that he can just put his hand out and catch the ball at its maximum height. How many seconds after launch does he catch the ball, most nearly?
    a. 1
    b. 2
    c. 3
    d. 4
    e 5
    f. None of the above is within 10% of the correct answer.

$v_0 - g t^{TOP} = 0 \Rightarrow t^{TOP} = v_0/g = 30/10 = 3\,sec.$

19. If an object moves in a straight line with a constant speed, we can conclude that
    a. the object is unaccelerated. T
    b. there is no net force acting on the object. T
    c. if there is any non zero force acting on the object, there must be two or more forces acting on it. T
    d. there is no unbalanced force acting on the object. T
    e. All of the above conclusions (a through d) are valid.
    f. None of the above answers is correct.

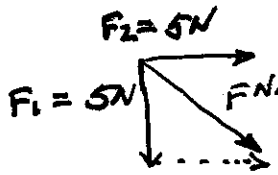
20. A train is moving with constant velocity along a level section of track. The net force on the first car is _____ the net force on the last car.
    a. equal to
    b. much greater than
    c. slightly greater than
    d. much less than
    e. slightly less than
    f. None of the above completions, a through e, yields a correct answer.

($\&$ $\vec{F}_{NET} = 0$ since $\vec{v} = \text{const} \Rightarrow \vec{a} = 0$).

21. If there is a constant net force acting on an object, its motion will be one with _____ acceleration.
    a. zero
    b. a constant, non-zero
    c. an increasing
    d. a decreasing
    e. It is not possible to say from the information given.

ORDINARILY "a constant net force" is taken to mean "a constant non-zero net force". Still, taken literally a net force of zero is indeed "a constant net force". Then (a) becomes a possible alternative to (b) & thus makes (c) the correct answer. Therefore we decided to accept all answers (a)…(e)

22. What is the magnitude, most nearly, of the net force acting on an object which is subject to a 5 N force acting south and a 5 N force acting east?
    a. 0 N
    b. 1 N
    c. 3 N
    d. 5 N
    e. 7 N
    f. 9 N
    g. None of the above is within 10% of the correct answer.



$F_{NET} = \sqrt{25+25} = 5\sqrt{2} = 7.07\ N$

23. You are applying a 600-newton force to a freezer full of chocolate chip ice cream in an attempt to move it across the basement. It will not budge. The weight of the freezer (including ice cream) is 1500 N. The coefficient of static friction, μ_{Static} is
    a. equal to 0.4, exactly.
    b. greater than 0.4 but less than 0.6.
    c. less than 0.4.
    d. greater than or equal to 0.4
    e. less than 0.4 but greater than0.25
    f. None of the above completions yields a true statement.

$F^{MAX}_{STATIC\ fr} \leq \mu_S |N| = \mu_S \cdot 1500$ &

$600 = |F^{APP}| = |F_{Stat\,fr}| < F^{MAX}_{Stat\,fr} < \mu_S \cdot 1500$

Conclude $600 < \mu_S \cdot 1500$

$\frac{6}{15} = 0.4 < \mu_S$

24. Which of the following is *not* a vector quantity?
    a. force ✓
    b. acceleration ✓
    c. weight ✓
    d. velocity ✓
    e. Displacement ✓
    f. speed ✗
    g. None of the above is a vector quantity
    h. All of these (a through f) are vector quantities.

25. What acceleration, most nearly, is produced by an applied force of 90 N acting on a mass of 2 kg if its velocity is 20 m/s and the frictional force is 40 N?
    a. 8 m/s^2
    b. 10 m/s^2
    c. 12 m/s^2
    d. 14 m/s^2
    (e.) 26 m/s^2
    f. None of the above is correct within 10%.

$F_{NET} = 90 - 40 = ma = 2a \Rightarrow a = \frac{50}{2} = 25 \frac{m}{sec^2}$

26. An astronaut on a strange planet has a mass of 80 kg and a weight of 160 N. What is the value of the acceleration due to gravity on this planet, most nearly ?
    (a.) 2 m/s^2
    b. 4 m/s^2
    c. 6 m/s^2
    d. 8 m/s^2
    e. 10 m/s^2

$W = F_G = m \hat{g}_S$
$160 = 80 \hat{g}_S \Rightarrow \hat{g}_S = 2 m/sec^2$

27. A ball with a weight of 35 N is thrown vertically upward. What is the force on the ball just as it reaches the top of its path, most nearly ?
    a. zero
    b. 10 N upward
    c. 10 N downward
    d. 20 N downward
    e. 20 N upward
    (f.) None of the above is within 10% of the correct answer.

