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Physics 117 Exam II, 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 you 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.

Multiple Choice: Please select the choice that best answers the question and insert its letter into the corresponding line of your NCS answer sheet.

Which of the following statements about Venus is correct?

a. Venus has a constant velocity.
b. There is no net force acting on Venus.
c. The sun exerts a stronger force on Venus than Venus exerts on the sun.
d. Venus is driven along its orbit by magnetic forces.
e. None of the above is true.

2. Which of the following statements about the moon is most correct?
   a. The acceleration due to gravity on the moon is weaker than on the earth.
   b. The earth's gravitational pull on the moon equals the moon's gravitational pull on earth.
   c. There is a net force acting on the moon.
   d. The moon is continually accelerating.
   e. All of the above are true.

3. What is the force of earth's gravity upon a 1 kg mass located 10 earth radii from the earth's center?
   a. 0.01 N
   b. 0.1 N
   c. 1.0 N
   d. 10 N
   e. None of the above answers is within 10% of the correct result.

4. How large is the acceleration of a 10 kg weight due to earth's gravity when it floating freely in an earth satellite at an altitude equal to one earth's radius?
   a. 10 m/s/s
   b. 5 m/s/s
   c. 2.5 m/s/s
   d. 0.5 m/s/s
   e. 0.25 m/s/s
   f. None of the above answers is within 10% of the correct result.

5. If you triple the radius of a sphere, its surface area increases by what factor?
   a. 3
   b. 6
   c. 9
   d. 27
   e. None of the above.

6. The law of universal gravitation is written $F = GMm/r^2$. Which of the following reasons, if any, provides a valid and complete justification for using the form $F = mg$ when we studied projectile motion?
   a. The first form is not valid for projectile motion.
   b. The first form does not work for projectile because it requires two masses.
   c. The first form is not valid near the surface of the earth.
   d. The second form is simpler and therefore aesthetically preferable to the first.
   e. None of the above is a valid and complete justification for using the second form.

7. Which of the following would **not** increase the gravitational force on an object near the surface of the earth?
   a. a vertical upward velocity
   b. a lower elevation
   c. an increase in its mass
   d. an ore deposit just under the surface
   e. All of the above increase the gravitational force.

8. Al the astronaut has a mass of 80 kg and a weight of 800 N when he is standing on the surface of the earth. What is his mass when he is in a space station orbiting earth with a radius of three earth radii?
   a. zero
   b. 8.8 kg
   c. 80 kg
   d. 88.9 kg
   e. None of the above

9. Over which of the following locations is it possible to have a geosynchronous satellite?
   a. New York City, because it is a communications center.
   b. El Quito, Ecuador, because it lies on the equator
   c. The North Pole, because it does not move as the earth rotates.
   d. London, because it is on the prime meridian..
   e. A geosynchronous satellite can be placed over any and all of the above locations.

10. Which, the moon or the sun, has the greatest influence on the earth's tides, and why?
   a. The moon, because it has less mass than the sun
   b. The sun, because its mass is larger than the moon's.
   c. The sun, because the difference between the gravitational force it exerts on the near side and that it exerts on the far side of earth is larger than the moon's analogous difference.
   d. The moon, because the difference between the gravitational force it exerts on the near side and that it exerts on the far side of earth is larger than the sun's analogous difference.
   e. None of the above statements correctly answers the question.

A 300-kg satellite experiences a gravitational force of 1200 N. What is the altitude above the earth's surface of the satellite in orbit? (R_E = Earth's Radius)
   a. 0.4 R_E
   b. 0.58 R_E
   c. 1.5 R_E
   d. 1.58 R_E
   e. 2.5 R_E

What is the gravitational force between two 5.0-kg iron balls separated by a distance of 0.5 m Most nearly? (The gravitational constant is $G = 6.67 \times 10^{-11}$ N-m^2/kg^2.)
   a. 6.67×10^{-9} N
   b. 3.34×10^{-9} N
   c. 6.67×10^{-10} N
   d. 3.34×10^{-10} N
   e. 6. 6.67×10^{-11} N

3 The acceleration due to gravity on Titan, Saturn's largest moon, is about 1.4 m/s^2. What would a 30-kg scientific instrument weigh on Titan, most nearly ?

a. 43 N
b. 60 N
c. 84 N
d. 300 N
e. None of the above is within 10% of the correct answer.

