SOLUTIONS (w. corrections #4 and #52)

Exam I: Physics 117 S08
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Physics 117 Exam I, Cover Page

A) GENERAL INSTRUCTIONS

This exam consists of 60 questions worth two points each for a maximum of 120 points.

ALL ANSWERS MUST BE ENTERED INTO THE NCS ANSWER SHEET BY MEANS OF HEAVY BLACK MARKS WITH A NUMBER 2 PENCIL. (Only a pencil mark will work; the optical scanner cannot read inked answers no matter what color or how dark.)

The questions are numbered from 1 to 60: make sure you enter your single letter answer into the answer line with the same number as the question you are answering.

Only the computer readable NCS answer sheet will be handed in. Keep this exam for your future use.

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B) PREPARE YOUR ANSWER SHEET IN ADVANCE:

1) SIGN YOUR PERSONAL SIGNATURE INTO THE TOP MARGIN ABOVE THE NAME BOX of the NCS SHEET.
2) PRINT YOUR NAME, **FAMILY NAME FIRST**, INTO THE BOXES PROVIDED AND DARKEN THE CIRCLE FOR THE CORRESPONDING LETTER BELOW EACH BOX
3) INSERT YOUR STUDENT ID NUMBER UNDER "IDENTIFICATION NUMBER" AND DARKEN THE CORRESPONDING CIRCLES BELOW EACH 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.

Physics 117 S08 Solutions

Multiple Choice

Insert the letter of the choice that best completes the statement or answers the question into your NCS answer sheet.

1. A speed of 20 m/hr is equal to _____ km/s, most nearly.
   a. $5.5X10^{-6}$
   b. $7.2X10^{-3}$
   c. 5.5
   d. $7.2X10^{1}$
   e. $5.5X10^{2}$

$\frac{20\ m}{hr} \times \frac{1\ hr}{60\ min} \times \frac{1\ min}{60\ sec} \times \frac{1\ km}{10^3\ m} = 5.6X10^{-6}\ \frac{km}{sec}$

2. A train covers 180 miles between 1 P.M. and 7 p.m. What was its speed at 1:30 P.M.?
   a. 30 mph
   b. More than 30 mph
   c. Less than 30 mph
   d. Not enough information is given to allow a conclusion.
   e. There is a definite answer, but none of the above is correct.

3. When you calculate the speed (in meters per second) in an experiment, your calculator display reads 1.2345678. If you are asked to record your result to four significant figures, you should write
   a. 1.234 m/s
   b. 1.235 m/s
   c. 1.2346 m/s
   d. 1.2345 m/s
   e. None of the above, because this result already has eight significant figures.

1.2345 Rounds up to 1.235 for 4 significant figures

4. Given that the circumference of the earth's orbit about the sun is 9.42 X 10^8 km, which of the calculations below yields the correct conversion of a speed of 1 orbit circumference per 365.2 days to the same speed in m/s?
   a. (1orbit/365.2day)(9.42X10^8km/orbit)(1day/24hr)(3600sec/1hr)(10^3m/1km) = $\frac{m\text{-}sec}{(hr)^2}$ X
   b. (1orbit/365.2day) (9.42X10^8km/orbit)(24hr/1day)(1hr/3600sec)(1km/10^3m) = $(?)/(day)^2$ X
   c. (1orbit/365.2day) (1orbit/9.42X10^8km)(1day/24hr)(1hr/3600sec)(10^3m/1km) = $(orbit)^2$ X
   d. (1orbit/365.2day) (9.42X10^8km/orbit)(1day/24hr)(1hr/3600sec)(10^3m/1km) = m/sec ✓
   e. (1orbit/365.2day) (9.42X10^8km/orbit)(1day/24hr)(1hr/3600sec)(1km/10^3m) = $km^2/?$ X
   f. None of the above conversions yields the correct answer. FALSE

5. Car A travels from milepost 343 to milepost 349 in 3 minutes. Car B travels from milepost 491 to milepost 500 in 4.5 minutes. Which car has the greater average speed?
   a. Car A
   b. Car B
   c. Their average speeds are the same.
   d. There is not enough information to allow a conclusion.
   e. None of the above answers is correct.

