MULTIPLE CHOICE: Choose the one most nearly correct and complete answer and insert its letter into your answer sheet.

1. The instantaneous speed of an object is defined to be
   a. the distance it travels divided by the time it takes.
   (b.) the distance it travels in a small interval of time divided by the time interval.
   c. the greatest magnitude of its velocity during the trip.
   d. the average magnitude of its velocity during the trip.
   e. none of the above.

2. When you calculate the speed (in meters per second) in an experiment, your calculator display reads 5.6789623. If you are asked to record your result to four significant figures, you should write
   a. 5.678 m/s
   (b.) 5.679 m/s [ROUND up : 89 to 90]
   c. 5.6789 m/s
   d. 5.6790 m/s
   e. None of the above, because this result already has eight significant figures.

3. On a trip to Helena, you start your parked car, drive to Three Forks, stop for a one hour coffee break and arrive and park in Helena exactly two hours after leaving Bozeman. Since it is 100 miles to Helena, your average speed would be 50 mph. Which of the following statements about this trip is correct?
   a. To average 50 mph the speed must have been at least 50 mph sometime during the trip. ✓
   b. The instantaneous speed is not 50 mph, but has a variable value as indicated on the speedometer at any moment during the trip. ✓
   c. You can average 50 mph even if the speed is zero for part of the trip. ✓
   d. Since the car speeds up after each stop and slows down before each stop the car must have traveled faster than 50 mph at some point in the trip ✓
   (e.) All of the above statements are true.
   f. None of the above statements is true.

4. What average speed, most nearly, is required to run 10 mi in 1 hour, most nearly? (1mi = 1.6 km)
   a. 0.5 m/s
   b. 1.0 m/s
   c. 2.0 m/sec
   (d.) 4.0 m/s
   e. 8.0m/s
   f. 16.0 m/s
   g. None of the above is within 10%.

$$\frac{10\,mi}{hr} \times \frac{1\,hr}{60\,min} \times \frac{1\,min}{60\,sec} \times \frac{1.6\,km}{1\,mi} \times \frac{10^3\,m}{1\,km} = \frac{1.6\times10^4}{3.6\times10^3} = 0.44\times10 = 4.4\,\frac{m}{sec}$$

5. The average acceleration of an object over a finite time interval, Δt, is defined to be
   a. one half of the sum of the initial and final velocities divided by Δt. X
   b. the average velocity divided by the time interval of the acceleration. X
   c. the distance traveled divided by $(\Delta t)^2$, the time interval squared.
   (d.) the difference between the final velocity and the initial velocity divided by Δt. DEFINITION ✓
   e. the value of the velocity at the midpoint of the time interval divided by Δt. X
   f. None of the above yields a correct definition of the average acceleration. X

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$

6. Which of the following quantities could specify a net-force vector ?
   a. 5 kg
   b. 5 kg downward
   c. 5 kg-m/s north
   d. 5 kg-m/s^2
   (e.) 5 kg-m/s^2 east
   f. None of the above could possible specify a net-force vector.

7. Which of the following should be considered to be an "accelerator" in an automobile?
   a. gas pedal, because it increases the speed
   b. brake pedal, because it decreases the speed
   c. steering wheel, because it changes direction.
   d. None of the above is an accelerator properly so called
   (e.) All of theses are accelerators properly so called.

8. If a rocket car requires 3 seconds to accelerate from zero to 90 km per hour, its average acceleration is, most nearly,
   a. 800 m/ sec^2
   b. 80 m/ sec^2
   c. 8 m/sec^2
   (d.) 0.8 m/sec^2
   e. 0.08 m/sec^2
   f. None of the above is within 10%.

$\frac{90 \times 10^3 m}{3 \ hr\text{-}sec} \times \frac{1hr}{3600 sec} = 0.83 \frac{m}{(sec)^2}$

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. Which of the following strobe diagrams could (subject to more precise checking) correspond to a situation where the ball moving to the left has a constant positive acceleration?
   a. o o o o o o o o o o o o o o...
   b. o o o o o o o o o o o o o o...
   c. o o o o o o o o oo o o o o o o o o o oo o o o o o...
   (d.) o o o o o o o o o o o o o.....
   e. none of the above could have a constant positive acceleration.

