**Physics 11**

**Midterm Examination**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_**

**Score: /91**



**Physics 11 Midterm**

**Please read all directions carefully. Remember if something is worth 4 marks to make sure you show 4 marks worth of work. Remember titles and labeling axis on graphs. Best of luck, relax, take a deep breathe you’ll do fine!**

**True/False**

\_\_\_\_ 1. All measurements are subject to some uncertainty.

\_\_\_\_ 2. Mass is the quantity of matter an object has.

\_\_\_\_ 3. Acceleration can never be negative.

\_\_\_\_ 4. The area under a velocity-time graph is the displacement of the object.

\_\_\_\_ 5. A free-body diagram represents forces acting on a system.

\_\_\_\_ 6. A ball that is dropped will hit the ground at the same time as a ball that is thrown horizontally with an initial velocity of 2 m/s.

**Multiple Choice**

\_\_\_\_ 7. Construct a position-time graph that shows the forward progress of Sunny The Dog in a straight line for 20 meters over the course of 4 seconds.

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

\_\_\_\_ 8. “Free fall” is the condition in which

|  |  |
| --- | --- |
| a. | the motion of a body is due to gravity alone, when air resistance is applicable. |
| b. | the motion of a body is due to velocity alone, when air resistance is negligible. |
| c. | the motion of a body is due to gravity alone, when air resistance is maximized. |
| d. | the motion of a body is due to gravity alone, when air resistance is negligible. |

\_\_\_\_ 9. The normal force (FN) refers to

|  |  |
| --- | --- |
| a. | the parallel contact force exerted by a surface on another object. |
| b. | the perpendicular contact force exerted by a surface on another object. |
| c. | the perpendicular tension exerted by a surface on a rope. |
| d. | the parallel acceleration of a body at terminal velocity. |

\_\_\_\_ 10. The static friction force is

|  |  |
| --- | --- |
| a. | the force need to keep an object moving at a constant velocity across a surface. |
| b. | the force needed to bring an object to rest.  |
| c. | the minimum force required to overcome static friction and move an object.  |
| d. | equal to the net force.  |

\_\_\_\_ 11. Which conditions will result in the smallest change in momentum?

|  |  |  |  |
| --- | --- | --- | --- |
| a. | a large force over a long time period | c. | a small force over a long time period |
| b. | a large force over a short time period | d. | a small force over a short time period |

**Short Answer: Don’t over think these, just answer as best you can.**

 12. Does mass affect the rate at which an object falls? Justify your answer with a specific example. (2)

 13. What happens to an object’s weight as it moves farther from Earth? And why?(2)

 14. Suppose a car hits a wall and comes to a rapid stop. The initial momentum is given by the velocity and mass of the car, and the final momentum is zero. Since these two factors (initial and final momentum) are the only things that determine impulse, how can a seat belt or air bag save lives?(2)

 15. Analyze the collision of a baseball with a bat. At what point or points during the collision is the baseball’s horizontal acceleration zero? At what point or points is the baseball’s acceleration not zero? Explain your answer.(3)

 16. What if the mass of a particle were to suddenly drop to zero? According to the information in chapter 9, what would happen to the momentum of the particle?(1)

**Problem: Again don’t over think these. Calculate as best as you can. Show work for part marks if your not sure. Formulas, that are correctly applied, will recive some marks as it demonstrates your part knowledge. Also remember that drawing a picture always helps YOU see what is needed to be found.**

 17. A body has a velocity of 72 km/hr. Find its value in m/s.(1)

 19. Marcee intercepts a spiked volleyball at ground level and it flies vertically upward at a speed of 6.78 m/s. Julius catches it on its way down at a height of 1.63 m from the ground. How much time elapsed between Marcee’s hit and Julius’s catch? (6)

 20. An elevator is moving down with an acceleration of 3.36 m/s2. What would be the apparent weight of a 64.2-kg man in the elevator?(3)

 22. Two horizontal forces, 145 N and 315 N are applied to a sled resting on a frictionless skating rink. If they are applied in *opposite* directions, what is the net horizontal force on the sled? (1)

 23. Three bugs that are connected by massless spider silk are pulled along a frictionless table top. The first bug has a mass of 1.5 g, the second, 2.0 g, and the third, 0.75 g. The spider pulling them exerts a force of 0.011 N. What is the acceleration of each bug?(3)