$F = mg = W = const = 35N$

28. A ball falling from a great height will reach terminal speed when its _____ goes to zero.
    a. velocity ✗
    b. gravity force ✗
    c. weight ✗
    d. speed ✗
    e. mass ✗
    (f.) acceleration ✓ yes ... because at that point the speed stops increasing.
    g. None of the above insertions yields a true statement.

29. You leap from a bridge with a bungee cord tied around your ankles. As you approach the river below, the bungee cord begins to stretch and you begin to slow down. The force of the cord on your ankles slowing you down is _____ your weight?
    a. much less than
    b. slightly less than
    c. just equal to
    (d.) greater than ... because the net force ($F_{cord} - W$) is upward
    e. There is not enough information to say for sure.

30. Terry and Chris pull hand-over-hand on opposite ends of a rope while standing on a frictionless frozen pond. Terry's mass is 75 kg and Chris's mass is 25 kg. If Chris's acceleration is 3 m/s^2, what is Terry's acceleration?
    (a.) 1 m/s^2
    b. 3 m/s^2
    c. 6 m/s^2
    d. 9 m/s^2
    e. None of the above is within 10% of the correct answer.

$m_C a_C = |F_{ST}| = |F_{T,C}| = m_T a_T$
$25 \cdot 3 = 75 a_T \Rightarrow a_T = 1 m/sec^2 = $ Terry's accln

31. When a snowflake falls, it quickly reaches a constant terminal velocity. This happens because
    a. the gravity force stops acting on the snowflake as it falls
    b. there is no force acting on it.
    c. the snowflake has no weight.
    d. the mass of the snowflake is smaller than its weight.
    e. None of the above explanations is sufficient and correct.

    In fact it happens because the drag force quickly becomes equal to the weight.

32. By what factor does the centripetal acceleration change if a car goes around a corner four times as fast?
    a. 0.25
    b. It stays the same.
    c. 2
    d. 4
    e. 16
    f. None of the above is within 10% of the correct answer.

    $a = v^2/R \qquad v \to 4v \Rightarrow a \to \frac{(4v)^2}{R} = 16\, v^2/R.$

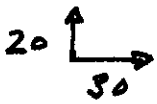
33. What net force acts on a 3 kg object moving in a circular path with a radius of 20 m at a constant speed of 40 m/s?
    a. 480 N
    b. 240 N
    c. 120 N
    d. 80 N
    e 60 N
    f. None of the above is within 10% of the correct answer.

    $F = m v^2/R = 3\,(40)^2/20 = 240\ N$

34. A 20-kg child on a merry-go-round is traveling in a circle with a radius of 12 m at a speed of 4 m/s. What is the acceleration experienced by this child, most nearly?
    a. zero
    b. 0.75 m/s^2
    c. 1.33 m/s^2
    d. 2.25 m/s^2
    e. 4.75 m/s^2
    f. 5 m/s^2
    g. None of the above is within 10% of the correct answer.

    $a = v^2/R = 16/12 = 1.33\ m/sec^2$

35. A golf ball is hit with an initial vertical speed of 20 m/s and an initial horizontal speed of 30 m/s. How long will the ball remain in the air? (Neglect air resistance and assume the course is flat.)
    a. 1 s
    b. 2 s
    c. 3 s
    d. 4 s
    e. 6 s
    f. None of the above is within 10% of the correct answer.

    $T = 2t^{TOP} = 2 \cdot v_{oy}/g = 2 \cdot \frac{20}{10} = 4\ sec.$

    since $v_y = 0 = v_{oy} - g t^{TOP} \Rightarrow t^{TOP} = \frac{v_{oy}}{g}$

Scenario 36-37
A gun is held horizontally and fired. At the same time the bullet leaves the gun's barrel an identical bullet is dropped from the same height. Neglect air resistance.

36. Refer to **Scenario 36-37**. Which bullet will hit the ground with the greatest speed?
    a. The bullet that was fired.
    b. The bullet that was dropped.
    c. It will be a tie.
    d. The question can't be answered with the information given.

    because its velocity has both vertical & horizontal components

    $S_{fired} = \sqrt{v_y^2 + v_x^2}$

    whereas $S_{dropped} = \sqrt{v_y^2} = v_y < S_{fired}$

37. Refer to **Scenario 36-37**above. If the bullets were not identical, but rather the dropped bullet had twice the mass of the one fired, which bullet would hit the ground first?
    a. The bullet that was fired.
    b. The bullet that was dropped.
    c. It will be a tie. Rate of fall is independent of mass, neglecting air resistance.
    d. The question can't be answered with the information given.