11. A sheet of paper and a book fell at different rates in the classroom until the paper was wadded up into a ball. We then claimed that if the air resistance could be neglected, all objects would fall at
   a. the same constant speed regardless of the type of material.
   b. the same constant speed regardless of how much they weigh.
   c. different constant speeds depending on the type of material.
   d. different terminal velocities proportional to the square roots of the masses.
   e. different accelerations proportional to their masses.
   (f.) the same constant acceleration.
   g. In fact, we claimed none of the above since not enough information is given to support any claim.

12. The motion of a block sliding down a frictionless ramp can be described as motion with
   a. a constant speed, independent of the slope of the ramp.
   b. a constant speed that increases with 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 the force of friction.
   (e.) a constant acceleration less than 10 m/s/s.
   f. None of the above.

13. If a ball is dropped from rest, it will fall 5 m during the first second. How far will it fall during the third and fourth seconds together, most nearly ?
   a. 15 m
   b. 25 m
   c. 35 m
   d. 40 m
   (e) 60 m
   f. 75 m
   g. None of the above is within 10%.

$d(t) = \frac{g}{2}t^2 = .5t^2\ m$

$d(2) = 20\ m$, $d(4) = 80\ m$ } $d(4) - d(2) = 60\ m$

14. A ball with a mass of 2.5 kg is thrown vertically upward with a speed of 25 m/s. What are its speed and direction 4.5 seconds later?
   a. 20 m/s upward
   b. 10 m/s upward
   c. zero
   d. 10 m/s downward
   (e.) 20 m/s downward

At 25/10 = 2.5 sec it comes to rest at top of trajectory & two seconds later, its speed is 20 m/sec downward { $v(t) = v_0 - gt = 25 - (4.5)(10) = -20$ m/sec }

15. If we use positive and negative signs to indicate the directions of velocity and acceleration in one dimension, in which of the following situations is the object speeding up?
   a. negative velocity and positive acceleration. ✗
   b. positive velocity and negative acceleration. ✗
   c. positive velocity and zero acceleration. ✗
   (d.) zero velocity and negative acceleration. ✓
   e. In all of the above cases the object is speeding up ✗
   f. In none of the above cases is the object speeding up. ✗

16. A car initially traveling north at 10 m/s has a constant acceleration of 5 m/s^2 northward. How far does the car travel in the first 20 s, most nearly?
   a. 200 m
   b. 1020 m
   (c.) 1200 m
   d. 2000 m
   e. 2200 m
   f. None of the above is within 10% of the correct answer.

$x(t) - x_0 = 10t + \frac{5}{2}t^2 = 200 + \frac{5(400)}{2} = 1200\ m$

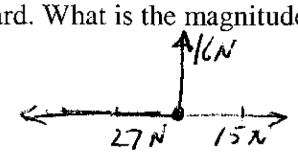
17. If a crate of oranges has several forces acting upon different ones of its 6 corners, then
   a) Its center of mass will accelerate as though the net force of all of those forces were applied at the location of the center of mass; ✓
   b) Under the influence of the applied forces, the crate may rotate, even as its center of mass moves through space. ✓
   c) If an additional force, exactly equal and opposite to the net of the several forces above is applied to one corner of the box, the center of mass will no longer accelerate. ✓
   (d)) All of the above completions lead to true statements about the motion of the center of mass.
   e) None of the above completions leads to a true statement about the motion of the center of mass.

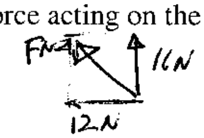
18. A circus clown plans to launch a ball vertically from a gun which gives it an initial upward speed of 40 m/s. How high above the gun should his partner be placed so that he can just put his hand out and catch the ball at its maximum height, most nearly?
   a. 10 m
   b. 20 m
   c. 40 m
   (d.) 80 m
   e 160 m
   f. None of the above is within 10% of the correct answer.