A: $6/3 = 2.0\ \frac{mi}{min}$ B: $9/4.5 = 2.0\ mi/min$

6. The instantaneous speed of an object is defined to be the
a. distance it travels divided by the time it takes.
b. distance it travels multiplied by the time it takes.
c. value of the average speed at the midpoint of the time interval.
(d.) average speed determined over an infinitesimally small time interval. ✓
e. The minimum speed plus one half the difference between the maximum speed and the minimum speed.

7. The average acceleration of an object during a certain time interval is defined to be
a. the distance it travels divided by the length of the time interval.
b. the change in its speed divided by the length of the time interval.
c. the mean value of the maximum and the minimum accelerations during the time interval. ✗
(d.) the change in its velocity divided by the length of the time interval. ✓
e. None of the above. Acceleration is about the rate of change of velocity.

8. An object is accelerating
a. only when its speed changes.
b. only when its direction changes.
c. if its velocity is very large.
(d.) whenever its speed or its direction changes.
e. even when its velocity is constant.
f. None of the above completions yields a correct statement.

9. A pitcher requires about 0.08 second to throw a baseball. If the ball leaves his hand with a speed of 32 m/s, what was its average acceleration during the throw?
a. 4 m/s
b. 4 m/s^2
c. 40 m/s^2
d. 400m/s
(e.) 400 m/s^2
f. None of the above is within 10% of the correct answer.

$|\vec{a}| = \frac{|\Delta v|}{\Delta t} = \frac{(32-0)\,m}{0.08\,(sec)^2} = 400\ m/s^2$

} BOTH ANSWERS (d) & (e) have the same numerical value, but only (e) has the units of acceleration.

10. A child traveling 4 m/s on a sled passes her younger brother. If her acceleration down the hill is 3 m/s^2 and constant, how fast is she traveling when she passes her older brother 2 s later?
a. 7 m/s
(b.) 10 m/s
c. 13 m/s
d. 16 m/s
e. 24m/s
f. None of the above is within 10% of the correct answer.

$v(t=2) = v_0 + at = 4 + 3\cdot 2 = 10\ m/s.$

11. 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. moving with a constant speed.
b. speeding up.
c. slowing down.
d. not accelerating.
e. accelerating, not because of its speed, but because its direction is changing.
f. None of the above completions provides a true statement.

12. A ping-pong ball and a smooth golf ball have approximately the same size but very different masses. Which hits the ground first if you drop them simultaneously from a great height while standing on the moon (which has no atmosphere)?

a. the ping-pong ball, because it is lighter.
b. the golf ball, because it is heavier.
c. They both hit simultaneously.
d. We are not able to predict the results because it depends upon the strength of gravity on the moon, which was not provided.
e. None of the above assertions is true.

13. A ping-pong ball and a smooth golf ball have approximately the same size but very different masses. Which hits the ground first if you drop them simultaneously from a great height in the earth's atmosphere?

a. the ping-pong ball, because it is lighter and acceleration is less affected by the drag force.
b. the golf ball, because it is heavier and its acceleration is less affected by the drag force.
c. They both hit simultaneously because there is no drag force in the earth's atmosphere.
d. We are not able to predict the results because it depends upon the strength of gravity on the moon, which was not provided..
e. None of the above assertions is true.

14. A ball is thrown straight up into the air with a velocity of 9.8 m/s. If we ***do not*** ignore air resistance, the acceleration of the ball as it is traveling upward has a magnitude

a. equal to 9.8 m/s^2.
b. greater than 9.8 m/s^2.
c. less than 9.8 m/s^2.
d. zero.
e. None of the above, because the acceleration depends upon the speed.

$\vec{F}^{NET} = \vec{F}_{GRAVITY} + \vec{F}_{AIR\,RES.}$ & when ball is travelling upward both F_{GRAV} & $F_{AIR\,RESIST}$ are directed downward. Then $|F^{NET}| > |F_{GRAVITY}| = mg$ & $a = \frac{F^{NET}}{m} > g = 9.8\ m/sec^2$

15. The motion of a block sliding down a frictionless ramp can be described as motion with

a. a constant speed.
b. a constant acceleration greater than 10 m/s/s.
c. a constant acceleration less than 10 m/s/s.
d. a constant speed that depends on the steepness of the ramp.
e. None of the above, since neither the speed nor the acceleration is constant.

because $F_{||}^{NET} = F_{GRAV} \cdot \sin\theta < F_{GRAV}$

16. Suppose that you look out a tenth-floor window and see a ball falling at 5 m/s. How fast will this ball be falling 0.2 s later?

