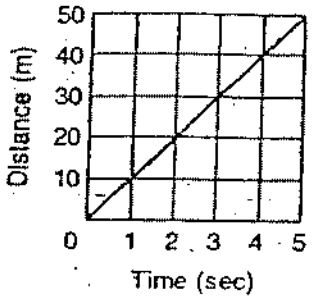
Physics Semester 1 Review

Name: KEY

1. Define: Speed – rate of how fast an object moves. $S = d/t$ m/s
   Velocity – speed given direction $v = \Delta d/\Delta t$ m/s N.
   Acceleration – Δ vel / time m/s²

Use the graph to the right to answer questions 2-4.

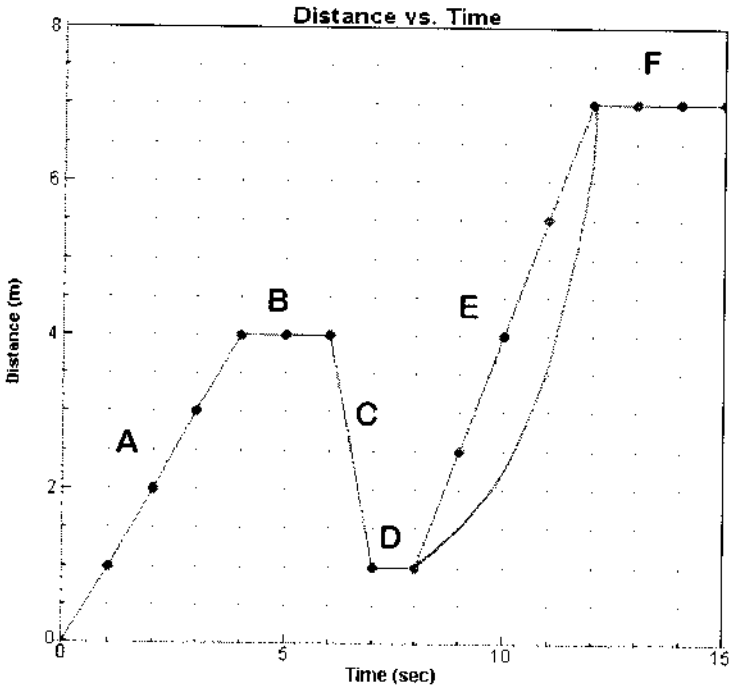


2. How far did the object travel in 3 seconds? 30 m

3. How long did it take for the object to travel 15 meters? 1.5 s

4. What is the average speed of the object? 10 m/s

Use the Distance vs. Time graph below to answer Questions #5 – 8. The graph has been divided into six sections, labeled A, B, C, D, E, and F.



5. Which section(s) of the graph indicate a . . .

   a) Positive velocity? A, E

   b) Zero velocity? B, D, F

   c) Negative velocity? C

6. Which section of the graph has the greatest <u>speed</u> (*not velocity*)? C

7. Is that speed in a positive or <u>negative</u> direction?

8. Using a different color pen or pencil, modify Section E so it appears the object was accelerating.

9. What is the average velocity for the first 6 seconds of the graph?

$v = \frac{\Delta d}{\Delta t}$ $\quad \frac{4\text{ m}}{6\text{ s}} = .67$ m/s

10. If an object goes from 20 m/s to 50 m/s in 5 seconds, what is its acceleration?

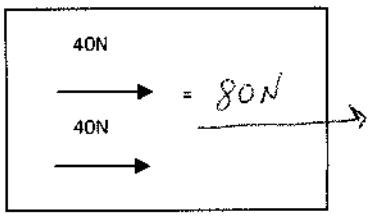
$Acc. = \frac{\Delta vel}{t}$ | $\frac{50-20}{5}$ | 6 m/s²

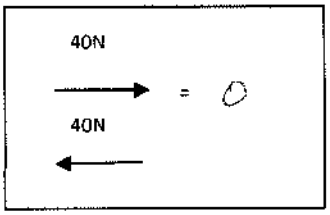
11. An object is consistently traveling 20 m/s around a curve.
Is the object's speed constant? YES If no, explain. _____
Is the object's velocity constant? NO If no, explain. Δ dir.
Is the object accelerating? YES If no, explain. Δ vel.