MAX height occurs at $t = 40/g_x = 4\,sec$, where $v_y = v_{0y} - gt = 0$.
& in 4 seconds ball will fall $d = \frac{1}{2}gt^2 = 5(16) = 80\,m$
[OR $x(4) - x_0 = v_0 \cdot 4 - \frac{10}{2} \cdot 16 = 160 - 80 = 80\,m$]

19. What is the net force on an 500-kg hot air balloon rising straight upward with a constant velocity of 4m/s, most nearly?
   (a.) zero
   b. 500 N
   c. 2000 N
   d. 5000 N
   e. 20, 000 N
   f. None of the above is within 10% of the correct answer.

20. There are three forces acting on an object: 27 N horizontally to the left, 15 N horizontally to the right, and 16 N upward. What is the magnitude of the net force acting on the object, most nearly?
   a. 1 N
   b. 12 N
   c. 15 N
   d. 16 N
   (e.) 20 N.
   f.. 27 N
   g.. None of the above is within 10% of the correct answer.





$|\vec{F}_{NET}| = \sqrt{16^2 + 12^2} = \sqrt{256 + 144} = \sqrt{400} = 20\,N$

21. If the net force on a hot-air balloon is directed straight upward, which way does the acceleration point?
   a. Downward only if the balloon is falling, otherwise upward.
   b. Upward only if the balloon is rising, otherwise downward.
   c. Upward only if the balloon is falling, otherwise downward.
   d. Downward only if the balloon is rising, otherwise upward.
   (e.) Upward, whether the balloon is rising or falling.
   f. None of the above is a correct statement about the acceleration..

22. If you push on a railroad boxcar with a force of 300 N and it doesn't move, you can conclude that
   a.. Newton's second law is not valid. X
   b. The force you applied is canceled by its third law partner force. X
   c. The boxcar has too much mass to accelerate. X
   d. There must be some object under a wheel which prevents it from rolling. X
   e. Galileo's Principle of inertia is not relevant X
   (f.) The net force acting on it is zero.
   g. None of the above conclusions can be validly inferred.

23....The same *known* net force is applied to object A and object B. The observed accelerations of the two objects are *not* the same: object A has an acceleration four times that of object B. Which of the following is correct?

a.. Object A has one fourth the mass of object B.
b. Object A has four times the mass of object B.
c. There may be some other unexpected force accelerating A.
d. There may be some other unexpected force decelerating B.
e. None of the above is consistent with the facts stated.

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

a. force
b. acceleration
c. weight
d. velocity
e. displacement
f. speed
g. All of the above are vector quantities.
h. Actually, two or more of the items, a through f, are non-vector quantities.

25. The strength of gravity on Mars is only 40% of that on earth. If a child has a weight of 600 N on earth, what would the child's mass be on Mars?

a 24 kg
b 60 kg
c 240 kg
d 600 kg
e None of the above is correct within 10%.

26. A ball with a weight of 20 N is thrown vertically upward. What is the acceleration of the ball just as it reaches the top of its path?

a. zero
b. 10 m/s^2 downward
c. 10 m/s^2 upward
d. 20 m/s^2 downward
e. 20 m/s^2 upward

27. A parachutist reaches terminal speed when

a. her weight goes to zero.
b. the force of air resistance exceeds her weight.
c. the force of air resistance equals her mass.
d. the force of air resistance equals her weight.
e. only when she spreads our her limbs to increase the air resistance.
f. None of the above completions yields a correct statement.

28. Two metal balls have the same size and shape (and therefore feel the same atmospheric drag force at any given speed) but one is hollow. They are dropped in air and their terminal speeds are measured to be exactly the same. Which of the following statements is correct?

a. The hollow ball has a smaller mass because it is hollow.
b. The hollow ball has a larger mass because it is solid.
c. The terminal speeds are the same because the acceleration of gravity doesn't depend on mass.
d. The terminal speeds are the same and equal to 10 m/s.
e. The two balls must have the same mass
f. None of the above statements is true.