$v(t=0.2) = v_0 + at = 5 + (10)(0.2) = 7\ m/sec$

a. 5 m/s
(b.) 7 m/s
c. 9 m/s
d. 25 m/s
e. 45 m/s
f. None of the above is within 10% of the correct answer.

17. You throw a ball straight up at 40 m/s. How many seconds elapse until it is traveling downward at 20 m/s?

$v_0 = +40 \quad v(t) = v_0 - gt = -20 \Rightarrow t = \frac{+20+40}{10} = 6\ sec$

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

18. If we use plus and minus signs to indicate the directions of velocity and acceleration along a one dimensional line, in which of the following situations is the object's speed increasing?

a. positive velocity and negative acceleration ✗
b. negative velocity and positive acceleration ✗
c. positive velocity and zero acceleration ✗
(d.) negative velocity and negative acceleration ✓
e. zero velocity and zero acceleration ✗
f. In none of the above situations does the speed increase. False

19. A car traveling eastward at 10 m/s turns around and travels westward at 20 m/s. If this takes place in 5 s, what is the average acceleration of the car? Let WEST be + direction

$\bar{a} = \frac{v_f - v_i}{t_f - t_i} = \frac{20 - (-10)}{5 - 0} = +6\ m/sec^2$ West.

a. 1 m/s^2 east
b. 2 m/s^2 west
c. 3 m/s^2 east
d. 4 m/s^2 west
e 5 m/ s^2 east
f. (f.) 6 m/ s^2 west ← This is the correct answer (f)
g. ~~f.~~ None of the above is within 10% of the correct answer.. ← This answer is mislabelled – it should be (g)

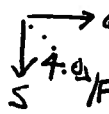
20. If there is no net force acting on an object traveling at the speed of sound, its motion will be one with _____ acceleration.

(a.) zero
b. constant, non-zero
c. increasing
d. decreasing
e. Not enough information to say.

21. If an object moves in a straight line with a constant speed, we can conclude that
a. the object has inertia.
b. there are no forces acting on the object.
c. there must be at least two forces acting on the object.
d. there can be no more than two forces acting on the object.
(e.) None of the above conclusions is valid. – We can conclude only that the NET FORCE = 0

22. The motion of a block sliding freely across a horizontal, frictionless surface can be described as one with
a. a decreasing speed.
b. an increasing speed.
(c.) a constant speed.
d. a constant, non-zero acceleration.
e. None of the above.

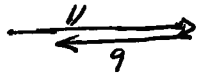
23. What is the magnitude of the net force acting on an object which is under the influence of a 4.0 N force acting south and a 6.93 N force acting east?
a. 2.93 N
b. 4.0 N
c. 6.93 N
(d.) 8.0 N
e. 10.93 N
f None of the above is within 10 % of the correct answer.



$|F_{NET}| = \sqrt{(4)^2+(6.93)^2} = 8\ N$

24. A subway train is moving with constant velocity along a level section of track. The net force on the first subway car is _____ the net force on the last subway car.
a. finite, but equal and opposite to
b. much greater than
c. slightly greater than
d. less than
(e.) exactly equal to zero, the same as
f. None of the above.

25. Forces of 9 N and 11 N act on an object. What is the minimum value for the vector sum of these two forces?
a. zero
(b.) 2 N
c. 9 N
d. 11 N
e. 20 N



$|F_{min}| = |\vec{F}_9 + \vec{F}_{11}|_{min}$.
occurs when forces are anti-parallel; i.e point in opposite directions
Then $|F_{min}| = 2N$

26. You are applying a 40-newton force to a freezer full of chocolate chip ice cream in an attempt to move it across the basement, but it will not budge. The weight of the freezer (including ice cream) is 1000 N, and $\mu = 0.1$ is the value of the coefficient of static friction. The frictional force exerted by the floor on the freezer while you push is

a. 40 N
b. greater than 40 N but less than 100 N
c. greater than 60 N but less than 100 N
d. 60 N
e. 100 N.
f. None of the above completions yields a true statement.

The force of static friction is equal to the applied force so long as $F_{APP} \leq F_{Static}^{MAX} (= \mu|N| = (1000N)(0.1) = 100N$ in this case.)