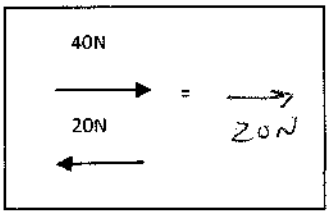
12. What is the difference between distance and displacement? - Δ in position
L length

13. A force can be defined as a push or a pull.

14. What is the "net force" of each example below?







15. State and explain Newton's 3 Laws of Motion.
1st Law: Concept of Inertia. Object @ rest stays @ rest. Object in motion, stays in a straight line motion unless outside force acts upon it.

2nd Law: $F_{net} = ma$

3rd Law: Action - Reaction. Forces occur in pairs.

16. Decide whether each of the following examples best describes Newton's 1st, 2nd, or 3rd Laws of Motion.
1 a. a person in a car keeps moving when brakes are applied to the car
3 b. the wall pushes back on you as hard as you push on the wall
1 c. inertia
2 d. more force is needed to accelerate a n F-150 than a Volkswagen
3 e. the ground pushes you forward with each step you take
1 f. deals with moving and nonmoving objects
2 g. if a pitcher throws a ball with twice the force, the acceleration would be doubled
3 h. forces occur in pairs
2 i. accelerations are produced by forces

17. A small car collides with a large truck; describe the forces acting on each vehicle. Describe the acceleration of each vehicle. Same forces - Newton's 3rd Law. $M_a = m_A$ (M: truck, m: small car)

18. What does a force produce? What is the relationship between force and acceleration? Between mass and acceleration? L motion

↑F – ↑A

↑m – ↓A

19. A nail falls from the hand of a rooftop worker. Neglecting air resistance, diagram the forces acting on the nail.

20. A rope attached to a water pail is used to pull the pail up from a water well at a constant velocity. Diagram the forces acting on the pail.

21. A space shuttle is launched straight up into the air. Neglecting air resistance, diagram the forces acting on the shuttle as it is launched.

22. A spacecraft moves at a constant velocity through outer space, removed from the gravitational field. Diagram the forces acting on the spacecraft.

23. Define: Weight – response to the pull of gravity $W = mg$ (N)
Mass – amt. of matter in an object (Kg)
Inertia-- resistance to change

24. An object with a mass of 1 kg would weigh 9.8 N.
25. On Earth, how fast do things accelerate when falling? $9.8\ m/s^2$
26. What happens to an object in each second of free fall? e.g. velocity, acceleration, distance covered.
velocity ↑ ($v = at$) ; acc. constant $9.8\ m/s^2$; distance ↑ each successive second.
27. What will the speed of an object be at the end of falling for 3.2 seconds? Neglect air resistance.
$V = at$ | $10\ m/s^2 \cdot 3.2\ s$ | $32\ m/s$

How far would that object fall?
$d = \frac{1}{2} a t^2$ | $\frac{1}{2}(10)(3.2)^2$ | $51.2\ m$

28. What condition must be met in order for an object to reach terminal velocity?
$W = AR$
29. A feather will fall through the air more slowly than a brick because of AR.
30. In the absence of air, a rock and a feather are dropped from the same height at the same time. Which will reach the ground first? Boom same time! Explain. All objects pulled @ $9.8\ m/s^2$.
31. A 10 kg bowling ball and a 15kg bowling ball are dropped from the same height at the same time. Which will reach terminal velocity first? 10 Kg Explain less W to equal AR
32. The force that causes you to ski down a hill is gravity.
33. The force of gravity on the moon is about 1/6 that on the Earth. Explain how your weight on the moon would differ from your weight on the Earth. would weigh less
Would your mass differ on the Earth and the moon? No, mass stays the same
34. The mass of a girl is 45 kilograms on Earth. What will her mass be on Pluto, where the acceleration due to gravity is ½ that of Earth? $W = mg$ 45 Kg. . mass is constant

35. Felicia, the ballet dancer, has a mass of 45.0 kg. What is Felicia's weight in Newton's on Earth?

$W = mg$ $45kg \cdot 9.8 m/s^2 =$ **441 N**

What is Felicia's mass on Jupiter, where the acceleration due to gravity is 25.0 m/s^2?

45 kg. Mass constant.

What is Felicia's weight on Jupiter?

$W = mg$ $45kg \cdot 25 m/s^2 =$ **1125N**

36. Gary the Golfer swings his club and accelerates his .08 kg golf ball at a rate of 13,250 m/s^2.

What is the force exerted by the golf club on the golf ball?