You have a mass of 70 kg. How fast (in mph) would you have to run to have the same momentum as an 18-wheeler (m = 20,000 kg) rolling along at 1 mph? (1 mi = 1609 m.)

a. 1.3 x 10^2 m/s
b. 2.9 x 10^2 m/s
c. 7.8 x 10^3 m/s
d. 4.6 x 10^5 m/s
e. 8.9 x 10^5 m/s
f. None of the above answers is within 10 % of the correct result.

Newton's second law can be rearranged to show that the _ is equal to the

a. change in momentum ... impulse
b. change in momentum ... change in impulse
c. momentum ... impulse
d. work .... kinetic energy
e None of the above insertions leads to a true statement

6. Air bags are used by stunt people when they fall off buildings to reduce the _____ that occurs during the collision.

a. change in momentum
b. force
c. impulse
d. change in velocity
e. work
f. None of the above.

A tail gunner jumped from a Lancaster bomber but did not break any bones or die because he fell into the branches of a tree and then into a snow bank. Physics explains this because

a. the change in momentum was less than hitting the ground directly.
b. the impulse in less in trees and snow than ground.
c. the increased stopping time in the tree and snow meant a smaller stopping force.
d. the decreased stopping time in the tree and snow meant a smaller stopping force.
e. the work done is still equal to the change in kinetic energy.
f. None of the above.

18. Which of the following will cause the largest change in the momentum of an object? A force of _____acting for _____.

a. 4 N ... 8 s
b. 5 N ... 7 s
c. 6 N ... 6 s
d. 7 N ... 5 s
e. 8 N ... 5 s
f. Both b and d above cause the same largest change in the momentum.

19. What average force is required to stop a 130-kg football player running at 7 m/s in a time of 0.4 s?
    a. 7.4 N
    b. 46.4 N
    c. 325 N
    d. 2275 N
    e. 15, 925 N
    f. None of the above is within 10% of the correct answer.

20. A very hard rubber ball ($m = 0.6$ kg) is falling vertically at 10 m/s just before it bounces on the floor. The ball rebounds back at essentially the same speed. If the collision with the floor lasts 0.03 s, what is the average force exerted by the floor on the ball?
    a. 400 N
    b. 200 N
    c. 90 N
    d. 20 N
    e. None of the above is within 10% of the correct answer.

If we examine a ball in free fall, we find that the momentum of the ball is not constant. This is not a violation of the law of conservation of momentum because
    a. The force of gravity acts on the ball.
    b. The ball experiences an external force.
    c. The ball is not an isolated system.
    d. A net work is done on the ball as it falls
    e. All of the above are correct answers.

22. When a star undergoes a supernova explosion, the total linear momentum of the star
    a. increases slowly
    b. increases suddenly in the outward direction
    c. decreases rapidly at first and then more slowly as the star expands.
    d. decreases at a nearly uniform rate once the explosion has occurred.
    e. There is not enough information to say.
    f. None of the above is correct.

23. We can explain the recoil that occurs when a rifle is fired by using
    a. conservation of momentum.
    b. Newton's second and third laws.
    c. equal and opposite impulses.
    d. equal and opposite changes in momentum
    e. Any of the above.

24. Larry has a mass of 60 kg and runs across the classroom with a speed of 4 m/s and jumps onto a giant skateboard, initially at rest and with a mass equal to Larry's. If we ignore friction, what is the final speed of Larry and the skateboard?
    a. 2 m/s
    b. 15 m/s
    c. 60 m/s
    d. 120 m/s
    e. 240 m/s
    f. None of the above is within 10% of the correct answer.

25. Two air-track gliders are held together with a string. The mass of glider A is four times that of glider B. A spring is tightly compressed between the gliders. The gliders are initially at rest and the spring is released by burning the string. If glider B has a speed of 3 m/s after the release, how fast will glider A be moving?
    a. 0.75 m/s
    b. 1.5 m/s
    c. 3 m/s
    d. 6 m/s
    e. 12 m/s
    f. None of the above is within 10% of the correct answer.