27. What is the mass, most nearly, of a vehicle that has an acceleration of 40 m/s/s when a net force of 24,000 N is applied to it?

a. 600 kg
b. 6,000 kg
c. 24,000 kg
d. 96,000 kg
e. 960,000 kg
f. None of the above is within 10% pf the correct answer..

$F = ma \Rightarrow \frac{F}{a} = m = \frac{2.4 \times 10^4 N}{40\ m/sec^2} = 6 \times 10^2 kg$

28. What acceleration, most nearly, is produced by a force of 120 N acting on a mass of 10 kg if its velocity is 13 m/s and the frictional force is 40 N?

a. 13 m/s/s
b. 10 m/s/s
c. 8 m/s/s
d. 1.3 m/s/s
e. 1 m/s/s

$F_{NET} = 120 - 40 = ma = 10a$

$a = 8\ m/sec^2$

29. Which of the following is not a vector quantity?

a. force ✓
b. acceleration ✓
c. weight ✓
d. displacement ✓
e. velocity ✓
f. All of the above are vector quantities.

30. An astronaut on a strange planet has a mass of 60 kg and a weight of 10 N. What is the value of the acceleration due to gravity on this planet?

a. 0.16 m/s/s
b. 0.60 m/s/s
c. 1.67 m/s/s
d. 6.0 m/s/s
e. None of the above is within 10% of the correct answer.

$W = m g_p \Rightarrow 10N = 60(kg) g_p$

$g_p = \frac{10}{60} = \frac{1}{6}\ m/sec^2$

31. A ball with a weight of 30 N is thrown vertically upward with a speed of 10m/s. What are the magnitude and direction of the force on the ball just as it reaches the top of its path? (Neglect air resistance.)

a. zero
b. 10 N upward
c. 10 N downward
d. 20 N upward
(e.) 30 N downward
f. None of the above is within 10% of the correct answer..

$W = F_G = -mg$ (downward) = constant = 30N
Same throughout motion!

32. A ball falling from a great height in the atmosphere will reach terminal speed when its _____ goes to zero.

a. inertia ✗
b. gravity force ✗
c. weight ✗
d. speed ✗
(e.) acceleration YES $a = 0 \Rightarrow v = \text{constant}$
f.. drag force ✗
g. None of the above completions yields a correct statement

33. When a snowflake falls, it quickly reaches a terminal velocity. This happens because

a. the mass of the snowflake is too small for gravity to have any effect. ✗
b. the gravity force acting on it becomes zero. ✗
c. the snowflake has no weight. ✗
d. the mass of the snowflake is smaller than its weight. ✗
e. The drag force acting on it becomes zero. ✗
(f.) None of the above completions yields a true statement. IN fact, v_T is achieved when drag force cancels gravity force & $F_{NET} = 0$.

34. Two steel balls have the same size and shape, but one is hollow. They are dropped in air and their terminal speeds are measured. Which of the following statements is correct?

(a.) The hollow ball has a smaller terminal speed because it requires a smaller air resistance to cancel the gravitational force on it.
b. The hollow ball has a larger terminal speed because it requires a smaller air resistance to cancel the gravitational force on it.
c. The terminal speeds are the same because the acceleration of gravity doesn't depend on mass.
d. The solid ball has the smaller terminal speed, because its inertia is larger.
e. None of the above can be asserted with certainty.

← These two balls have same air resistance but hollow one has smaller mass, so that slower velocity allows drag force to cancel its smaller gravitational force (weight)

35. 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 to slow you is _____ the force of your ankles on the cord to stretch it , and _____.

a. less than..... and less than your weight
b. greater than.....and greater than your weight
c. equal to.....and less than your weight
(d.) equal to .....and greater than your weight
e less than.....and greater than your weight
f. greater than..... and less than your weight.
g. None of the above insertions yields a true statement.

SINCE it slows you down, it must exceed force of gravity = Weight
& By NIII Force on Ankle by cord = " " cord by ankle

36. A rocket is launched with an initial velocity $\mathbf{v}_o = (v_x, v_y) = (80, 10)$ m/s (where the velocity is written in component form) in a large level field. How far from the launch point does it land?

a. 10 m
b. 80 m
c. 800 m
(d.) 160 m
e. It is not possible to say from the information given.
f None of the above statements is true or within 10% of the correct answer.