38. A 1 kg ball is thrown straight down from the edge of a tall cliff with a speed of 30 m/s. At the same time a 2 kg ball is thrown straight up with the same speed. If the 2 kg ball travels up, stops, and then drops to the bottom of the cliff, which ball (if either) will be traveling faster when it reaches the ground below?
    a. The 1kg ball, because its mass is smaller and it moves faster
    b. The 2kg ball, because its mass is larger and it accelerates at a greater rate.
    c The 1 kg ball, but not for the reason given in (a) above.
    d. The two balls will be traveling at the same speed when they hit.
    e. There is not enough information to say.

39. Which of the following statements about projectile motion is true (neglecting air resistance)?
    a. The horizontal and vertical motions are independent. T
    b. The force on the projectile is constant throughout the flight. T
    c. The acceleration of the projectile is constant throughout the flight. T
    d. The path depends upon the initial velocity, but not upon the mass of the projectile. T
    e. All of the above statements are true. T
    f. None of the above statements is correct. X

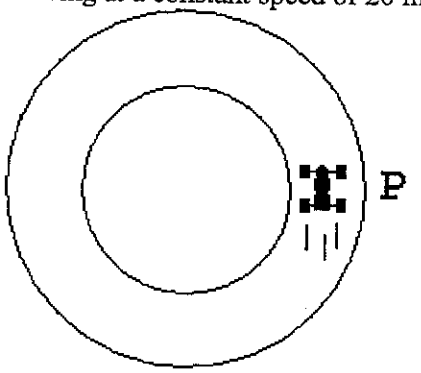
40. In projectile motion the
    a. acceleration is parallel (or antiparallel) to the velocity. F
    b. acceleration is perpendicular to the velocity. F
    c. acceleration is vertical, while the velocity can be in any direction. T
    d. acceleration is vertical and the velocity is horizontal. F
    e. The acceleration reaches its minimal value of zero at the top of the trajectory. F
    f. None of the above.

41. A baseball player throws a ball from left field toward home plate. Assume that you can neglect the effects of air resistance. At the instant the ball approaches home plate, the ball's acceleration
    a. reaches its maximal value
    b. reaches its minimal value
    c. retains its constant value, zero.
    d. Has the same magnitude as it had at the highest point of the ball's trajectory.
    e. There is not enough information to say.

42. If a small child stands on a spring scale at rest, it reads 100 N, which means his mass is 10 kg. If instead he stands on the scale while accelerating upward in an elevator at 4 m/s^2, what force would the scale exert and register?
    a. 104 N
    b. 110 N
    c. 140 N because scale must cancel Weight & supply 40N extra to cause acceleration.
    d. 410 N

e. None of the above is correct within 10%.

Figure 43-44
A 400 kg race car is moving counterclockwise on a circular path of radius 800 m as shown in the diagram below. Suppose that at this instant, the car is at point P and moving at a constant speed of 20 m/s in the upward direction on the page.



43. Refer to **Figure 43-44.** In what direction, precisely, does the net force point at the instant described?
    a. ↑
    b. ↓
    c. →
    d. ← towards center
    e. None of the above.

44. Suppose that the race track of Fig 43-44 is covered with a film of oil which reduces the coefficients, (both static and kinetic) of friction on the tires to zero and that the car is kept in its circular paths by cables attached to a post at the center of the track. What, most nearly, is the tension in the cable attached to the car in Fig.38 at the instant described above?
    a. 2×10^2 N
    b. 4×10^2 N
    c. 2×10^3 N
    d. 4×10^3 N
    e. 2×10^4 N
    f. 4×10^4 N
    g. None of the above is within 10% of the correct answer.

$T = F_c = m v^2/R = \frac{(400)(20)^2}{800} = 200\ N$

45. A mass, m = 0.900kg, hanging on a spring of spring constant , k= 10N/m, oscillates with a period, T= 1.88 s. If another oscillator has a mass four times as large and a spring constant one fourth as large, its period will be (most nearly)?
    a. 0.12 s
    b. 0.47 s
    c. 0.94 s
    d. 1.88 s
    e. 3.76 s
    f. 7.52 s
    g. 30.08 s
    None of the above is within 10% of the correct answer.

$T_0 = 2\pi\sqrt{\frac{M_0}{K_0}}$ $T_2 = 2\pi\sqrt{\frac{4M_0}{K_0/4}} = 2\pi\sqrt{16\frac{M_0}{K_0}} = 4T_0$

$= 7.52$ sec.

Ten Matching Questions, #46 through #55 follow.
For each numbered item, fill in the circle on you NCIS answer sheet which corresponds to the letter of the item on the right which correctly matches it.