$F = ma$ $.08kg \cdot 13,250 m/s^2 =$ **1060N**

What is the force exerted by the golf ball on the golf club?

1060 N

What is the acceleration of the .78 kg club?

$a = \frac{F}{m}$ $1060N / .78 =$ **1358.97 m/s^2**

37. How much force is needed to accelerate a 50 kg object at a rate of 5 m/s/s?

$F = ma$ $50kg \cdot 5 m/s^2 =$ **250 N**

38. If 100 N of force is applied to an object to get it to accelerate 2 m/s/s, what is its mass?

$m = F/a$ $100N / 2 m/s^2 =$ **50 kg**

39. You push a friend on a sled. Your friend and the sled together have a mass of 70 kg. If the net force on the sled is 35 N, what is the acceleration?

$a = \frac{F}{m}$ $\frac{35N}{70kg} =$ **.5 m/s^2**

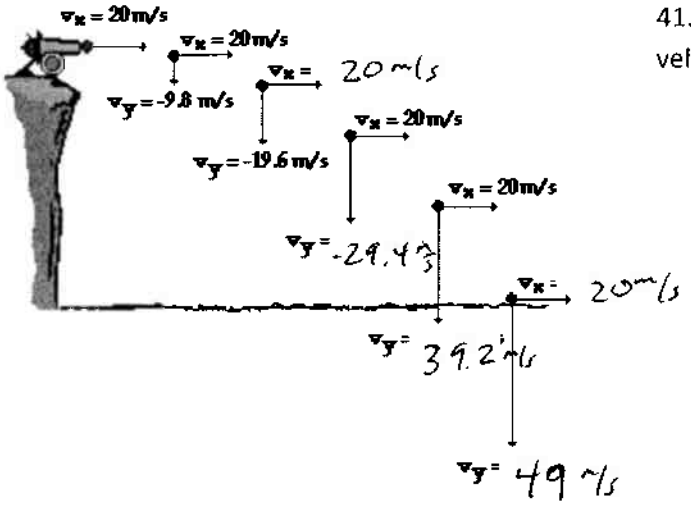
40. Dan runs off of the high dive with an initial horizontal velocity of 8.0 m/s. What is Dan's horizontal velocity after .75 seconds? 8 m/s. Horizontal vel. is constant.

What is Dan's vertical velocity after .75 seconds? $v = at$ $9.8 m/s^2 \cdot .75 =$ **7.35 m/s**

How far will Dan travel horizontally in 0.75 seconds? $d = v \cdot t$ $8 m/s \cdot .75 =$ **6m**

How far will Dan fall vertically in 0.75 seconds? $d = 1/2\, at^2$ $1/2(9.8)(.75)^2 =$ **2.76 m**

How long will it take Dan to reach the water, 10.0 meters below? $t = \sqrt{\frac{2 \cdot d_y}{g}}$ $\sqrt{\frac{2 \cdot 10}{9.8}} =$ **1.43 sec.**



41. Fill in the missing horizontal velocities and the vertical velocities in the diagram to the right.

$v = at$

42. A projectile is..... an object thrown into air/space only acted upon by gravity.

43. How are the horizontal and vertical components related to each in a projectile? independently

44. A high speed horizontal projectile is fired and a similar object is dropped from the same height:
Which one hits the ground first? BOOM SAME TIME!

How do their times in air compare? SAME

45. A ball at the top of its trajectory has:
a. V_y? 0
b. V_x? it's same original V_x
c. Acceleration? $9.8\ m/s^2$

46. Why does a projectile maintain a constant horizontal speed? No force acting on it

47. Find the resultant velocity of an airplane that has a velocity of 100 m/s north with an east wind of 20 m/s.

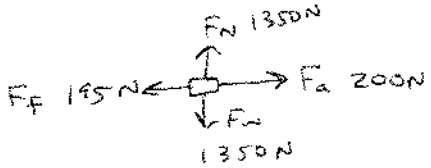
$a^2 + b^2 = c^2$
$100^2 + 20^2 = c^2$
$R = 102\ m/s$

42. A kicker has to make a field goal from 45 yards. Which angle will give him the greatest range? 45°

Which angle will give him the greatest height? 90°

43. Describe the difference between static friction and kinetic friction.
↳ rest ↳ moving

44. Rodney, the refrigerator repairman, pushes on a 135.0 kg refrigerator with a force of 200 N. The force of friction between the refrigerator and the floor is 195.0 N. Draw a free body diagram of the horizontal forces acting on the refrigerator.