29. A 150-kg crate is being pushed across a horizontal floor by a horizontal force of 450 N. If the coefficient of sliding friction is 0.20, what is the acceleration of the crate?
   a. zero
   b. 1 m/s^2
   c. 3 m/s^2
   d. 6 m/s^2
   e. 9 m/s^2
   f. None of the above is within 10% of the correct answer.

FNET = $F_H - F_f$ = 450 − (0.20)(150)(10) = 150 N
300 N
a = FNET/M = 150 N / 150 kg = 1 m/sec²

30. You must apply a 75-N force to pull a child's wagon across the floor at a constant speed of 0.6 m/s. If you increase your pull to 100 N, the wagon will
   a. continue to speed up as long as you keep pulling. because NET FORCE is > 0.
   b. speed up immediately and then move at the faster constant speed of 0.8 m/s.
   c. speed up gradually until it reaches the speed of 0.8 m/s and then move at that constant speed.
   d. continue to move at 0.6 m/s.
   e. do none of the above.

31. If the earth exerts a gravitational force of 1000 N on a satellite of mass 500 kg moving in a circular orbit orbit, what force does the satellite exert on the earth?
   a. 10^{-23} N, or, approximately zero
   b. a small, but non-negligible fraction of 1 N
   c. 10,000 N
   d. 5,000 N
   e. 1000 N
   f. None of the above is even approximately correct.

32. Which of the following is the third-law partner force to the force that a book exerts on the bookshelf where it rests? It is
   a. the force that the earth exerts on the book.
   b. the force that the book exerts on the earth.
   c. the force that the book exerts on the shelf.
   d. the buoyant force that the air exerts on the book.
   e. None of the above forces is the required partner force..

33. A book sits at rest on a table. Which force does Newton's third law tell us is equal and opposite to the gravitational force acting on the book?
   a. the normal force by the table on the book
   b. the normal force by the book on the table
   c. the gravitational force by the book on the Earth
   d. the net force on the book
   e. None of the above.

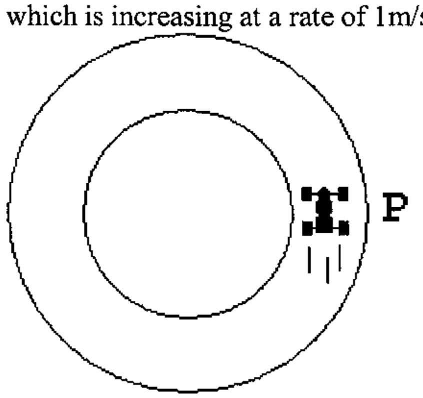
34. You leap from a bridge with a bungee cord tied around your ankles. As you approach the river below, the bungee cord stretches and you begin to slow down. Just before you come to a stop the force of the cord on your ankles which is slowing you down must be __________ your weight?
   a. greater than
   b. equal to
   c. less than
   d. much less than
   e Not enough information has been given to support of any of the above statements.

35. Terry and Chris pull hand-over-hand on opposite ends of a rope while standing on a frictionless frozen pond. Terry's mass is 30 kg and Chris's mass is 90 kg. If Terry's acceleration is 12 m/s^2, what is Chris's acceleration?
   a. 36 m/s^2
   b. 12 m/s^2
   c. 6 m/s^2
   d. 4 m/s^2
   e. None of the above is within 10% of the correct answer.

36. A child stands on a bathroom scale while riding in an elevator. The child's weight when the elevator is not moving is 100 lbs. What must the scale read when the elevator accelerates upward while travelling downward?
   a. Exactly 100 lbs
   b. Less than 100 lbs
   c. Greater than 100 lbs
   d. The same as it reads when accelerating downward while traveling upward, by symmetry.
   e. None of the above.

37. If a race car is traveling around a circular track at a constant speed, we know that the car experiences
   a. no net force.
   b. a centripetal force.
   c. a centrifugal force.
   d. a net force in the forward direction.
   e. all of the above.
   f. none of the above.

