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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.
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

Insert into your NCS answer sheet the letter of the single choice which best answers the question.

1. Which of the following statements about the moon is most correct?
   a. The moon has a non-constant velocity.
   b. There is a net force acting on the moon due to the sun, the earth and the other planets.
   c. The earth exerts an equally strong force on the moon as the moon exerts on the earth.
   d. The moon experiences a centripetal acceleration toward the earth.
   e. All of the above statements abut the moon are true.

2. Which of the following statements about the moon is not 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 not accelerating.
   e. The moon's rotation about the earth causes high tide to come later on successive days.

3. An astronaut weighs 900 N when measured on the surface of the earth. How large would the force of gravity on him be if he were in an earth satellite at an altitude equal to the earth's radius?
   a. 225 N
   b. 450 N
   c. 900 N
   d. 3600 N
   e. None of the above is correct within 10%

4. If you triple the length of each side of a cube, its surface area increases by what factor?
   a. 3
   b. 6
   c. 9
   d. 12
   e. 18

5. A future space traveler, Skip Parsec, lands on the planet MSU3, which has twice the mass of Earth and twice its radius. If Skip weighs 400 Newtons on Earth's surface, how much does he weigh on MSU3's surface?
   a. 1600 N
   b. 800 N
   c. 400 N
   d. 200 N
   e. 100N

6. What is the magnitude of the earth's gravitational field at a distance equal to four times the earth's radius?
   a. 40 N/kg
   b. 20 N/kg
   c. 10 N/kg
   d. 2.5 N/kg
   e. 0.62 N/kg

7 During the Apollo flights to the moon a well-known TV newscaster made the following statement, "The Apollo space craft is now leaving the gravitational force of the earth." This statement is incorrect. He should have said that the space craft
   a. was now being attracted only by the moon.
   b. was now being attracted only by the sun
   c. was now attracted more by the sun than by the earth.
   d. was now in a region of space where there no gravitational forces act upon it.
   e. Was now being attracted more strongly by the moon than by the earth.

8. The numerical value of G, the gravitational constant, was determined
   a. from knowledge of the earth's mass density and volume
   b. from the law of universal gravitation and the value of the acceleration due to gravity.
   c. from the value of the moon's acceleration.
   d. by measuring the force between masses in the laboratory.
   e. From a very precise knowledge of the mass of the earth.

9. Which of the following would <u>not</u> cause the gravitational force on an object near the surface of the earth to increase?
   a. an ore deposit just under the surface
   b. a lower elevation
   c. an increase in its mass
   d. a horizontal velocity
   e. All of he above would cause an increase in the gravitational force on the object.

10. In an orbiting satellite such as SkyLab , physical objects
   a. have mass but no weight.
   b. have mass but no force due to gravity.
   c. have neither mass nor weight.
   d. fall to the floor with an acceleration of 9.5 m/s/s.
   e conform to al of the above statements.

11 Geosynchronous communications satellites orbit the earth each
   a. 90 minutes
   b. 24 hours
   c. 28 days
   d. 1 year
   e. They don't orbit the earth; they just stay in one place.

12. Because the moon rotates about the earth about once every 28.3 days, there will occur on earth during some, but not most, 24 hour intervals,
   a. one high tide and one low tide;
   b. one high tide and two low tides, or two high tides and one low tide;
   c. two high tides and three low tides, or three high tides and two low tides.
   d. two high tides and two low tides.
   e. All of the above combinations occur in some, but not most, 24 hour intervals

13. Which of the following is true of the momenta of an 18-wheeler parked at the curb and a Volkswagen rolling down a hill?
    a. The 18-wheeler has the greater momentum
    b. The Volkswagen has the smaller momentum
    c. Their momenta are equal.
    d. Either could have the greater momentum.
    e. None of the above

14. How fast would you have to throw a baseball (m = 145 g) to give it the same momentum as a 5-g bullet traveling at 800 m/sec
    a. 1.1 m/s
    b. 1.8 m/s
    c. 5.5 m/s
    d. 27.6 m/s
    e. 160 m/s

15. Newton's second law can be rearranged to show that the _____ is equal to the _____.
    a. momentum ... impulse
    b. change in momentum ... change in impulse
    c. change in momentum ... impulse
    d. momentum ... change in impulse
    e. None of the above statements can be obtained by simply rearranging Newton's second law.