Calculate the net force acting on the refrigerator.
$F_a - F_f = 200N - 195N = 5N$
What is the acceleration of the refrigerator?
$a = F_{net}/m \quad 5N/135\ kg = .04\ m/s^2$
What is the acceleration of the refrigerator he reduces his applied force to 195.0 N?
0

45. Sally, the secretary, is moving her 1130.0 N filing cabinet across the carpet in her new office. Suppose that the coefficient of kinetic friction for the filing cabinet is .41. Calculate the force of kinetic friction that opposes the motion of the filing cabinet as it is pushed across the carpet.

$F_f = \mu F_N \quad (41)(1130\ N) = 463.3\ N$
How much force must Sally exert to keep the filing cabinet moving at a constant velocity? 463.3 N

46. Define: Momentum – mass × velocity kg·m/s
Impulse – Δ momentum = $m\Delta v = F \cdot t$

47. Use the formula for impulse to explain why a boxer should "roll with the punches". $\Delta p = F \cdot t$ (↓ ↑)

48. How do you increase the impulse on hitting a golf ball? Reducing the force on catching a baseball.
$J = F \cdot t$ (↑ ↑)

49. How do you calculate the change in momentum?
$J = F \cdot t$ (− ↓ ↑)

$\Delta p = m\Delta v = F \cdot t$

50. What is the momentum of a 60 kg bowling ball rolling at 2 m/s? What force is needed to stop the ball in 3 sec?

$p = mv \quad 60 \cdot 2 = 120\ kg \cdot m/s \qquad \Delta p = F \cdot t \quad \frac{120}{3} = 40N$

51. Explain conservation of momentum of a rifle firing a bullet.

$p_b = p_a \qquad Mv = mV$

gun bullet

52. Rhonda, who has a mass of 60.0 kilograms, is riding at 25.0 m/s in her sports car when she must suddenly slam on the brakes to avoid hitting a dog crossing the road. She is wearing her seatbelt, which brings her body to a stop in .400 seconds.

What is Rhonda's momentum before she brakes?

$p = mv \quad 60kg \cdot 25\ m/s = 1500\ kg \cdot m/s$

What average force does the seatbelt exert to stop her body?

$\Delta p = F \cdot t \quad 1500\ kg\frac{m}{s} = F \cdot .4sec. \qquad F = 3,750N$

53. A .150 kg dart is fired with a velocity of 45.0 m/s at a 2.00 kg wooden block that rests on a frictionless table. The dart sticks to the wooden block and the two objects move forward across the table. What is the total momentum of the dart before the collision? $m_1v_1 + m_2v_2$

$(.15\ kg)(45\ m/s) + (2kg)(0) = 6.75\ kg \cdot m/s$

What is the velocity of the dart and block combination immediately after the collision?

$m_1v_1 + m_2v_2 = (m_1 + m_2)v'$

$6.75\ kg\ m/s = (2.15\ kg)v' \qquad v' = 3.14\ m/s$

54. Tubby and his twin brother Chubby have a combined mass of 200.0 kg and are zooming along in a 100.0 kg amusement park bumper car at 10.0 m/s. They bump Melinda's car, which is sitting at rest. Melinda has a mass of 25.0 kg, and her car also has a mass of 100.0 kg. After the collision, the twins continue ahead with a speed of 4.12 m/s.

What is the momentum of Tubby and Chubby before the collision?

$m_1v_1 + m_2v_2$

$(300\ kg)(10\ m/s) + (125kg)0 = 3000\ kg \cdot m/s$

What is the momentum of Tubby and Chubby after the collision? How fast is Melinda bumped across the floor?

$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$

$3000\ kg \cdot m/s = (300)(4.12) + (125\ kg)v_2'$

1236

$v_2' = 14\ m/s$

52. Define: Work – $F \cdot d$ (J)

Power – W/t (W)

Energy – ability to do work (J)

53. A 150kg student and a 200kg student walk up the stairs side by side. Describe the work and power of the two students.