26. A father (m = 80 kg) and son (m = 30 kg) are standing facing each other on a frozen pond. The son pushes on the father and finds himself moving backward at 3 m/s after they have separated. How fast will the father be moving?
    a. 1.1 m/s
    b. 1.84 m/s
    c. 3.0 m/s
    d. 4.9 m/s
    e. 8.0 m/s
    f. None of the above is within 10% of the correct answer.

27. Which of the following objects has the largest kinetic energy? A mass of _____ with a speed of _____.
    a. 2 kg ... 6 m/s
    b. 4 kg ... 5 m/s
    c. 6 kg ... 4 m/s
    d. 8 kg ... 3 m/s
    e. 10 kg ... 2 m/s
    f. None of the above.

28. Assume that a red car has a mass of 1000 kg and a white car has a mass of 3000 kg. If the red car has three times the velocity of the white car,
    a. The white car's kinetic energy is one-third as big
    b. their momenta are equal.
    c. the red car's kinetic energy is three times as big.
    d. All of the statements a, b, & c above are true.
    e. None of the above.

29. Under what conditions is the kinetic energy conserved (in the strict sense) in a collision?
    a. Kinetic energy is never "conserved" (in the strict sense) in a collision.
    b. When the collision is totally elastic.
    c. When there is no net outside force.
    d. When there is no friction.
    e. Kinetic energy is always conserved.
    f. None of the above answers is correct.

30. In physics, the **net work** is defined as the product of the
    a. net force and the distance traveled.
    b. net force and the time it is applied.
    c. net force parallel to the motion and the distance traveled.
    d. net force parallel to the motion and the time it is applied.
    e. applied force and the distance traveled.
    f. None of the above.

Two objects have different masses but the same momentum. If you stop them with the same retarding force, which one will stop in the shorter distance?

a. the heavier one, because it travels a shorter distance in the same time.
b. the lighter one, because it travels a shorter distance in the same time
c. Both stop in the same distance, because both require the same impulse to stop.
d. Both stop in the same distance, because both require the same net work to stop.
e. None of the above statements is correct.

32. How much work is performed by the gravitational force F on a synchronous satellite during one day

a. The work done is F*C, where C is the circumference of the orbit
b. The work done is zero, because the net force vanishes.
c. The work done is zero, because the satellite does not move.
d. The work done is zero, because the force is perpendicular to the velocity
e. The work done is Fr, where r is the radius of the orbit.
f. None of the above.

33. Which of the following properties of a ball is conserved as it falls freely in a vacuum?

a. kinetic energy
b. mechanical energy
c. momentum
d. gravitational potential energy
e. None of the above.

34. If we examine a ball in free fall, we find that the kinetic energy of the ball is not constant. This is not a violation of the law of conservation of energy because the

a. force of gravity does work on the ball.
b. system is not closed.
c. the gravitational potential energy also changes.
d The outside world performs work on the ball during its fall.
e. All of the above statements are correct.

35. A man with a mass of 90 kg falls 10 m. How much kinetic energy does he gain

a. 9 J
b. 90 J
c. 900 J
d. 9000 J
e. None of the above statements is within 10% of the correct answer.

36. A 800-kg frictionless roller coaster starts from rest at a height of 20 m. What is its kinetic energy when it goes over the top of a hill that is 15 m high?

a. 4000 J
b. 12,000 J
c. 40,000 J
d. 120,000 J
e. None of the above answers is within 10% of the correct result.

37. A ball dropped from a height of 8 m only bounces to a height of 7 m. Which of the following statements is valid for this process?
    a. Kinetic energy is conserved.
    b. Mechanical energy is conserved.
    c. Gravitational potential energy is conserved.
    d. All of the above.
    e. None of the above.

38. A 7-kg mass is released from rest at the top of a frictionless slide that is 3 m high. What is the kinetic energy of the mass when it reaches the bottom?
    a. 630 J
    b. 315 J
    c. 210 J
    d. 21 J
    e. None of the above answers is within 10% of the correct result.

39. How much energy is required to light a 60-W bulb for 4 h?
    a. 8.6×10^5 J
    b. 1.4×10^4 J
    c. 8.6×10^3 J
    d. 2.4×10^2 J
    e. None of the above answers is within 10% of the correct result

40. Imagine riding in a glass-walled elevator that goes up the outside of a tall building at a constant speed of 20 meters per second. Assuming that you drop a ball, you will observe the ball
    a. fall starting from rest.
    b. fall starting with an upward speed of 20 m/s.
    c. fall starting with a downward speed of 20 m/s.
    d. remain stationary.
    e. None of the above.

