Final Exam | Unit 1A – Chapter 2 (Horizontal Speed and Acceleration)

[2.1.A.b] Analyze the velocities for two objects in terms of distance and time (verbally and mathematically).

[2.1.B.a] Measure and analyze an object's motion in terms of speed, velocity and acceleration.

key

Pages 10 – 24 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Define the following terms:

1. Acceleration (2.4) $a = \frac{\Delta v}{t}$
2. Average speed (2.2) $\frac{v_1 + v_2}{2}$
3. Instantaneous speed (2.2)
4. Speed (2.2) $\frac{d}{t}$
5. Velocity (2.3) $\frac{d}{t}$ + direction

Answer the following questions:

1. What is meant when it is said that "motion is relative"?

   all motion is measured compared to something else usually the earth

2. What is the difference between instantaneous and average speed?

   instantaneous is a moment in time

   avg is over a time period

3. What is the difference between speed and velocity?

   same but velocity includes directions

4. If a car travels at a constant speed of 40 km/h, can you say the car has a constant velocity? Why?

   no, it may be going in circles

5. What two controls in a car causes a change in speed? What control causes a change in velocity?

   brake pedal, gas pedal steering wheel

6. Calculate the average speed of a cheetah that runs 150 meters in 5 seconds.

   $s = \frac{d}{t}$ $\frac{150}{5} = 30 m/s$

7. Calculate the acceleration of a car that goes from rest to 100 km/h in 10 seconds.

   $a = \frac{\Delta v}{t}$ $\frac{100 - 0}{10} = 10 km/h/s$

Final Exam | **Unit 1A – Chapter 2 (Horizontal Speed and Acceleration)**

[2.1.A.b] Analyze the velocities for two objects in terms of distance and time (verbally and mathematically).

[2.1.B.a] Measure and analyze an object's motion in terms of speed, velocity and acceleration.

8. Calculate the speed of a skateboarder who accelerates from rest for 3 seconds down a ramp at 5 m/s^2.

$v = at$ $\quad 5 \cdot 3 = 15\ m/s$ down

9. If humans originated in Africa and migrated at a rate of 1 kilometer per year, how long would it take to migrate to a location 10,000 km away?

$10{,}000\ km / 1\ yr = 10000$ years

10. A dragster going at 15 m/s increases its velocity to 25 m/s in 4 seconds. What is the car's acceleration?

$a = \frac{\Delta v}{t}$ $\quad \frac{25-15}{4}$ $\quad \frac{10}{4} = 2.5\ m/s^2$

11. A car going at 30 m/s accelerates 2 m/s2 for 4 seconds. What is the car's final speed?

$2 = \frac{x-30}{4}$ $\quad 8 = x - 30$ $\quad 38\ m/s$

12. We drive for 1 hour at 20 km/h. Then we drive for 1 hour at 30 km/h. What is our average speed?

$20\ km + 30\ km = \frac{50\ km}{2\ hrs} = 25\ km/h$

13. We drive a distance of 1 kilometer at 20 km/h. Then we drive an additional 1 kilometer at 30 km/h. What is our average speed?

$20 = \frac{1}{t} = \frac{1}{20}\ h$ $\quad .05\ h$

$30 = \frac{1}{t} = \frac{1}{30}\ h$ $\quad .03\ h$

$.03 + .05 = .08\ h$

$\frac{2}{.08} = 25\ km/h$

14. Why is it that an object can accelerate while traveling at a constant speed but not at a constant velocity?

turning

Key

Final Exam | Unit 1B – Chapter 2 and 3 (Vertical Motion + Projectiles)

[2.2.B.a] Describe gravity as an attractive force among all objects.
[2.2.B.b] Recognize all free falling bodies accelerate at the same rate due to gravity regardless of their mass.
[2.2.E.c] Predict the path of an object when the net force changes.

Chapter 2: Pages 10 – 24 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*
Chapter 3: Pages 28 – 39 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Define the following terms:

1. Free Fall (2.5) any object in flight with no force other than gravity acting on it.
2. ~~Projectile~~ (3.4) any object falling vertical
3. Resultant (3.2) result of adding 2 vectors
4. Scalar quantity (3.1) # description Ex: Speed
5. Vector quantity (3.1) #description with direction Ex: velocity

Answer the following questions:

1. What is the instantaneous speed of a freely falling object at the end of 5 seconds of fall?

$v = gt$ $10 \cdot 5 = 50 m/s$

2. What is the acceleration of a freely falling object at the end of 5 seconds of fall?

$a = g$ $g = 10 m/s^2$

3. What is the distance fallen for a freely falling object at the end of 5 seconds of fall?

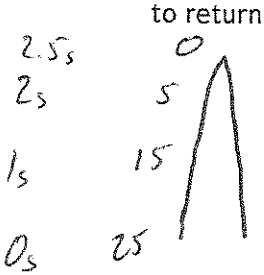
$d = .5gt^2$ $.5 \cdot 10 \cdot 5^2 \Rightarrow 5 \cdot 25 \Rightarrow 125 m$

4. An object is dropped off a cliff on a planet that has double Earth gravity. What is the instantaneous speed, acceleration and distance fallen for the freely falling object at the end of 5 seconds?