16. The 12-ounce boxing gloves used in amateur fights hurt less than the 6-ounce gloves used in professional fights because the _____ stopping times mean _____ forces.
    a. increased ... smaller
    b. decreased ... smaller
    c. increased ... larger
    d. decreased ... larger
    e. None of the above.

17. An astronaut training at the Craters of the Moon in Idaho jumps off a platform in full space gear and hits the surface at 5 m/s. If later on the moon the astronaut jumps from the LEM and hits the surface at the same speed, the impulse will be _____ that on earth.
    a. the same as
    b. larger than
    c. smaller than
    d. larger or smaller depending upon the height of the jump.
    e. It is not possible to compare the impulses.

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

19. Which of the following will cause the largest change in the momentum of an object?
    A force of _____ acting for _____.
    a. 3 N ... 9 s
    b. 4 N ... 8 s
    c. 5 N ... 7 s
    d. 6 N ... 6 s
    e. 7N ... 5 s

20. What average force is required to stop a 120-kg football player running at 8 m/s in a time of 0.4 s?
    a. 6 N
    b. 37.5 N
    c. 384 N
    d. 2400 N
    e. None of the above is within 10% of the correct answer.

21. It takes about 30 s for a jet plane to go from rest to the takeoff speed of 100 mph (44.7 m/s). What is the average horizontal force that the seat exerts on the back of a 80-kg passenger during takeoff?
    a. 11.9 N
    b. 16.8 N
    c. 53.7 N
    d. 238 N
    e. None of the above is within 10% of the correct answer.

22. A very hard rubber ball (m = 0.6 kg) is falling vertically at 6 m/s just before it strikes the floor. The ball rebounds back at essentially the same speed. If the collision with the floor lasts 0.04 s, what is the average force exerted by the floor on the ball?
    a. 45 N
    b. 90 N
    c. 180 N
    d. 360 N
    e. None of the above is within 10% of the correct answer.

23. 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. All of the above reasons are valid
    e. None of the above statements is true

24. If rockets are fired in the forward direction from a moving airplane, the momentum of the airplane will
    a. decrease just enough to conserve the momentum of the plane plus rocket system .
    b. be unchanged, by conservation of momentum.
    c. increase just enough to conserve the momentum of the plane plus rocket system
    d. decrease, but not by an amount we can specify
    e. Increase, but not by an amount that we can specify.

_25. Which of the following properties of a ball is conserved as it falls freely in a vacuum?
   a. kinetic energy
   b. gravitational potential energy
   c. momentum
   d. mechanical energy
   e. None of the above is a conserved quantity in the strict sense of the word.

_26. Under what conditions is the kinetic energy (KE) conserved, in the strict sense of the word, during a collision?
   a. It is always conserved.
   b. When the collision is totally elastic.
   c. When there is no net outside force.
   d. When there is no friction.
   e. KE is never conserved during a collision because its value does not remain constant.

_27. A ball moving at 4 m/s toward the right has a head-on collision with an identical stationary ball. Each of the following final velocity pairs satisfies the law of conservation of linear momentum. Which one also preserves kinetic energy? One ball has a velocity of _____ while the other has a velocity of _____ to the right.
   a. 2 m/s to the right ... 2 m/s
   b. zero ... 4 m/s
   c. 2 m/s to the left ... 6 m/s
   d. 4 m/s to the left ... 8 m/s
   e. None of the above has a final kinetic energy equal to the initial value.

_28. A 3-kg toy car with a speed of 5 m/s collides head-on with a stationary 2-kg car. After the collision, the cars are locked together with a speed of 3 m/s. How much kinetic energy is lost in the collision?
   a. 10 J
   b. 20 J
   c. 30 J
   d. 40 J
   e. None of the above is within 10% of the correct value.

_29. In physics, **work** is defined as the product of the
   a. net force and the distance traveled.
   b. net force parallel to the motion and the distance traveled.
   c. net force parallel to the motion and the time it is applied.
   d. applied force and the distance traveled.
   e. net force and the time it is applied.

_30. Two objects have different masses but the same kinetic energies. If you stop them with the same retarding force, which one will stop in the shorter distance?
   a. The heavier one.
   b. The lighter one.
   c. The one with the larger momentum.
   d. The one with the smaller momentum
   e. Both stop in the same distance.