4 While you are standing on the ground, you observe your friends pass by in a van traveling at a constant velocity. They drop a ball and you all make measurements of the ball's motion. Which of the following quantities has the same value in both reference systems?
    a. velocities
    b. kinetic energies
    c. momenta
    d. Work done by gravity
    e. None of the above quantities is the same in both frames.

42. You can throw a ball vertically up in a car moving with a constant velocity and have it land back in your hand because
    a. there is no net vertical force acting on the ball.
    b. the reference system attached to the car is non-inertial.
    c. there is a net force in the forward direction.
    d. the pseudo-force in the backward direction is canceled by the inertial force.
    e there is no net horizontal force acting on the ball
    f. None of the above.

43. A ball is thrown horizontally at 30 m/s from a flatcar that is moving in a straight line at 40 m/s. Relative to a person on the ground, what is the horizontal speed of the ball when it is thrown directly sideways?
   a. 70 m/s
   b. 50 m/s
   c. 40 m/s
   d. 30 m/s
   e. 10 m/s
   f. None of the above.

An aircraft carrier is moving to the north at a constant 25 mph on a windless day. A plane requires a speed relative to the air of 125 mph to take off. How fast must the plane be traveling relative to the deck of the aircraft carrier to take off if the plane is headed south?
   a. 150 mph
   b. 125 mph
   c. 100 mph
   d. 25 mph
   e None of the above is within 10% of the correct answer.

45 An observer drops a ball in a train traveling along a straight, horizontal track with a constant acceleration in the forward direction. What would an observer in the train say about the force acting on the ball?
   a. The force has no horizontal component.
   b. The force has no vertical component.
   c. The force has a horizontal component in the forward direction.
   d. There is a centrifugal force.
   e. The force has a horizontal component in the backward direction.
   f. None of the above.

46. Greg stands on his bathroom scale in the morning and finds that he weighs 700 N. He takes a ride in the elevator that goes up the side of the Space Needle in Seattle. Much to the amusement of the other passengers he brings his bathroom scale and stands on it during the ride. During the time that the elevator is accelerating upward at a rate of 3 m/s/s, the reading on the scale is _____ N, approximately.
   a. 414 N
   b. 538 N
   c. 700 N
   d. 910 N
   e 1183 N
   f None of the above is within 10 % of the correct result

You and a friend are rolling marbles on a horizontal table in the back of a moving van on a straight, level section of interstate highway. You start the marble rolling directly toward the side of the truck and observe that it curves toward the front. You conclude that the truck is
   a. not moving
   b. moving at a constant velocity
   c. speeding up
   d. slowing down
   e. None of the above conclusions can be validly drawn from the information given.

48 An elevator is moving downward and speeding up with an acceleration equal to one-quarter that of gravity. If a person who weighs 800 N when at rest on Earth stands on a bathroom scale in this elevator, what will the scale read, most nearly ?

a. 200 N
b. 600 N
c. 800 N
d. 1000 N
e. None of the above is within 10 % of the correct result.

49. A room is being accelerated through space at 10 m/s^2 relative to the "fixed stars." It is far away from any massive objects. If a man weighs 700 N when he is at rest on earth, how much will he weigh in the room, most nearly ?

a. zero
b. 350 N
c. 700 N
d. 1050 N
e. 1400 N
f. None of the above answers is within 10% of the correct result.

50. A person who weighs 600 N when at rest is riding in the rotating cylinder ride, fixed by friction to the wall of the cylinder, whose floor has already dropped away. The cylinder rotates fast enough to create an 800-N centrifugal pseudo-force in the rotating frame of reference. What is the magnitude of the net force which the contact and frictional forces of the wall exert upon him most nearly?

a. 600 N
b. 800 N
c. 1200 N
d. 1400 N
e. 1600 N
f. None of the above answers is within 10% of the correct result.