$g \cdot 2 = 20 m/s^2$ $v = gt$ $d = .5gt^2$ $20(5) = 100 m/s$ down $d = .5(20)(5^2)$

$a = g$ $g = 20$ $10(25) = 250 m$

5. A ball is thrown straight up at 25 m/s. How long will it take to reach zero speed? How long will it take to return to the starting point? How fast will it be going when it returns?



2.5s for $v = \emptyset$

$2.5 \times 2 = 5$ sec

$25 \uparrow = \downarrow 25 m/s$

Final Exam | **Unit 1B – Chapter 2 and 3 (Vertical Motion + Projectiles)**

[2.2.B.a] Describe gravity as an attractive force among all objects.
[2.2.B.b] Recognize all free falling bodies accelerate at the same rate due to gravity regardless of their mass.
[2.2.E.c] Predict the path of an object when the net force changes.

6. How does a vector quantity differ from a scalar quantity?

Vector includes direction

7. If a vector is 1 cm long and represents 10 km/h, what velocity does a 2 cm line represent?

$1cm = 10km/h \approx 2cm = 20km/h$

8. If a cannonball is launched horizontally at the same time another cannonball is dropped off a cliff, which cannonball will hit the ground first? Explain why...

Same time, gravity pulls both down equally

9. Calculate the resultant velocity of an airplane that flies at 200 km/h and encounters a 50 km/h tailwind. Calculate the resultant velocity of the airplane if the tailwind became a headwind.

200 → + 50 → = 250 km/h 200 → + 50 ← = 150 km/h

10. A cannonball is launched horizontally off a 25 meter cliff at a speed of 37.2 m/s. Calculate the distance that cannonball traveled.

37.2 →

25

$d = .5gt^2$ $25 = .5(10)t^2$ $37.2 = \frac{d}{2.24}$

$v = \frac{d}{t}$ $25 = 5t^2$

$5 = t^2$ $t = 2.24 sec$ $83.33m = d$

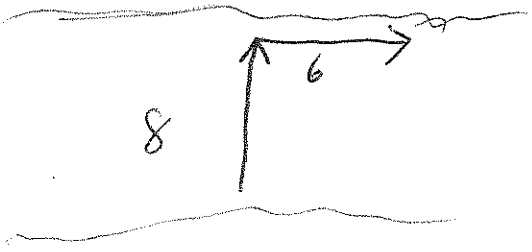
11. A cannonball is launched horizontally off a 75 meter cliff over a distance of 143 meters. Calculate the launch speed of the cannonball.

75

$d = .5gt^2$ $75 = 5t^2$ $\frac{143}{3.87} = 36.95 m/s$

$v = \frac{d}{t}$ $15 = t^2$ $3.87 = t$

12. A boat is rowed at 8 km/h directly across a river that flows at 6 km/h. What is the resultant speed of the boat?



$8^2 + 6^2 = r^2$

$64 + 36 = r^2$

$100 = r^2$

$10 = r$

10 km/h

Final Exam | Unit 2A – Chapters 4, 5 and 6 (Newton's Laws of Motion)

[2.2.D.a] Recognize that inertia is a property of matter that can be described as an object's tendency to resist a change in motion and is dependent upon the object's mass.

[2.2.D.b] Determine the effect of the sum of the forces acting on an object.

[2.2.D.c] Using information about net force and mass, determine the effect of acceleration.

[2.2.D.e] Analyze force pairs when given a scenario and describe their magnitudes and directions.

Chapter 4: Pages 43 – 55 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Chapter 5: Pages 59 – 70 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Chapter 6: Pages 74 – 82 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Define the following terms:

1. Force (4.3) any push or pull
2. Inertia (4.3) resistance to change ← names are interchangeable
3. Mass (4.5) how much material in an object
4. Action force (6.2) initial force in time
5. Reaction force (6.2) responding/second force in time

Answer the following questions:

1. Does the Law of Inertia apply to moving objects, objects at rest, or both? Explain your answer...
   yes - they continue to move
   yes - they continue to not move ≈ Both
2. Does a 2-kg rock have twice the mass of a 1-kg rock? Twice the inertia? Twice the weight?
   yes, yes, no - due to gravity
3. Does a liter of molten lead have the same volume as a liter of apple juice? Same mass?
   yes, no
4. What is the net force on an object if there is a 10-N and 15-N force pushing in the same direction?
   10N → + 15N → = 25N →
5. What is the weight of 2-kg of yogurt? (Both Newtons and pounds)
   1kg = 2.2lbs 2·2.2 = 4.4lbs
   g = 10 2·10 = 20N
6. A cart is being pushed with a certain force. If the force is doubled, how does the acceleration change?
   F=ma
   Doubles Ex: 2 = 2a ⇒ a = 1m/s²
   4 = 2a ⇒ a = 2m/s²

Final Exam | **Unit 2A – Chapters 4, 5 and 6 (Newton's Laws of Motion)**

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[2.2.D.c] Using information about net force and mass, determine the effect of acceleration.