_31 Two objects have different masses but the same momenta. If you stop them with the same retarding force, which one will stop in the shorter distance?
a. the heavier one
b. the lighter one
c. The one with the larger kinetic energy
d. Both stop in the same distance
e. There is not enough information to say.

_32. The kinetic energy of an object moving in a circle at a constant speed
a. is continually changing as the force changes direction.
b. is equal to the force times the time for one revolution.
c. is equal to one-half of the potential energy.
d. is constant.
e. depends upon the radius of the circle.

____ 33. Which of the following has the physical dimension of power?
a. Newton-meter/sec
b. kilowatt
c. Joule/sec
d. kg-m^2/sec^3
e. All of the above have the physical dimension of power.

34. How much work is performed by the gravitational force F on a geosynchronous satellite during one day?
a. Zero, because the satellite does not move.
b. Zero, because the force is perpendicular to the velocity.
c. FC, where C is the circumference of the satellite orbit.
d. Fr, where r is the radius of the orbit.
e. Zero, because a geosynchronous satellite is placed in a stationary position above the earth.

35. A bowler lifts a bowling ball from the floor and places it on a rack. If you know the weight of the ball, what else must you know in order to calculate the work she does on the ball?
a. mass of the ball
b. the time required
c. nothing else
d. height of the rack
e. acceleration due to gravity

36. How much work does a 50-kg person do against gravity in walking up a trail that gains 700 m in elevation?
a. 500 J
b. 7000 J
c. 35,000 J
d. 350,000 J
e. There is not enough information to say, because the work depends on the slope of the trail.

37. 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 as you pass a window washer, the window washer will see 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 statements is true
38. 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. total mechanical energies
    c. forces
    d. total momentum
    e. No physical quantity is the same in both reference systems.
39. Assume that you are riding in a windowless room on a perfectly smooth surface. (You can't feel any motion.) Imagine that you have a collection of objects and measuring devices in the room. Which of the following experiments could you do to prove that the room is moving horizontally at a constant velocity?
    a. Determining an object's mass by applying a net horizontal force.
    b. Weighing an object and comparing it to its known weight.
    c. Determining the force necessary for an object to move in a circle.
    d. Measuring the verticality of a hanging object
    e. None of the above.
40. 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 horizontal force acting on the ball.
    b. the reference system attached to the car is noninertial.
    c. there is a net force in the forward direction.
    d. the force in the forward direction is canceled by the inertial force.
    e. None of the above.
41. A person drops a ball in train traveling along a straight, horizontal track at a constant velocity of 50 mph. What would the person in the train say about the horizontal forces acting on the ball?
    a. There are no horizontal forces acting on the ball.
    b. There is a fictitious (inertial) force acting forward.
    c. There is a fictitious (inertial) force acting backward.
    d. There is a centrifugal force.
    e. None of the above.
42. A rock is thrown horizontally at 10 m/s from the back of a flatbed truck that is moving with a constant velocity of 30 m/s. Relative to an observer on the ground, what is the horizontal velocity of the rock when it is thrown in the backward direction?
    a. 20 m/s forward
    b. 20 m/s backward
    c. 40 m/s forward
    d. 40 m/s backward
    e. 30 m/s on average

43. An aircraft carrier is moving to the north at a constant 30 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 north?
    a. 25 mph
    b. 30 mph
    c. 95 mph
    d. 125 mph
    e. 155 mph

44. A train is traveling along a straight, horizontal track with a constant acceleration in the forward direction. At the instant the speed is 50 mph, a ball is dropped by an observer in the train. An observer on the ground determines that the horizontal speed of the ball during the fall is
    a. decreasing
    b. increasing
    c. zero
    d. equal to 50 mph.
    e. None of the above.

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 horizontal force acting on the ball?
    a. There is no horizontal force.
    b. A force acts backward.
    c. A force acts forward.
    d. There is a centrifugal force.
    e. None of the above

46. You and a friend are rolling marbles on a horizontal table in the back of a van traveling straight forward on a 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

47. An elevator is moving upward and slowing down with an acceleration equal in magnitude to one-quarter that of gravity. If a person who weighs 800 N when at rest on Earth steps on a bathroom scale in this elevator, what will the scale read?
    a. 200 N
    b. 600 N
    c. 800 N
    d. 1000 N
    e. None of the above.

