Forces, Motion & Energy Textbook
Chapter 2.2 Text Notes
Pages 43 – 51

VOCABULARY page 11

Term	Definition
Force (review from chapter 1.2)	
Inertia	
Momentum	

TEXT NOTES pages 43-47

NEWTON'S LAWS OF MOTION

In _____ (6618), _____ (saaci) _____ (etwnno) published his book _____ (ppriiinca) in which he described his _____ (hrtee) laws of that relate _____ (rcofe) and _____ (tnmooi). These laws are commonly known as _____ (etwnons) laws of _____ (tnmoio).

Newton's First Law of Motion

Newton's _____ (rstif) law of motion states:

> An object at _____ (esrt) remains at _____ (stre).
> An object in _____ (timnoo) remains in _____ (mtooin) at _____ (cnsttao) _____ (pdees) and travels in a _____ (trghtsai) _____ (neil), _____ (lssune) it is acted upon by an _____ (blncunaade) _____ (rcoef)

Part 1: Objects at Rest

Objects at _____ (esrt) will _____ (emainr) at _____ (rste). This means that objects that are _____ (nto) _____ (mvingo) will _____ (nto) start _____ (mvngio) unless an _____ (nubalncead) _____ (suhp) or a _____ (llpu) is exerted on them.

Draw 2 objects at rest that illustrate Newton's first law and receive no force at all or receive 2 balanced forces so net force is zero

Part 2: Objects in Motion

Objects in _____ (mtoino) will continue to _____ (mvoe) _____ (rvofree) in _____ (emsa) _____ (edpes) and _____ (smea) _____ (niodtirce) unless acted upon by an _____ (blncdnuaae) _____ (suhp) or a _____ (llup).

Draw 2 objects in motion that illustrate Newton's first law

Friction and Newton's First Law

Objects in real life do ____ (ton) move _____ (refrove) when _____ (suhdep) because a _____ (rceof) _____ (esirsts) _____ (vmeomnte). This _____ (ecrof) that _____ (esitsr) _____ (notmio) is called _____ (rtficoni). _____ (ricfiont) occurs because every _____ (sfcearu) has microscopic _____ (lishl) and _____ (leyvals) that _____ (tcksi) together.

Draw 2 examples that illustrate friction slowing down an object in movement

Draw 2 examples of objects in movement in world without any friction

Inertia is Related to Mass

_____ (ntreiia) is the _____ (endcyent) of objects to _____ (tsires) change in their _____ (nitomo) or _____ (tesr). Newton's _____ (irsft) _____ (wal) is sometimes called the _____ (wal) of _____ (itreni).

Mass is a Measure of Inertia

The amount of _____ (intiaer) is related to amount of _____ (sams) of the object. _____ (reggib) mass objects have _____ (ermo) _____ (terniiat) and are _____ (rerdha) to _____ (sttra) or _____ (post) moving. In chapter 1.3, this concept was called _____ (tatsci) _____ (rctinoif).

_____ (mllsare) mass objects will have _____ (sesl) _____ (nitreia) and are _____ (sireea) to _____ (strat) or _____ (tpso) moving.

Draw 2 objects with **HIGH** inertia and are *hard* to start moving or change movement

Draw 2 objects with **LOW** inertia and are *easy* to start moving or change movement

Newton's Second Law of Motion

The _____ (ccaniotelrea) of an object depends on the _____ (ssma) of the object and the amount of _____ (orcfe) applied.

Part 1: Acceleration Depends on Mass
For same force applied:

As _____ (sams) _____ (ncreseais), the _____ (celcaretoni) _____ (ecdecearses)

As _____ (sams) _____ (crdeeasse), the _____ (celcaretoni) _____ (ncreseais)

Draw 2 examples of relationship of acceleration & mass

Part 2: Acceleration Depends on Force
For same force applied:

As _____ (rfoce) _____ (ncreseais), the _____ (celcaretoni) _____ (ncreseais)

As _____ (orcfe) _____ (ecdecearses), the _____ (celcaretoni) _____ (ecdecearses)

Draw 2 examples of relationship of acceleration and force

Expressing Newton's Second Law Mathematically
Newton's _____ (ecodns) _____ (wla) is expressed mathematically as:

F = m * a	a = F / m	m = F / a
With:		
A = _____	F = _____	M = _____
Units = _____	Units = _____	Units = _____

The acceleration due to _____ (rvtygai) is 9.8 m/s^2

Solve the following word problems using the {f = m / a} formula:

1. A skater with a mass of 50 kg pushes off from a wall with a force of 200 N. What is the skater's acceleration?

   Given: Unknown:
   Formula:

   Solve: (show your work)

   Answer: _____ (don't forget units)

2. Calculate the total force pulling down on your backpack and books due to **acceleration due to gravity**. Your backpack has a mass of 0.5 kg and has a history book (2 kg), a science book (1.25 kg), a notebook (0.25 kg), folder with hw papers (0.75 kg) and an English novel (0.5 kg) inside.