Figure 38 Caption:
A 800 kg race car is moving counterclockwise on a circular path of radius 300 m as shown in the diagram below. Imagine that at this instant, the car is at point P and moving at a speed of 20 m/s which is increasing at a rate of 1m/s, in the upward direction on the page.



38. Refer to **Figure 38.** In what direction, precisely, does the net force point at the instant described?
   a. →
   b. ←
   c. ↑
   d. ↓
   e. None of the above.

39. Suppose that the race track of Fig 38 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 in the Figure 38 caption above?
   a. 1.1×10^2 N
   b. 3.6×10^2 N
   c. 1.1×10^3 N
   d. 3.6×10^3 N
   e. 1.1×10^4 N
   f. 3.6×10^4 N
   g. None of the above is within 10% of the correct answer.

40. Suppose that the track architects decide to bank the frictionless track in question 39 at some angle, θ, chosen to make the horizontal component of the force normal to the roadway equal to 3.6×10^2 N for a situation where the force on the car normal to the (banked) roadway is 4800N. (Recall that for small values of θ in radians, Sin(θ) ≈ θ.)Then the banking angle is, most nearly, θ =
   a. 0.75 radians = 42.9°
   b. 0.075 radians = 4.29°
   c. 0.0075 radians =0.429°
   d. 0.00075 radians = 0.0429°
   e. There is a correct banking angle, but none of the above is within 10% of that angle.
   f. In fact, it is not possible to obtain the specified force on the car in question by banking.

41. In uniform circular motion the
   a. acceleration is parallel (or antiparallel) to the velocity.
   b. acceleration is horizontal and the velocity is horizontal.
   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 completions yields a true statement.

42. In motion along a straight line the
   a. acceleration is parallel (or antiparallel) 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. acceleration is horizontal and the velocity is horizontal.
   f. None of the above completions yields a true statement.

43. A migrating bird is initially flying south at 6 m/s. To avoid hitting a high-rise building, the bird veers and over a period of 4 s changes its direction to east with the same 6 m/s speed. What is the (approximate) magnitude of the bird's average acceleration during this 2-s interval, most nearly?
   a. 1 m/s^2
   b. 2 m/s^2
   c. 3 m/s^2
   d. 4 m/s^2
   e. 5 m/s^2
   f. None of the above is within 10% of the correct answer.

44. What centripetal acceleration is required to follow a circular path with a radius of 25 m at a speed of 10 m/s?
   a. 2 m/s^2
   b. 4 m/s^2
   c. 6 m/s^2
   d. 8 m/s^2
   e. None of the above is within 10% of the correct answer.

45. A mass of 0.2 kg hangs on a spring whose spring constant is 0.8 N/m^2. If the mass is pulled downward and released, it will oscillate with a period of T_1. If a mass of 0.8kg is hung on the same spring, its period of oscillation will be T_2 =
   a. 0.25*T_1
   b. 0.5*T_1
   c. 1.0*T_1
   d. 2.0*T_1
   e. 4.0*T_1
   f. None of the above is within 10% of the correct answer.

$T_1 = 2\pi\sqrt{M/k_1} \rightarrow T_2 = 2\pi\sqrt{\frac{4M_1}{k_1}} = (2) \times T_1$

46. A cyclist turns a corner following a circular arc with a radius of 100 m at a speed of 7 m/s. What is the magnitude of the cyclist's acceleration, most nearly?
   a. 0.5 m/s^2
   b. 1.4 m/s^2
   c. 5.0 m/s^2
   d. 14.0 m/s^2
   e. 140 m/s^2
   f. 1400 m/s^2
   g. None of the above is within 10% of the correct answer.

$a_{cent} = \frac{v^2}{R} = \frac{49}{100}\frac{m}{sec^2} \approx 0.5$

47. 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 many seconds later than the red ball will it land? (Neglect air resistance.)
   a. 1 s
   b. 2 s
   c. 3 s
   d. 4 s
   e. None of the above is within 10% of the correct answer.

IT Takes $20/g = 2$ sec to reach top & 2 more seconds to fall back to launch point (with velocity of 20 m/sec downward, - same as red ball.