	Numbered Items	Lettered Matching Items
C	46. Projectile Motion	A. Focuses attention on acceleration rather than velocity
H	47.Speed with direction	B. Encompasses and Replaces Galileo's Principle of Inertia.
J	48.Acceleration	C. Simultaneous vertical motion with $a_y = -g$ and horizontal motion with $a_x = 0$.
G	49. Period of a Harmonic Oscillator	D. Pairs equal and opposite forces
B	50.Newton's First Law	E. Doubles when speed and radius of trajectory both double.
A	51.Newton's Second Law	F. Is greatest for largest mass among similarly shaped objects.
D	52. Newton's Third Law	G. Triples if mass is increased nine times.
F	53.Terminal Velocity	H. Velocity.
E	54.Centripetal Acceleration	I. Average speed over a very short time interval.
I	55. Instantaneous speed	J. Rate of change of velocity with time.

Note: The following problems may require somewhat more calculation than the average. You may wish to sequence your work accordingly.

56. A 40-kg crate is being pushed across a horizontal floor by a horizontal force of 240 N. If the coefficient of sliding friction is 0.1, what is the acceleration of the crate, most nearly?

a. zero
b. 1 m/s^2
c. 2 m/s^2
d. 3 m/s^2
e. 4 m/s^2
(f.) 5 m/s^2
g. 6 m/s^2
h. None of the above is within 10 % of the correct answer.

$\mu |N| = F_{fr} = (0.1)(40 \cdot 10) = 40\ N$

$F_{NET} = F_{APP} - F_{fr} = 240 - 40 = 200\ N = ma$

$\Rightarrow a = \frac{200}{40} = 5\ m/sec^2$

57. Angel Falls in southeastern Venezuela is the highest uninterrupted waterfall in the world. If the water is flowing horizontally at a speed of 3 m/s as it passes over the lip of the falls, and the height of the falls above the pool is 1125 m, how far out from the lip does the falling water hit the pool?

a. 0 m
b. 3 m
c. 15 m
(d.) 45 m
e. 3375 m
f. None of the above is within 10% of the correct answer.

$\frac{1}{2} g (t_{fall})^2 = 1125 \Rightarrow t_{fall} = \sqrt{\frac{2250}{10}} = 15\ sec$

$d_x = v_{0x} t_{fall} = 3 \cdot 15 = 45\ m$

58. A red ball is thrown straight down from the edge of a tall cliff with a speed of 20 m/s. At the same time a green ball is thrown straight up with the same speed. If the green ball travels up, stops, and then drops to the bottom of the cliff, how long after the red ball will the green ball hit the ground?

a. 1 s
b. 2 s
c. 3 s
(d.) 4 s.
e. 5 s
f. 6 s
g. None of the above is within 10% of the correct answer

$v_{G\,y0} = +20$. Then green ball rises for 2 sec (= 20/10) & then falls for 2 sec ... at which point it is at just the same location and speed as RED ball, but 4 seconds later.

59. A man stands on a large platform merry-go-round which is rotating at a constant angular speed, $\omega = 1.0$ radians/second. The normal force between his shoes and the platform is equal to his weight, 500 N, and the coefficient of static friction is $\mu_{STATIC} = 0.4$. How far from the center can he stand without sliding off the platform, most nearly ?

a. 1 m
b. 2 m
c. 3 m
(d.) 4 m
e. 5 m
f. 6 m
fg None of the above is within 10% of the correct answer.

$F_f = \mu |N| = (0.4)(500) = 200$ N is MAX force friction can supply & $F_{centripetal} = m R \omega^2 = 50 R \cdot (1)^2$ is required to keep him going in circle. Then if $50R > 200$ i.e. $R > 4$ m friction can not keep him from sliding

60. Suppose Newton lived on another planet and thought of launching his apple horizontally at such a speed as to make it travel around that planet (presumed smooth for the present discussion) in a circle at fixed height. What horizontal speed must it have to have to stay at the same (small) height above the planet's surface? (Take the radius of the planet to be 2×10^6 m, and the planet's gravitational acceleration to be 8 m/s^2.)

to achieve circular motion, gravity force must equal Fcentrip $:= \frac{m v^2}{R} = m g$

$v^2 = gR = 8 \cdot 2 \times 10^6$

$= 4 \times 10^3$ m/sec

a. 4×10^2 m/s
b. 4×10^3 m/s
c. 4×10^4 m/s
d. 2×10^6 m/s
e. 16×10^6 m/s
f. None of the above is within 10% of the correct answer.

END of EXAM