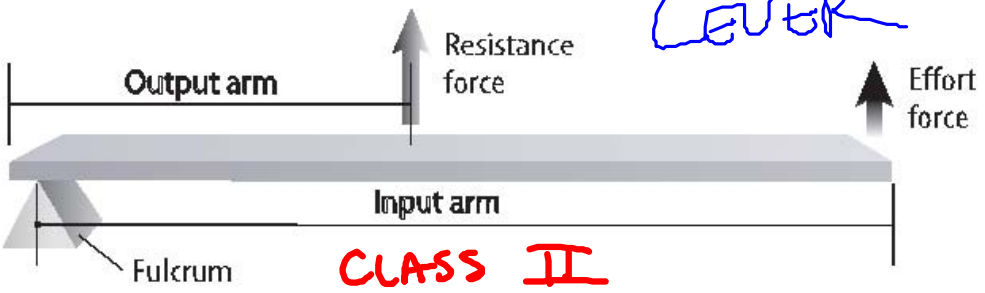
Name Date Class

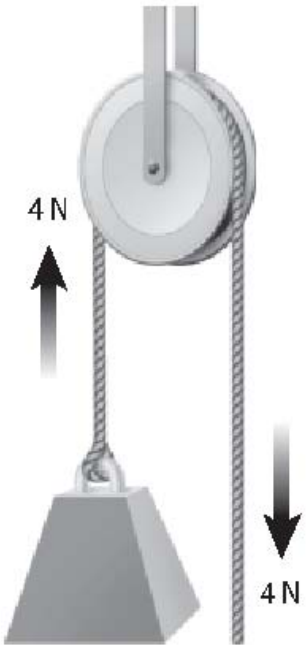
SECTION 3 Teaching Transparency Activity