48. While driving to the movies you decide to take advantage of a sharp right-hand corner to slide your date over next to you. (Assume that the seat is frictionless.) From your point of view your date experiences a net force to the left, while a person standing on the roadway says your date experiences
    a. a net force to the right.
    b. a net force to the left.
    c. a net force forward.
    d. a net force backward
    e. no net force.

The following problems may require some numerical computation. Place the letter of the most nearly correct answer into the corresponding line on your NCS answer sheet.

49. The masses of the Moon and Earth are 7.4×10^{22} kg and 6×10^{24} kg, respectively. The Earth-Moon distance is 3.8×10^{8} m. What is the size of the gravitational force between Earth and the Moon? The gravitational constant is $G = 6.67 \times 10^{-11}$ N-m^2/kg^2.
    a. 2.05×10^{36} N
    b. 7.79×10^{28} N
    c. 3.07×10^{30} N
    d. 7.79×10^{44} N
    e. 2.05×10^{20} N

50. Mercury has a radius of about 0.38 Earth radii and a mass of only 0.055 Earth masses. Estimate the acceleration due to gravity on Mercury.
    a. 1.4 m/s^2
    b. 3.8 m/s^2
    c. 26 m/s^2
    d. 69 m/s^2
    e. None of the above is within 10% of the correct value

51. A 90-kg satellite orbits a distant planet with a radius of 4000 km and 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 is within 10% of the correct value.

52. A boxcar traveling at 10 m/s approaches a string of four identical boxcars sitting stationary on the track. The moving boxcar collides and links with the stationary cars, and the five move off together along the track. What is the final speed of the five cars immediately after the collision? (You may take the mass of each boxcar to be 18,537 kg.)
    a. 2 m/s
    b. 2.5 m/s
    c. 3.33 m/s
    d. 10 m/s
    e. None of the above.

53. A woman with a mass of 50 kg runs at a speed of 6 m/s and jumps onto a giant skateboard with a mass of 30 kg. What is the combined speed of the woman and the skateboard?
    a. 3.75 m/s
    b. 4.74 m/s
    c. 6 m/s
    d. 10 m/s
    e. None of the above

54. A 3-kg ball traveling to the right with a speed of 5 m/s overtook and collided with a 4-kg ball traveling in the same direction with a speed of 2 m/s. The total momentum after the collision was _____ kg-m/s to the right.
    a. 8
    b. 15
    c. 23
    d. 26
    e. None of the above.

55. A 1200-kg frictionless roller coaster starts from rest at a height of 24 m. It travels 500 m under a frictional force of 288 N to the crest of a hill that is 12 m high. What is its kinetic energy at the top of the 12 m hill?
    a. 288,000 J
    b. 144,000 J
    c. 28,800 J
    d. 14,400 J
    e 0 J

56. A block weighing 30 N, which is lifted straight upward by applying a force of 45 N, has an initial kinetic energy of 25 J. If the block is lifted 3 m, what is the block's final kinetic energy?
    a. 160 J
    b. 115 J
    c. 70 J
    d. 45 J
    e 25 J

57. What average power is required to accelerate a 1300-kg car from rest to 20 m/s in 8 s? (1 kW = 1000 J/sec)
    a. 1.3 kW
    b. 26 kW
    c. 32.5 kW
    d. 325 kW
    e None of the above is within 10 % of the correct answer.

58. An observer drops a ball in a train traveling along a straight, horizontal track with a constant acceleration of 5 m/sec^2 in the forward direction. The observer is unaware of the acceleration and notices that the ball falls in a straight line that is slanted toward the back of the train. The acceleration of the ball along this line has a magnitude of _____ m/s^2, ,most nearly.
    a. 5.1 m/s^2.
    b. 9.9 m/s^2.
    c. 11.2 m/s^2.
    d. 14.9 m/s^2.
    e. None of the above.

59. What would an observer measure for the magnitude of the free-fall acceleration in an elevator near the surface of Earth if the elevator accelerates upward at 4 m/s^2?
    a. 4 m/s^2
    b. 6 m/s^2
    c. 10 m/s^2
    d. 14 m/s^2
    e. 16 m/s^2

60. A cylindrical space habitat with a 4000-m radius is rotating so that a person standing on the inside feels a centripetal acceleration equal to g = 10 m/sec^2. What is the tangential speed of a point just inside the cylinder?

    a. 5 m/s
    b. 20 m/s
    c. 63.2 m/s
    d. 100 m/s
    e. 200 m/s

...End of exam..