$t_{MAX} = 10/10 = 1$ sec to reach highest point & 1 sec to fall down again
In 2 seconds $x(t) - x_0 = 80 \cdot 2 = 160$ m

37. Terry and Chris pull hand-over-hand on opposite ends of a rope while standing on frictionless ice skates on a frozen pond. Terry's mass is 80 kg and Chris's mass is 20 kg. If Terry's acceleration is 2 m/s^2, what is Chris's acceleration?

a. 0.5 m/s^2
b. 1.0 m/s^2
c. 2 m/s^2
d. 4 m/s^2
(e.) 8 m/s^2
f. None of the above.

$m_T a_T = F_{T,C} = -F_{C,T} = m_C a_C$
$(80)(2) = 20(a_C) \Rightarrow a_C = \frac{80 \cdot 2}{20} = 8$ m/sec^2

38. You are riding an elevator from your tenth-floor apartment to the parking garage in the basement. As you approach the garage, the elevator begins to slow. The force which the elevator floor exerts upon on you is

a. equal to your weight.
(b.) directed upward, and greater than your weight. … because it must exceed weight to cause an upward acceleration & slow your downward velocity.
c. directed downward, and greater than your weight.
d. zero
e directed downward and smaller than your weight.
f. directed upward and smaller than your weight
g. It is not possible to day from the information given.

39. If you stand on a spring scale in your bathroom at home, it reads 600 N, which means your mass is 60 kg. If instead you stand on the scale while accelerating at 2 m/s^2 downward in an elevator, how many Newtons would it read?

a. 120 N
(b.) 480 N
c. 600 N
d. 720 N
e. None of the above.

$\vec{F}_{NET} = \vec{F}_G + \vec{F}_{Scale}$ & $\begin{cases} F_G = W = -mg = -600N \Rightarrow m = 60\ kg \\ F_S = \text{upward} \end{cases}$
Then $|F_S| - 600 = ma = (60)(-2) \Rightarrow |F_S| = (600 - 120) = +480\ N$

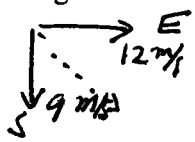
40. A mass, M, hanging upon a spring with a stiffness constant, k, is set into oscillation by displacing it from its equilibrium point and releasing it. The frequency of such a simple harmonic oscillation

a. increases with k. ✓
b. decreases with M. ✓
c. is equal to the inverse of its period. ✓
d. doubles if k quadruples. ✓
e. None of the above completions yields a true statement. False
(f.) All of the completions (a) through (d) above yield true statements about the simple harmonic oscillation.

41. In a straight line motion through space the
(a.) acceleration is parallel (or anti-parallel) to the velocity. ✓
b. acceleration is perpendicular to the velocity. ✗
c. acceleration is vertical, while the velocity can be in any direction. ✗
d. acceleration is vertical and the velocity is horizontal. ✗
e. None of the above statements is valid for straight line motion.

42. In uniform circular motion
a. the acceleration is parallel (or anti-parallel) to the velocity. ✗
(b.) the acceleration is perpendicular to the velocity. ✓
c. the acceleration is horizontal, while the velocity can be in any direction. ✗
d. both the the acceleration and the velocity are horizontal. ✗
e. None of the above is true. False

43. A migrating bird is initially flying south at 9 m/s. To avoid hitting a high-rise building, the bird veers and changes its velocity to 12 m/s east over a period of 2 s. What is the magnitude of the bird's average acceleration during this 2-s interval?
a. 3.0 m/s^2
(b.) 7.5 m/s^2
c. 9.0 m/s^2
d. 15.0 m/s^2
e. 21.0 m/s^2
f. None of the above is within 10% of the correct answer.



$|\vec{a}| = \frac{|\Delta \vec{v}|}{\Delta t} = \frac{\sqrt{81+144}}{2} = \frac{15}{2} = 7.5 \frac{m}{sec^2}$

44. A fox is chasing a bunny. The bunny is initially hopping east at 4 m/s when it first sees the fox. Over the next half second, the bunny changes its velocity to west at 8 m/s and escapes. What was the magnitude of the bunny's average acceleration during this half-second interval?
a. 0 m/s^2
b. 8 m/s^2
c. 16 m/s^2
(d.) 24 m/s^2
e. 48 m/s^2
f. None of the above is within 10% of the correct answer.