 24. An Eskimo pushes a loaded sled with a mass of 300 kg for a distance of 25 m over the frictionless surface of hard-packed snow. He exerts a constant 170 N force as he does so. If the sled starts from rest, what is its final velocity?(4)

 25. A mover pushes a 30.0 kg crate across a wooden floor at a constant speed of 0.75 m/s. If the coefficient of static friction for wood-on-wood is 0.20, what is the **normal force** exerted by the floor on the crate?(2)

 26. A lion runs 2.40 km due north, then 3.60 km due west. What is the lions **resultant** direction (angle please) and displacement?(4)

 27. You need to move a 53-kg armoire across the room. You put some cardboard under the feet of the armoire. If you push with a force of 38 N, and the armoire accelerates at 0.20 m/s2, what is the coefficient of friction of the cardboard over the carpet?(5)

 28. A racecar driver is driving her car down the drag strip at 120 m/s. What is the shortest distance in which she can brake and stop if the coefficient of static friction between the tires and the road is 0.71? (4)

 29. A bolt is shot horizontally from a crossbow 1.5 m above the ground. The initial velocity is 45 m/s. How far will the arrow travel before hitting the ground?(4)

 30. What is the gravitational force between two 0.300 kg coffee mugs that are 0.75 m apart?(2)

 31. A 6110-kg bus traveling at 20.0 m/s can be stopped in 24.0 s by gently applying the brakes. If the driver slams on the brakes, the bus stops in 3.90 s. What is the average force exerted on the bus in both these stops?(4)

 32. A force of 200 N acts on a 7.20-kg bowling ball for 0.350 s. Calculate its change in velocity.(3)

 33. A 1.5  10-2 kilogram bullet traveling at 850 m/s hits a block of wood. The bullet and wood together fly off in the same direction at 25 m/s. What is the impulse on the bullet?(3)

**Longer Answer: There is graph paper attached at the back for you use. With the exception of 35 and 41 these are basically explanation questions with no ‘work’ required.**

 35. Tom drives his car at a constant speed on a straight road for two hours while going to meet his friend. He noted the position of his car after every 15 minutes, assuming his house to be the origin. On his way back home, he again noted the positions of the car after every 15 minutes, without changing the origin. If on both of the trips, his car covers 25 km in every 15 minutes, then:

a. Draw the position-time graphs of the car for the two sides of the journey.(3)

b. Find the difference between the average velocities of the two sides of the journey. (1)

c. Find what happens if during the return journey, the friend’s house is taken as the origin.(1)

 36. When riding in an elevator, why does a person appear to lose weight when accelerating downward? Explain using scientific principles and laws we learned so far.(2)

 37. Laika the dog was the first animal from Earth to enter space, and was sent into orbit by the Soviet Union in 1957. Using words and mathematical formulas, describe what happened to Laika’s apparent weight during take-off and while in orbit 2100 km above Earth (g = 5.499 m /s2). What happened to her mass? (3)

 38. A person’s mass is 60 kg. He or she is standing on a bathroom scale in an elevator. Starting from rest, the elevator accelerates downward at 3 m/s for 2 s and then continues at constant speed. Is the scale reading during acceleration greater than, equal to, or less than the scale reading when the elevator is at rest? (2)

 40. Compare the collision of a baseball and bat with the collision of a baseball and a fielder’s glove when the baseball is caught. During which collision is there a greater momentum change for the baseball? Why?(3)

 41. Critique the following argument: “I don’t need a seat belt, because if my car stops suddenly I can catch myself with my arms.” Use the following data in your response: mass of driver, 68 kg, initial velocity 25 m/s, final velocity 0.0 m/s, stopping time 0.20 sec.(4)

 42. Criticize the following statement, based on what you know of momentum and gravity.

“When I drop a ball of clay to the ground, it sticks. The momentum started as zero, went up to a maximum just before impact, and went back to zero. Clearly, momentum is not conserved.”(3)

YAY!!!!!!! ALL DONE!!!!!!!!!!!!!!!!!!!! Great work!!!!!!!!!!

**Physics 11 Midterm**

**Answer Section**

**TRUE/FALSE**

 1. ANS: T

No measurement is totally exact.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 11

NAT: UCP.3

 2. ANS: T

The quantity of matter an object has is called mass.