48. A red ball is thrown straight down from the edge of a tall cliff with a speed of 10 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, which ball (if either) will be traveling fastest when it reaches the ground below? (Neglect air resistance.)
   a. The red ball
   b. The green ball
   c. Both balls will be traveling at the same speed.
   d. Without air resistance there is not enough information to say.
   e. None of the above conclusions can be validly inferred.

Scenario 49

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.

49. Refer to **Scenario 49**. Which bullet will hit the ground with the greatest speed?
   a. The bullet that was fired, because it is also moving horizontally.
   b. The bullet that was dropped, because all of its motion is vertical.
   c. It will be a tie, because the acceleration of gravity is the same for both.
   d. The bullet that was fired, because it feels the force of gravity over a longer time.
   e. The bullet that was dropped, feels the force of gravity over a longer time.
   f. None of the above assertions is correct

50. Which of the following statements about projectile motion is true (neglecting air resistance)?
   a. The horizontal and vertical motions are independent. ✓
   b. The force on the projectile is constant throughout the flight. ✓
   c. The acceleration of the projectile is constant throughout the flight. ✓
   d. The force on the projectile is always vertically downward ✓
   (e.) All of the above statements are true.
   f. None of the above answers is correct.

51. In projectile motion the
   a. acceleration is parallel (or antiparallel) to the velocity. ✗
   b. acceleration is perpendicular to the velocity. ✗
   c. acceleration varies with the direction of the velocity. ✗
   d. acceleration is horizontal and the net velocity is horizontal. ✗
   e. acceleration varies with the height of the projectile. ✗
   (f.) acceleration is vertical, even when the velocity is horizontal.
   g. None of the above is true of projectile motion

52. A physics student reports that upon arrival on planet X, he promptly sets up the "monkey-shoot" demonstration. If the acceleration due to gravity on planet X is twice what it is on earth, he should obtain a
   a. miss since the monkey's weight is twice as big now.
   b. hit only if the bullet's horizontal velocity is increased.
   c. miss since the monkey's mass is unchanged.
   d. hit since the ball and the monkey feel attractive gravitational forces towards one another.
   (e.) None of the above completions leads to a true statement.

53. Just after being hit into a pop fly, a baseball has a horizontal speed of 20 m/s and a vertical speed of 50 m/s upward. Ignoring air resistance what are these speeds ten seconds later?
   a. 20 m/s horizontal and 50 m/s upward
   b. 20 m/s horizontal and 25 m/s upward
   c. 20 m/s horizontal and 0 m/s upward
   d. 20 m/s horizontal and 25 m/s downward
   (e.) 20 m/s horizontal and 50 m/s downward
   f. None of the above is within 10% of the correct answers.

$v_x = 20 = \text{constant}$

$v_y = 50 - 10g = -50\ \text{m/sec}$

54. A golf ball is hit with a vertical speed of 30 m/s upwards and a horizontal speed of 10 m/s. How far will the ball travel horizontally before landing on the (flat) fairway again?
   a. 30 m
   (b.) 60 m
   c. 90 m
   d. 120 m
   e. 180 m

Ball travels up for $t=$ 3 seconds & down for $t=$ 3 seconds before hitting fairway $d = v_{ox} \cdot (2t) = 60\ m$

The remaining problems may require some computation. Choose the single best answer and enter your choice into the NCS-Scantron answer sheet.

55. To determine the height of a steep cliff an experimenter stations his assistant on the top of the cliff and fires a pellet vertically upward with a speed of 50 m/s. His assistant notes that the pellet reaches its maximum height just 25 m above the edge of the cliff. How high is the cliff, most nearly?
 a). 20m; b). 50m; c).75m; d).100 m; e). 125m; f) None of these answers is correct within 10 %.