[2.2.D.e] Analyze force pairs when given a scenario and describe their magnitudes and directions.

7. A cart is being pushed with a certain force. If the mass is doubled, how does the acceleration change?

   ½ original

8. How much force does a 20,000-kg rocket develop to accelerate 1 m/s^2?

   $F=ma \qquad 20{,}000(1) = 20{,}000\,N$

9. Calculate the acceleration of a 2-kg block being pushed with a 20-N force.

   $F=ma \qquad 20=2a \qquad 20/2 = 10\,m/s^2$

10. Calculate the acceleration of a 2-kg block being pushed with a 20-N force which encounters a 4-N friction force.

    $20N \rightarrow + 4N \leftarrow = 16N \rightarrow \qquad 16=2a \qquad \frac{16}{2}=8\,m/s^2$

11. When a hammer exerts a force on a nail, how does the amount of force compare with that of the nail on the hammer?

    same

12. If the action force is a bow string acting on an arrow, what is the reaction force?

    arrow pushes on string

13. If you hit a wall with a force of 200-N, how much force is exerted back on you?

    200N

14. Your weight is the result of the gravitational force of Earth on your body. What is the corresponding reaction force?

    my gravity pulling up on earth

15. Why is it easier to walk on a carpeted floor than on a smooth, polished floor?

    Friction from carpet allows equal + opposite to happen

Final Exam | Unit 2B – Chapters 7 and 8 (Momentum + Energy)

[2.1.C.a] Compare the momentum of two objects in terms of mass and velocity.
[2.2.C.b] Explain that the total momentum remains constant within a system.
[1.2.B.a,b,c,d] Mechanical energy comes from motion and/or relative position of an object.

Chapter 7: Pages 86 – 99 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*
Chapter 8: Pages 103 – 118 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Define the following terms:

1. Momentum (7.1) $m \cdot v$
2. Impulse (7.2) $\frac{F}{t}$
3. Work (8.1) $F \cdot d$
4. Energy (8.3) KE = Energy $.5mv^2$ when moving PE = Energy of position mgh
5. Power (8.2) $\frac{w}{t}$

Answer the following questions:

1. Which one has more mass: A rolling skateboard or a dump truck at rest? Explain...

   Dump truck - made of more stuff

2. Which one has more momentum: A rolling skateboard or a dump truck at rest? Explain...

   skateboard $m \cdot v$ = #some number

   $m \cdot 0 = 0$ ← Truck

3. What is the momentum of an 8-kg bowling ball rolling at 2 m/s?

   $8 \cdot 2 = 16$ kg·m/s

4. What is the momentum of a 50-kg carton that slides across an icy surface at 4 m/s?

   $50 \cdot 4 = 200$ kg·m/s

5. A 2-kg blob of clay moving at 3 m/s slams into a 2-kg blob of clay at rest. Calculate the resulting speed.

   $2 \cdot 3 = 6$ $6 + 0 = 6$ $m_B = m_a$ $2 + 2 = 4$

   $2 \cdot 0 = 0$ m_B $m = mv$ $6 = 4v$ $v = 1.5$ m/s

6. In terms of impulse and momentum, why are air bags in automobiles a good idea?

   increases time of impact.

   Less force per unit of time

Final Exam | Unit 2B – Chapters 7 and 8 (Momentum + Energy)

[2.1.C.a] Compare the momentum of two objects in terms of mass and velocity.
[2.2.C.b] Explain that the total momentum remains constant within a system.
[1.2.B.a,b,c,d] Mechanical energy comes from motion and/or relative position of an object.

7. Which requires more work: Lifting a 10-kg barbell 2 meters or a 5-kg barbell 4 meters? Explain...

F·d $10 \cdot 10 \cdot 2 = 200$ J

$5 \cdot 10 \cdot 4 = 200$ J Same

8. How much power is necessary to do 100 J of work on an object in 0.5 seconds? 1 second?

$P = \frac{W}{t}$ $\frac{100}{.5} = 200$ watts $\frac{100}{1} = 100$ watts

9. Suppose an automobile has 2000 J of kinetic energy. When it moves twice the speed, what will be its kinetic energy? Three times the speed?