PTS: 1 DIF: Bloom’s Level1 REF: p. 10

NAT: UCP.1

 3. ANS: F

Acceleration is a vector quantity, and it can be either positive (showing that an object is speeding up) or negative (showing that an object is slowing down).

PTS: 1 DIF: Bloom's Level 1 REF: p. 61

NAT: B.4

 4. ANS: T

The displacement of an object is equal to the area under the velocity-time graph of that object.

PTS: 1 DIF: Bloom's Level 2 REF: pp. 66-67

NAT: B.4

 5. ANS: T

One can represent the forces acting on a system with a free-body diagram.

PTS: 1 DIF: Bloom’s Level 1 REF: p. 89

NAT: B.4

 6. ANS: T

Horizontal motion is independent of vertical motion.

PTS: 1 DIF: Bloom’s Level 2 REF: pp. 148-149

NAT: B.4

**MULTIPLE CHOICE**

 7. ANS: B

A position-time diagram shows the distance traveled over a time interval. The slope of the line is the distance (20 m) divided by the time (4 s). Answer B shows a line with the slope of 20/4 = 5m/s, in the positive direction.

PTS: 1 DIF: Bloom's Level 4 REF: p. 38

NAT: B.4

 8. ANS: D

Free fall is the motion of a body due to gravity alone, when air resistance is negligible.

PTS: 1 DIF: Bloom's Level 2 REF: p. 72

NAT: B.4

 9. ANS: B

The perpendicular contact force exerted by a surface on another object is called the normal force.

PTS: 1 DIF: Bloom’s Level 1 REF: p. 107

NAT: B.4

 10. ANS: C

The minimum force required to overcome friction and move an object is the static friction force.

PTS: 1 DIF: Bloom’s Level 1 REF: pp. 126-127

NAT: B.4

 11. ANS: D

Impulse is directly proportional to both force and time.

PTS: 1 DIF: Bloom's Level 2 REF: p. 230

NAT: B.4

**SHORT ANSWER**

 12. ANS:

No, mass does not affect the rate of the fall of objects. For example, a stack of two bricks would fall at the same rate as a single brick.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 10

NAT: UCP.2

 13. ANS:

The weight of the object decreases as it moves farther from Earth.

PTS: 1 DIF: Bloom’s Level 3 REF: p. 182

NAT: B.4

 14. ANS:

It is not impulse that is changed by a seat belt, but force and time. A seat belt or air bag lengthens the time of the collision, thereby lessening the force.

PTS: 1 DIF: Bloom's Level 2 REF: p. 231

NAT: B.4

 15. ANS:

The baseball’s horizontal acceleration is zero both before and after the collision, because its horizontal velocity is not changing during these times. The only time the baseball experiences a horizontal acceleration is during the collision. At this time, both the speed and direction of the baseball change.

PTS: 1 DIF: Bloom's Level 4 REF: p. 230

NAT: B.4

 16. ANS:

Since momentum equals mass times velocity, the momentum would equal zero.

PTS: 1 DIF: Bloom's Level 5 REF: p. 230

NAT: B.4

**PROBLEM**

 17. ANS:



PTS: 1 DIF: Bloom’s Level 2 REF: Page 6

OBJ: 1.1.3 Evaluate answers using dimensional analysis.

TOP: Evaluate answers using dimensional analysis. KEY: Dimensional analysis

MSC: 2 NOT: 1 km = 1000 m and 1 hr = 60\*60 s = 3600 s

 18. ANS:

0.92 s

PTS: 1 DIF: Bloom’s Level 3 REF: Page 72

OBJ: 3.3.2 Solve objects involving objects in free fall. NAT: B.4

TOP: Solve objects involving objects in free fall. KEY: Free fall

MSC: 3

NOT: The total time is the sum of the time taken by the ball to reach its topmost point and the time to come down from the topmost point to the point where the ball is caught.