$|\vec{a}| = \frac{\Delta v}{\Delta t} = \frac{8-(-4)}{(0.5)} = 24 \text{ m/sec}$ (taking WEST as + direction)

45. By what factor does the centripetal acceleration change if a car goes around a corner three times as fast?
a. 0.33
b. It stays the same.
c. 3
d. 6
(e) 9
f. None of the above is within 10% of the correct answer.

$a = v^2/R \rightarrow a' = (3v)^2/R = 9v^2/R = 9a$

46. What is the centripetal acceleration of an object following a a circular path with a radius of 10 m at a speed of 20 m/s?
a. 10 m/s/s $v^2/R = 400/10 = 40\ m/sec^2$
b. 20 m/s/s
c. 40 m/s/s
d. 80 m/s/s
e. None of the above is within 10% of the correct answer.

Scenario 47-48
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.

47. Refer to **Scenario 47-48 above**. Which bullet will hit the ground with the greatest velocity?
a. The bullet that was fired. because its velocity has a horizontal component as well as its vertical
b. The bullet that was dropped.
c. It will be a tie, because both fall at the same rate
d. The question can't be answered with the information given.

48. Refer to **Scenario 47-48 above.** Which bullet would hit the ground first?
a. The lighter bullet that was fired.
b. The heavier bullet that was dropped.
c. It will be a tie, because both bullets fall at the same rate.
d. The question can't be answered with the information given.

49. A red ball is thrown straight down from the edge of a tall cliff with a speed of 30 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 many seconds later than the red ball does the green ball arrive at the bottom of the cliff?
a. 1 second $v_{oy} - gt^{MAX} = v_y(t^{MAX}) = 0$ when $t^{MAX} = \frac{v_{oy}}{g} = \frac{30}{10} = 3$ sec
b. 2 seconds
c. 3 seconds
d. 4 seconds & $2t^{MAX} = 6$ seconds = time for Green ball to fall back to launch height with same velocity (30 m/sec downward) as red ball had initially
e. 5 seconds
f. 6 seconds
g. Because the height of the cliff is unspecified, there is not enough information to say.

50. Which of the following statements best characterizes projectile motion, 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 vertical acceleration is constant through out the flight. T
e. The horizontal velocity is constant. T
f. All of the above statements (a through e) are true.
g. None of the above statements (a through f) is true.

51. In projectile motion the
a. acceleration is parallel (or anti-parallel) 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. acceleration is zero at the top of the trajectory. F
f. None of the above statements (a through e) is true F

52. 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 reaches its highest point, what is the direction of the ball's acceleration?
a. Up
b. Down
c. Horizontal
d. Because the acceleration is zero there, its direction is not well defined.
e. There is not enough information to say.

53. A rock is thrown off a tall cliff with a vertical speed of 30 m/s upward and a horizontal speed of 20 m/s. If the rock lands 5 s later, how far from the base of the cliff will it land?
a. 20 m
b. 30 m
c. 100 m
d. 200 m
e 600 m
f.. None of the above is within 10% of the correct answer.

$x(t) - x_0 = 5 v_{x0} = 5 \cdot 20 = 100\,m$

54. The Center of Mass of an extended object
a. moves in accordance with Newton's Laws. ✓
b. may lie outside the physical boundaries of the object. ✓
c. has acceleration equal to zero if all of the forces applied anywhere upon the object sum to zero. ✓
d. has an acceleration inversely proportional to the total mass of the object. ✓
e. All of the above completions (a through d) yield true statements about the Center of Mass
f. None of the above completions (a through e) yields a true statement about the Center of Mass. False

The following problems may require more calculation than those above. Choose the single best answer for each question, and insert its letter into your NCS answer sheet.

55. You decide to launch a ball vertically so that a friend located 80 m above you can catch it. What is the minimum launch speed you can use?

a. 10 m/s
b. 20 m/s
c. 30 m/s
(d.) 40 m/s
e. 50 m/s
f. None of the above is within 10% of the correct answer.