$KE = .5mv^2$ 4x's ≈ 8000 J ← v=2

9x's $= 18000$ J ← v=3

10. Calculate the kinetic energy of a 3-kg toy cart that moves at 4 m/s. Double its speed and recalculate.

$KE = .5(3)(4^2) \Rightarrow .5(3)(16) = 24$ J

$.5\ 3\ (8^4) = 96$ J

11. Calculate the potential energy of 8 million kilograms of water dropping 50 meters over Niagara Falls.

$PE = mgh$ 8million (10)(50) = 4000000000 J

12. If an elephant and a mouse run with the same amount of kinetic energy, which animal is running faster? Explain in terms of the equation for kinetic energy.

mouse, it has less mass so it needs more speed to make up for it.

13. State two reasons why a rock projected by a sling shot will go faster if the rubber is stretched an extra distance.

more contact time with sling

pull further back stores more energy

14. Does an object with momentum always have energy? Explain...

yes, its moving (KE)

15. Does an object with energy always have momentum? Explain...

no, could be PE and just above the ground

Final Exam | Unit 3 – Chapters 9, 12, and 36 (Circular Motion + Gravity + Magnetism)

[2.2.E.a] Describe the force(s) that keep an object traveling in a circular path.
[2.2.B.b] Compare and describe the gravitational forces between two objects in terms of mass and distance.
[2.2.C.a] Recognize changing magnetic fields can produce electrical current and vice versa.

Chapter 9: Pages 122 – 132 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*
Chapter 12: Pages 168 – 179 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*
Chapter 36: Pages 562 – 574 *TEXTBOOK (Conceptual Physics; Paul G. Hewitt)*

Define the following terms:

1. Rotation (9.1) spin on internal axis (earth spin)
2. Revolution (9.1) move around external axis (moon orbits)
3. Centripetal force (9.3) Force acting toward center of spinning object
4. Centrifugal force (9.4) apparent force when spinning (not real)
5. Magnetic field (36.2) Area of force surrounding a magnet

Answer the following questions:

1. Does a child on a merry-go-round revolve or rotate around the axis of the ride?

   revolve

2. At a given distance from the axis, how does linear speed change as rotational speed changes?

   increases as you move/spin faster

3. Which state in the United States has the greatest linear speed as Earth rotates around its axis?

   Florida

4. Explain why the faster Earth spins, the less a person weighs whereas the faster a space station spins, the more a person weighs. nothing holds you on earth other than gravity

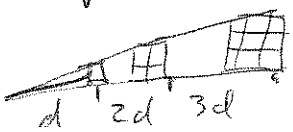
   in space you push harder on outside

5. What would be the difference in your weight if you were five times farther from the center of Earth than you are now? Ten times farther?

   5 x's $= 5^{-2} = 25$ x's less $10^2 = 100$ x's less

6. Explain the Inverse Square Law.

   as you move out same force spread over greater area,



Final Exam | Unit 3 – Chapters 9, 12, and 36 (Circular Motion + Gravity + Magnetism)

[2.2.E.a] Describe the force(s) that keep an object traveling in a circular path.
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[2.2.C.a] Recognize changing magnetic fields can produce electrical current and vice versa.

$G = 6.67 \times 10^{-11}$

7. Calculate the force of gravity on a newborn baby (mass = 4-kg) and the planet Mars (mass = 6.4×10^{23} kg) when Mars is at its closest to Earth (distance = 8.0×10^{10} m).

$F = G\frac{m_1 \cdot m_2}{d^2}$

$F = G\frac{4 \cdot 6.4 \times 10^{23}}{(8 \times 10^{10})^2} = G\frac{2.56 \times 10^{24}}{6.4 \times 10^{21}} = G \cdot 400 = 2.668 \times 10^{-8}\ N$

8. Calculate the force of gravity on a newborn baby (mass = 4-kg) and the doctor delivering the baby (mass = 75-kg) who is 0.3 meters away during delivery.

$\frac{4.75}{.3^2} = G\frac{300}{.09} = G \cdot 3333 = 2.22 \times 10^{-7}\ N$

9. Referring to Problems 6 and 7, which object has a greater force on the baby:. the doctor or Mars? Explain...

Doctor, He is closer

10. Jupiter is about 300 times as massive as Earth but an object on its surface would weigh only 2.5 times as much as it would on Earth. Explain...(hint: think about mass and distance)

The planet is so large, on the surface you are long way from center

11. What is a magnetic field and what is its source?

Area of force surrounding magnets, electrons spinning/moving

12. What is a magnetic domain?

large number of electrons aligned in a substance

13. If a current-carrying wire is bent into a loop, why is the magnetic field stronger inside the loop than outside?

they are closer together

14. What kind of field surrounds a stationary electric charge? A moving electric charge?

electric magnetic

15. Why will the magnetic field strength be further increased inside a current-carrying coil if a piece of iron is placed in that coil?

the iron electrons will align to match and add to the mag field.