   Given: Unknown:
   Formula:

   Solve: (show your work)

   Answer: _____ (don't forget units)

3. What is the force necessary to accelerate a race car with a mass of 1,125 kg with a driver having a mass of 125 kg at a rate of 40 m/s^2?

   Given: Unknown:
   Formula:

   Solve: (show your work)

   Answer: _____ (don't forget units)

4. What is the acceleration of a container having a mass of 4 kg with hair care products having a mass of 3 kg that fall out of the back of a truck moving on highway and lands with a force of 68.6 Newtons.

   Given: Unknown:
   Formula:

   Solve: (show your work)

Answer: _____ (don't forget units)

5. What is the mass of a shopping cart and groceries if a force of 20 Newtons is required by yourself and 14 Newtons by your friend to move the cart with an acceleration of 4 m/s^2?

Given: Unknown:
Formula:

Solve: (show your work)

Answer: _____ (don't forget units)

SECTION REVIEW QUESTIONS page 47

1. How is inertia related to Newton's first law of motion?

2. Name or draw two ways to increase the acceleration of an object? (hint – think of f = m*a)

Name or draw two ways to decrease the acceleration of an object? (hint – think of f = m*a)

3. If the acceleration due to gravity were suddenly doubled from 9.8 m/s2 to 19.6 m/s2, what would happen to your weight? (Hint – your weight is the force calculated by using your mass in Kg {multiply your mass in pounds by 0.45 to convert to kilograms) multiplied by acceleration due to gravity).

Mass in kilograms (multiply mass in pounds by 0.45)	Acceleration due to gravity	F = m * a	Resulting force (Newtons)
	Standard (9.8 m/s2)		
	Doubled (9.8 m/s2)		

TEXT NOTES pages 48-51
Newton's Third Law of Motion

Whenever one object exerts a _____ (ercof) on a second object, the second object exerts an _____ (luaqe) and _____ (ppstooie) _____ (ecfro) on the first object.

This ____ (wla) is commonly involves _____ (ctniao)-_____ (ctrnioea) _____ (ofrce)- _____ (sraip).

Draw figure 17 below and include captions

Force Pairs Do Not Act on the Same Object

_____ (aincto)-_____ (erctnaio) _____ (rceof)- _____ (srpai)

- Are always _____ (eqlua) & _____ (psptooei)
- May cause a change in _____ (mtnooi) or may remain at _____ (stre) – especially if one object is much _____ (ggbrie) than other object
- Act on _____ (prais) of objects, not on _____ (smea) object

The Effect of a Reaction Can be Difficult to See

The _____ (arthes) _____ (rvgytai) causes _____ (cainto)-_____ (ercatino) _____ (rcefo)- _____ (parsi), but the _____ (heart) will ____ (ton) move because it is so much _____ (grbige) than the other object.

More Examples of Action and Reaction Force Pairs

Draw 6 action-reaction force pairs

Momentum is a Property of Moving Objects

_____ (mmmntoeu) is a property of _____ (mgnvio) objects that depends on object's _____ (ssma) and _____ (vlcityeo). The _____ (rmoe) _____ (mmnmoetu) the object has, the _____ (rdarhe) it is to _____ (tops) or change its _____ (mntioo).

Mass

- As _____ (ssma) ⇑ , the _____ (mmntmoeu) ⇑
- As _____ (mssa) ⇓, the _____ (momunetm) ⇓

Draw 2 examples of relationship mass & momentum

Velocity

- As _____ (vcityeol) ⇑ , the _____ (memuontm) ⇑
- As _____ (vceitoyl) ⇓ , the _____ (omemuntm) ⇓

Draw 2 examples of relationship velocity & momentum

Momentum is Conserved

____ (wal) of _____ (cnsvatniooe) of _____ (mnmtmoeu) – when 2 objects _____ (lidleoc), _____ (mose) or _____ (lal) of the _____ (mommutne) is _____ (trnsfrrdaee). The _____ (ttloa) amount of _____ (mutnemom) is _____ (lwaays) the _____ (ames).

Draw 4 examples of law of conservation of momentum below

Conservation of Momentum and Newton's Third Law

Because the _____ (ctaoin) and _____ (ractneoi) forces are _____ (uaqel) and _____ (popoteis), _____ (monemmut) is _____ (nsrvdcoee).

SECTION REVIEW QUESTIONS page 51

1. Name 4 action and reaction force pairs involved in doing your homework. Name what objects are exerting the forces and what objects are receiving the forces.

2. Which has more momentum, a mouse running at 1 m/s north or an elephant walking 3 m/s east? Explain & draw your answer.

3. When a tuck pulls a trailer, the trailer and truck accelerate forward even though the truck and trailer experience friction in opposite direction of truck's movement. Why don't these forces balance each other out? (Hint: the tuck is exerting a force on the trailer to pull it, and the trailer experiences friction – draw these forces in a drawing below).

4. Draw or explain 4 ways that Newton's laws relate to your favorite sport or hobby.

Newton's _____ law	Newton's _____ law
Newton's _____ law	Newton's _____ law