$H = \frac{1}{2} g (t^{MAX})^2$ defines time it takes to fall to ground or rise to H from ground

$\sqrt{\frac{80 \cdot 2}{10}} = 4\,\text{sec} = t^{MAX}$

Then object must have $v_y(t) = v_{oy} - gt$ so that $v_y(t) = 0 = v_{oy} - g \cdot 4$

and $\boxed{v_{oy} = 10 \cdot 4 = 40\ \text{m/sec}}$

56. A car initially traveling westward at 12 m/s has a constant acceleration of 2 m/s^2 eastward. After 12 seconds how far is the car from its starting point?

a. 0 m
b. 72 m
c. 144 m
(d.) 288 m
e. 422 m
f. None of the above is within 10% of the correct answer.

$x(t) - x_0 = v_{ox} t + \frac{1}{2} a t^2$

$= 12 \cdot 12 + \frac{1}{2} \cdot 2 (12)^2 = 288\ m$

NOTE: THE above solution is INCORRECT

IF we take Eastward as +, then WESTWARD IS −.

& $a = +2$, but $v_{ox} = -12$, so that

$x(t) - x_0 = (-12)(12) + \frac{1}{2} \cdot 2 (12)^2 = -144 + 144 = 0$

& (a) [NOT (d)!] IS the correct answer

[NOTE this problem was regraded by hand & correction ±2, 0 was applied to raw score as needed] 3/3/08

57. A 40-kg crate is being pushed across a horizontal floor by a horizontal applied force of 200 N. If the coefficient of sliding friction is 0.3, and the speed is 2m/s at time t = 0, how far does the crate move in the next ten seconds??

a. 20 m
b. 120 m
c. 200 m
d. 300 m
e. 500 m
f. None of the above is within 10% of the correct answer.

$F_{NET} = F_{APP} + F_{fr} = 200 - (0.3)(40)(10) = 40 \cdot a$

Since $F_{fr} = \mu |N| = \mu \cdot mg =$ ↗

$\frac{200-120}{40} = a = 2 m/sec^2$

$X(t) - X_0 = v_0 t + \frac{1}{2} a t^2$

$= (2 \cdot 10) + \frac{2}{2}(10^2) = 120 m$

58. A 50 kg. man stands on a large platform merry-go-round turning at a constant angular speed, $\omega = 0.707$ 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 $\mu = 0.4$. what is the furthest distance from the center where he can stand without sliding off the platform, most nearly?

a. 1 m
b. 2 m
c. 4 m
d. 8 m
e. 16 m
f. None of the above is within 10% of the correct answer.

Need $F_c = Mv^2/R \leq F_{fr}^{MAX} = \mu |N| = (0.4)(50)(10) = 200N$

Thus $= MR^2\omega^2 / R = MR\omega^2 \leq 200 N$

$R \leq \frac{200 N}{(50)(0.707)^2} = 8 m$

59. A baseball is hit with a speed of 70 m/s at an angle 60° upward from the horizontal. How far has the ball traveled horizontally when it reaches its highest point, most nearly?

a. 35 m
b. 60 m
c. 70 m
d. 122 m
e. 210 m
f. 367 m
g. None of the above is within 10% of the correct answer.

$\vec{v_0} = (v_{0x}, v_{0y}) = (70\cos 60°, 70\sin 60°) = (35, 60.62)$

$v_y(t) = v_{0y} - g t^{MAX} = 0 \Rightarrow t^{MAX} = \frac{60.62}{10} = 6.06$ sec

$x(t^{MAX}) - x_0 = v_{0x}\, t^{MAX}$

$= (35)(6.06) = 212$ m

60. If Newton had lived on a planet where the acceleration due to gravity was 0.625 m/s^2 instead of 10 m/s^2 and he attempted to launch his apple horizontally in order to make it travel in a circle around that planet, what horizontal speed would it have to have to stay at the same small height above the planet's (presumed smooth, for the present discussion, and atmosphere free) surface? (Take the radius of the planet to be the same as that of the earth, 6.4X10^6 m)

a. 2X10^3 m/s
b. 8X10^3 m/s
c. 2X10^4 m/s
d. 8X 10^4 m/s
e. 2X 10^5 m/s
f. None of the above is within 10% of the correct answer.

$v^2/R = g = 0.625$ m/sec^2

$v = \sqrt{(6.4\times10^6)(0.625)} = \sqrt{4\times10^6} = 2\times10^3$ m/sec

END of EXAM