 19. ANS:

The total time is the sum of the time for the ball to rise to its maximum height, and the time for it to fall to 1.63 m above the ground.

vf = vi + atf

0 = 6.78 m/s + (9.8 m/s2)(t)

6.78 m/s = (9.8 m/s2)(t)

t = 0.69 s to reach the apex

How high did it go?

df = di + vitf + 1/2atf2

df  = 0 m + 6.78 m/s (0.69 s) + 1/2(9.8 m/s2)(0.69 s)2

df  = 4.68 m + (2.33 m)

df  = 2.35 m

How long did it take to fall from 2.35 m to 1.63 m?

df = di + vitf + 1/2atf2

1.63 = 2.35 m + 0 m/s (t) + 1/2(9.8 m/s2)(t)2

0.72 = (4.9 m/s2)(t)2

t = 0.38 s

Total time = 0.69 s + 0.38 s = 1.07 s

PTS: 1 DIF: Bloom's Level 5 REF: pp. 68, 72-73

NAT: B.4

 20. ANS:

413 N

PTS: 1 DIF: Bloom’s Level 3 REF: Page 97

OBJ: 4.2.2 Differentiate between actual weight and apparent weight.

NAT: B.4 TOP: Differentiate between actual weight and apparent weight.

KEY: Apparent weight MSC: 3

NOT: Use Newton's second law to find the apparent weight of the man.

 21. ANS:

6.1 N

PTS: 1 DIF: Bloom’s Level 3 REF: Page 102

OBJ: 4.3.2 Explain the tension in ropes and strings in terms of Newton's third law.

NAT: B.4 TOP: Explain the tension in ropes and strings in terms of Newton's third law.

KEY: Tension MSC: 3

NOT: Draw the free-body diagram for each block and then use Newton's second law to find the tension.

 22. ANS:

315 N - 145 N = 170 N toward the smaller force.

PTS: 1 DIF: Bloom’s Level 3 REF: p. 92

NAT: B.4

 23. ANS:

The bugs are all moving with the same acceleration, so the overall acceleration is F/ m = a

0.011 N / 0.00425 kg = 2.6 m/s2

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 92-93, 105

NAT: B.4

 24. ANS:

a = F/m

a = 170 N / 300 kg

a = 0.57 m/s2

Recall that

vf2 = vi2 + 2a(df -di)

vf2 = 0 + 2(0.57 m/s2 )(25 m - 0)

vf2 = 28.5 m2/s2

 vf = 5.3 m/s

PTS: 1 DIF: Bloom’s Level 6 REF: pp. 79, 93

NAT: B.4

 25. ANS:

FN = Fg

= mg

= (30.0 kg)(9.8 m/s2)

= 294 N

PTS: 1 DIF: Bloom’s Level 3 REF: pp. 126-131

NAT: B.4

 26. ANS:

 = tan-1 (Ry/Rx)

 = tan-1 (2.40/3.60)

 = tan-1 (.667)

 =  north of west

PTS: 1 DIF: Bloom’s Level 4 REF: p. 120

NAT: B.4

 27. ANS:

Fnet = F  kFN = F  k mg = ma

k = (F  ma) / mg

k = [38 N  (53 kg)(0.20 m/s2)] / [(53 kg)(9.8 m/s2)]

k = 0.053

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 126-127

NAT: B.4

 28. ANS:

vf2 = vi2 + 2a(df  di)

Let vf  = 0 and df  di = d

0 = vi2 + 2a(d)

d = - vi2 / 2a

The weight in the y-direction = the normal force.

F = F = smg = ma

a = sg

d = - vi2 / (2(sg)

d = vi2 / (2(sg)

d = (120 m/s)2 / [2(9.8 m/s2)(0.71)]

d = 1000 m

The cars had better have other mechanisms for stopping, besides the brakes.

PTS: 1 DIF: Bloom’s Level 6 REF: pp. 79, 126-127

NAT: B.4

 29. ANS:

The only force acting on the crossbow bolt to cause it to hit the ground is gravity. The time that it will take for a fired bolt to hit the ground is the same as if it were dropped vertically from the same height. There is no initial velocity downward.

df = di + vitf + 1/2atf2

1.5 m = 0 m + 0(t) + 1/2(9.8 m/s2)(t)2

t = 0.55 s

The bolt will travel at 45 m/s in a straight line until it hits the ground.