150 kg vs. 200 kg

↑ work & power

$F \cdot d$

↑

53. Atlas and Hercules are two carnival sideshow strong men. In tonight's performance, Atlas lifted a 200.0 kg barbell 2.00 m off the ground in 1.00 s, while Hercules lifted a 400.0 kg barbell 1.00 m off the ground in 3.00 s (Assume that these lifts were performed at a constant velocity). Calculate the force exerted by each strongman. Atlas – $F = mg$

$2000\,N$ $(200)(10)$

Hercules – $F = mg$

$4000\,N$ $= 400 \cdot 10$

Calculate the work done by each strongman.

Atlas $W = F \cdot d$

$= 2000N \cdot 2$

$4000\,J$

Hercules $W = F \cdot d$

$= 4000N \cdot 1\,m$

$4000\,J$

Calculate the power generated by each strongman.

Atlas $P = W/t$

$4000\,W = 4000/1$

Hercules $P = W/t$

$4000J/3 = 1333.3\,W$

55. Decide whether each of the following examples involve work (W) or no work (NW).

NW a. A person pushing against a stationary wall

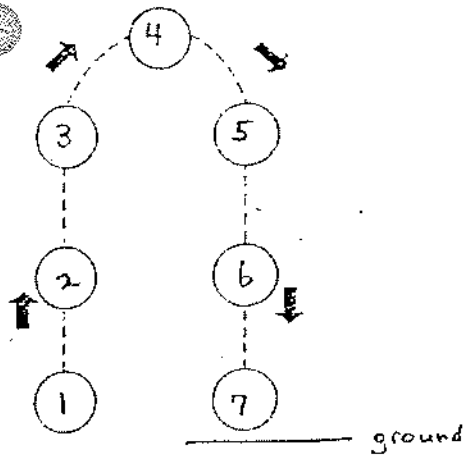
W b. A person pushing a door closed

W c. A person pushing a lawn mower and cutting grass

NW d. A person carrying a bag of groceries to the car

NW e. A person holding a large weigh above their head

Use the figure below, which shows an object bouncing, to answer questions #56-60.



56. Which number(s) represent maximum PE? 4

57. Which number(s) represent maximum KE? 1, 7

58. As the ball goes up towards its maximum height, what is happening to its kinetic energy? ↓

59. What is happening to its potential energy? ↑

60. Does g, acceleration due to gravity, change at any points? no, constant

Explain. _____

61. What would be the gravitational potential energy of a 25,000 N boulder if it was 100 meters above Earth's surface?

$PE = mgh$ $25{,}000N \cdot 100m = 2{,}500{,}000J$

62. A 7.0 kg bowling ball is moving down a bowling lane with a velocity of 5.0 m/s. What is the kinetic energy of the bowling ball?

$KE = \frac{1}{2}mv^2$ $= \frac{1}{2}(7)(5)^2$

$KE = 87.5\,J$

63. A 15 kg ball is released at the top of a frictionless incline that is 10m high. What is the potential energy at the top of the incline? $PE = mgh$ $15\,kg \cdot 10\,m/s^2 \cdot 10\,m = 1500\,J$

Calculate the work done to elevate the ball to the top of the ramp?

1500 J $W = E$

What is the ball's velocity at the bottom of the hill?

$PE_{top} = KE_{Bot}$ $1500 = \frac{1}{2}(15)v^2$ $v = 14.14\,m/s$

64. A 2.5 kg cart rolls across the floor at a velocity of 7.0 m/s. The force of friction slowing the cart is 12.0 N. Calculate the initial kinetic energy of the cart.

$KE = \frac{1}{2}mv^2 = \frac{1}{2}(2.5)(7)^2 = 61.25\,J$

How much work must be done on the cart by friction in order to bring the cart to a stop?

$PE_1 + KE_1 + W = PE_2 + KE_2$

$0 + 61.25J + W = 0 + 0$ $W = -61.25J$

Calculate the distance traveled by the cart until it comes to a stop.

$W = F \cdot d$ $61.25J = 12N \cdot d$ $d = 5.1m$

65. As a swinging pendulum moves from the highest point to the lowest point, what happens to its potential energy? ↓ Kinetic energy? ↑

66. Which has a greater kinetic energy...a bowling ball moving at 5 m/s or a half-massive bowling ball moving at 10 m/s.

$KE = \frac{1}{2}mv^2$

$100\,J = \frac{1}{2}(1)(10^2)$ vs. $25\,J = \frac{1}{2}(2)(5)^2$