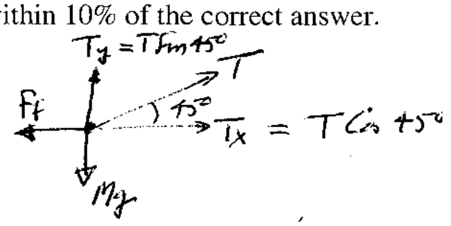
Pellet rises for $50/g = 5$ seconds to $y_{max} = \frac{1}{2}g(5)^2 = 125$ m
then Height of cliff edge $= 125 - 25 = 100$ m. (d)

56. A biker starts up a steep hill with a speed of 6m/s. His speed decreases at the rate of 0.3m/s as he climbs the hill. He just reaches the crest of the as his speed falls to zero. How far did the biker travel up the hill?
 a). 360 m; b). 240 m; c) 180 m; d) 120 m; e) 60 m; f) none of these is correct within 10%.

$v(t_f) = 0 = v_0 - at_f = 6 - (0.3)t_f \Rightarrow t_f = 20$ sec

$D = x(t_f = 20) - x_0 = v_0 t_f - \frac{0.3}{2}(t_f)^2 = 6(20) - (0.15)(400)$
$= 120 - 60 = 60$ m (e)

57. A rope is used to drag a box across a rough warehouse floor. Its angle is 45° (= π/4 radians above the horizontal, and its tension is T. If the box has a mass of 40 kg, feels a frictional drag force of 80 N, and is accelerating horizontally at 0.3 m/s^2, what is the value of T?
 a). 12 N; b). 68 N; c) 80 N; d) 92 N; e) 130 N; f) None of the preceding is within 10% of the correct answer.



$F_x^{NET} = -F_f + T_x \cos 45° = ma = (40)(0.3)$

i.e. $T_x \frac{\sqrt{2}}{2} = 12 + 80$

$T_x = (92)\sqrt{2} = 130.1$ N (e)

58. Just after it is launched a 3000 kg rocket feels a gravitational attraction by the earth of about 30,000 N. Compute the acceleration of the earth due to the force which Newton's third law guarantees that the satellite exerts on the earth. (Use $M_E = 6 \times 10^{24}$ kg). The acceleration is most nearly
a) 0.5×10^{20} m/s^2; b) 0.5×10^{21} m/s^2; (c) 0.5×10^{-20} m/s^2; d) 0.5×10^{-21} m/s^2;
e) None of these is within 10% of the correct answer..

$$a = \frac{F_{E,S}}{M_E} = \frac{3\times10^4}{6\times10^{24}} = \frac{10^{-20}}{2} \qquad \text{Since } |\vec{F}_{E,S}| = |\vec{F}_{S,E}|$$

$$= 0.5\times10^{-20} \text{ m/sec}^2 \quad (c)$$

Scenario 59-60. Suppose that a moon of Jupiter travels in a circle about the planet at a distance of 1.6×10^8 meters once in every 11.6 days, and that has a mass of 10^{22} kg. Then answer the following two questions.

59. The speed of the moon is most nearly:
a) 10 m/s; (b) 10^3 m/s; c) 10^5 m/s; d) 10^7 m/s; e.) 10^9 m/s.

$$v = \frac{2\pi\times1.6\times10^8 \text{ m}}{11.6 \text{ d}} \times \frac{1 \text{ d}}{24 \text{ hrs}} \times \frac{1 \text{ hr}}{3600 \text{ sec}} = 1.003 \frac{\times10^{8+1}}{10\cdot100\cdot10^3} = 1.0\times10^3$$

$$\text{Roughly} \sim \frac{6\cdot2\times10^8}{12 \cdot 24\times3.6\times10^3} \simeq \frac{10^8}{10^2\cdot10^3} = 10^3 \text{ m/sec} \quad (b)$$

60. The acceleration of the moon is most nearly:
a) 6×10^3 m/s^2; b) 6 m/s^2; (c) 6×10^{-3} m/s^2; d) 6×10^{-6} m/s^2; e) 0.6×10^{-9} m/s^2.

$$a = v^2/R = \frac{(10^3)^2}{1.6\times10^8} = \frac{10^{6-8}}{1.6} = 6.2\times10^{-3} \quad (c)$$

END of EXAM I