45 m/s  0.55 s = 25 m

PTS: 1 DIF: Bloom's Level 4 REF: pp. 148-149

NAT: B.4

 30. ANS:

Fg = G[m1m2/r2]

Fg = 6.67  10-11[(0.300 kg)(0.300 kg)/(0.75 m)2]

Fg = 6.67  10-11 N m2/kg2[(0.0900 kg2)/(0.5625 m2)]

Fg = 6.67  10-11 N m2/kg2[(0.16 kg2/m2]

Fg = 1.1  10-11 N

PTS: 1 DIF: Bloom’s Level 3 REF: p. 175

NAT: B.4

 31. ANS:

**  N

**  N

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3

NOT: Apply the impulse-momentum theorem to obtain the force needed to stop the vehicle.

 32. ANS:

9.72 m/s

PTS: 1 DIF: Bloom's Level 3 REF: Page 230

OBJ: 9.1.2 Determine the impulse given to an object. NAT: B.4

TOP: Determine the impulse given to an object. KEY: Impulse

MSC: 3 NOT: Apply the impulse-momentum theorem to obtain the change in velocity.

 33. ANS:

12 kg m/s

PTS: 1 DIF: Bloom's Level 3 REF: p. 230

NAT: B.4

 34. ANS:

25.0 cm

PTS: 1 DIF: Bloom's Level 3 REF: Page 379

OBJ: 14.1.2 Determine the energy stored in an elastic spring.

TOP: Determine the energy stored in an elastic spring. KEY: Energy in elastic spring

MSC: 3 NOT: Use the equation for the elastic potential energy stored in a stretched spring.

**ESSAY**

 35. ANS:

a.



b. There is the difference of sign in the two velocities. During the return journey, the displacement is negative. Therefore, the average velocity is also negative.

c. The average velocity during the return journey also becomes positive.

PTS: 1 DIF: Bloom’s Level 3 REF: Page 38

OBJ: 2.3.1 Develop position-time graphs for moving objects. NAT: B.4

TOP: Develop position-time graphs for moving objects.

KEY: Displacement, Position-time graph, Average velocity MSC: 2

 36. ANS:

A person’s apparent weight is equal to the normal force on him or her. This force decreases below mg when he or she accelerates downward.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 98

NAT: B.4

 37. ANS:

During take-off, Laika would have been subjected to a great deal of force and her apparent weight would have been much greater than it was on Earth. Once in orbit, she would have been experiencing acceleration due to gravity at a much lower level than on Earth, and her apparent weight would have been near zero.

Her mass would not have changed due to any of her launch conditions; however, she only had enough food and water aboard to live for approximately 10 days. Sadly, she died 5 to 7 hours into the mission due to stress and overheating.

PTS: 1 DIF: Bloom’s Level 4 REF: p. 98

NAT: B.4

 38. ANS:

Fnet = ma

Fnet = Fscale + Fg

At rest, Fscale = Fnet  Fg = Fg = mg = 60 kg \* 9.8 m/s2 = 588 N

During acceleration,

Fscale = ma  mg

 = m (ag)

 = 60 (1.5 m/s2  (9.8 m/s2))

 = 498 N

The reading on the scale during downward acceleration is less than it would be at rest.

PTS: 1 DIF: Bloom’s Level 5 REF: pp. 108-109

NAT: B.4

 39. ANS:

For practical purposes, most gravitational interactions are small enough to be ignored when solving physics problems.

PTS: 1 DIF: Bloom's Level 4 REF: p. 236

NAT: B.4

 40. ANS:

There is a greater momentum change in the collision of a baseball and bat. In this collision, the baseball changes direction, going from a large negative momentum to a large positive momentum. In the collision of a baseball and glove, momentum changes from a large positive value to zero.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 230-231

NAT: B.4

 41. ANS:

The force on the driver of the car described above is 68 kg  25 m/s / 0.20 sec = 8500 N or nearly one ton. Could you hold up a ton? The claim that seat belts are unnecessary is false.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 230-231

NAT: B.4

 42. ANS:

Answers will vary. Two important points are these: First, the system of just the clay is not a closed, isolated system, because the clay is interacting with Earth. Second, the clay falls due to gravitational attraction from Earth. According to gravitational theory, Earth is also attracted by the clay. The initial momentum was zero, and the total momentum of clay and Earth remained zero throughout the event, since Earth, with its relatively huge mass, was attracted to the clay just as the clay, with its relatively small mass, was attracted to Earth. Only in the system of just the clay did the momentum change, and that is not an isolated system.

PTS: 1 DIF: Bloom's Level 6 REF: pp. 236-237

NAT: B.4