51 Which of the following could be cited as valid evidence that the earth rotates?

a. The plane of a pendulum rotates as time passes.
b. The sun rises and sets each day.
c. Hurricane winds rotate counterclockwise in the Northern Hemisphere; clockwise in the Southern.
d. A high precision measurement of the weight of a standard mass yields a slightly smaller value at sea level on the equator than at the north pole.
e. All of the above.
f. None of the above answers is correct.

The following questions many require more computation that those preceding. Please Select the choice that best answers the question and insert its letter into the corresponding line of your NCS answer sheet.

52. A cylindrical space station, far from any large masses, can be spun so that people on the inside surface of the station feel the effects of an "artificial gravity" force directed inward towards the axis of the cylinder. If the cylinder has a radius of 50 km, what must its angular velocity be in order to provide an artificial gravity just equal to g = 10 m/s/s.
    a. 1.4×10^{-2} radians/sec
    b. 1.4×10^{2} radians/sec
    c. 2.0×10^{-4} radians/sec
    d. 2.0×10^{4} radians/sec
    e. None of the above answers is within 10% of the correct result.

53. An 90-kg satellite orbits a distant planet in a circle of radius of 4000 km with a period of 280 min. From the radius and period, you calculate the satellite's acceleration to be 0.56 m/s^2. What is the gravitational force on the satellite?
    a. 50.4 N
    b. 90 N
    c. 720 N
    d. 12,000 N
    e. None of the above answers is within 10% of the correct result

54. A solid lead sphere of radius 10 m (about 66 ft across!) has a mass of about 57 million kg. If two of these spheres are floating in deep space with their centers 20 m apart, compute the gravitational force of attraction between them, and select the best answer from those listed below. ($G = = 6.67 \times 10^{-11}$ N-m^2/kg^2.)
    a. 60 N
    b. 180 N
    c. 540 N
    d. 1620 N
    e. 4860 N
    f. None of the above answers is within 10% of the correct result.

55. A 0.5-kg air track sled (#1) traveling to the right with a speed of 4 m/s collides inelastically with a similar 0.5-kg sled (#2) traveling to the left with a speed of 2 m/s. The two stick together as they move away from the collision point. Calculate their final velocity.
   a. 1 m/s to the right
   b. 1 m/s to the left
   c. 2 m/s to the right
   d. 2 m/s to the left
   e. 4 m/s to the right
   f. 4 m/s to the left
   g. None of the above answers is within 10% of the correct result.

56. A 1400-kg car traveling north at 14 m/s is struck by a 2000-kg truck traveling east at 25 m/s. If the truck and car crunch and stick together, what is their speed immediately after the collision?
   a. 8.9 m/s
   b. 14.0 m/s
   c. 15.8 m/s
   d. 19.5 m/s
   e. 20.4 m/s
   f. None of the above answers is within 10% of the correct result.

57. A 10 kg block of wood loses 160 J of mechanical energy to friction as it slides down a ramp after starting at rest. If it has 90 J of kinetic energy at the bottom of the ramp, we can conclude that it started at a height of
   a. 0.9 m
   b. 1.6 m
   c. 2.5 m
   d. 9.0 m
   e. 16.0 m
   f. 25.0 m
   g. None of the above answers is within 10% of the correct result.

58. A 15-N block lifted straight upward by a net force of 20 N has an initial kinetic energy of 46 J. If the block is lifted 2 m , what is the block's final kinetic energy, most nearly?
   a. 90 J
   b. 70 J
   c. 50 J
   d. 30 J
   e. 10 J
   f None of the above answers is within 10% of the correct result

59. An observer drops a ball in a train traveling along a straight, horizontal track with a constant acceleration of 10 m/s/s in the forward direction. The observer in the train measures that the acceleration of the ball has (most nearly) the magnitude,
   a. 5 m/s/s
   b. 10 m/s/s
   c. 15 m/s/s
   d. 20 m/s/s
   e. 25 m/s/s
   f. None of the above answers is within 10% of the correct result.

60. Assuming that the earth is a perfect sphere and that the force of gravity is constant over the surface, your weight (as determined by a bathroom scale) at the equator would be less that at the North Pole. by the factor, _____, by virtue of the rotation of the earth about its axis. (Use $R_E = 6.4 \times 10^6$ m)
   a. 0.67
   b. 0.967
   c. 0.9967
   d 0.99967
   e. 0.999967

End of exam