Simple Machines

LEVER

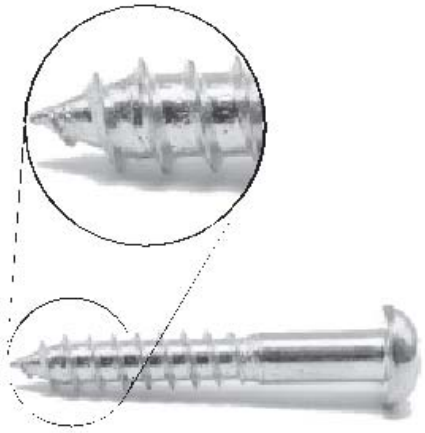


CLASS II



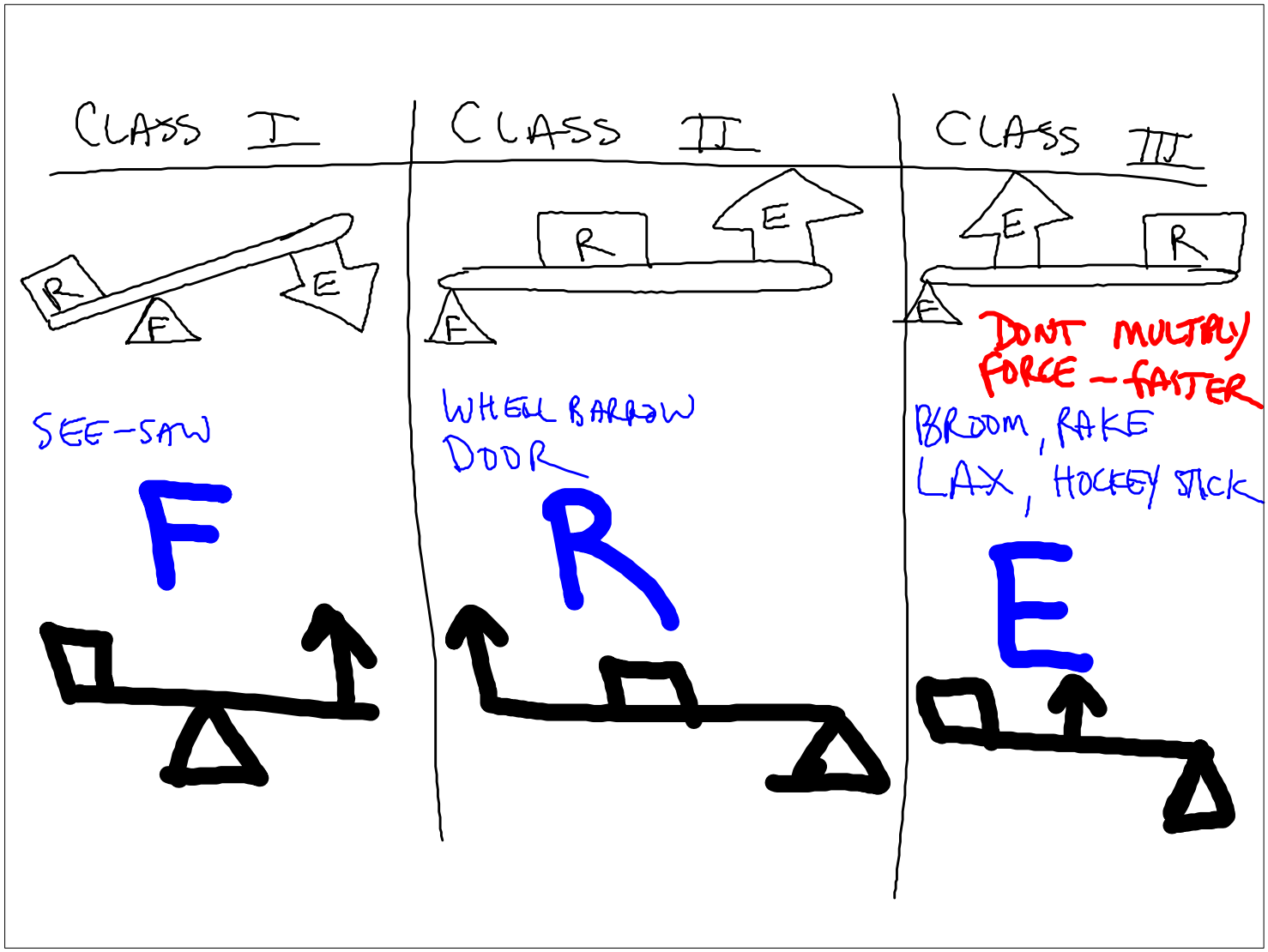
FIXED PULLEY

KNIFE (WEDGE)



SCREW

Transparency Activities


CLASS I
CLASS II
CLASS III
R
E
F
R
E
F
E
R
F
DONT MULTIPLY FORCE - FASTER
SEE-SAW
WHEEL BARROW
DOOR
BROOM, RAKE
LAX, HOCKEY STICK
F
R
E

Name Date Class

Teaching Transparency Activity (continued)

1. What is a simple machine?

DEVICE THAT MAKES WORK SEEM EASIER WITH ONE MOVEMENT

2. List the six types of simple machines.

LEVER, PULLEY, WHEEL-N-AXLE
INCLINED PLANE, WEDGE, SCREW

3. What is a compound machine?

COMBINATION OF 2 OR MORE SIMPLE MACHINES

4. On the transparency, which two simple machines are forms of the inclined plane.

SCREW, WEDGE (KNIFE)

5. Is the lever on the transparency a first-class, second-class, or third-class lever?

CLASS II

6. What type of lever cannot multiply force?

CLASS III

7. What kind of pulley is illustrated on the transparency? Does it multiply force?

FIXED PULLEY, NO

NAME_____ DATE_____ CLASS_____

STUDY GUIDE Chapter 5

The Simple Machines

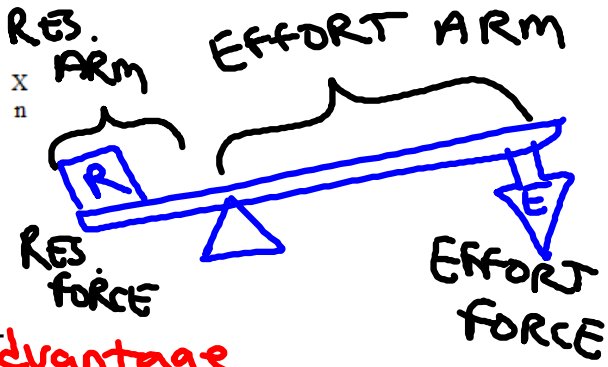
Short crypts are lists of related words written in a simple code in which a different set of letters has been substituted for the correct letters. The title of each list will give you a hint as to the subject of the list. Remember, the same code is used for the entire list. For example, if c stands for k in one word, c will stand for k in every word on the list. Each list has its own code.

Code

A	C	D	E	F	G	I	J	K	L	N	O	R	T	U	W	X
e	r	h	i	c	l	o	s	m	v	d	u	t	g	a	f	n

Prying into Things

1. GALAC lever
2. WOGFCOK fulcrum
3. AWWICR UCK effort arm
4. CAJEJRUXFA UCK resistance arm
5. KAFDUXEFUG UNLUXRUTA mechanical advantage
6. NECAFREIX direction
7. FGUJJ class

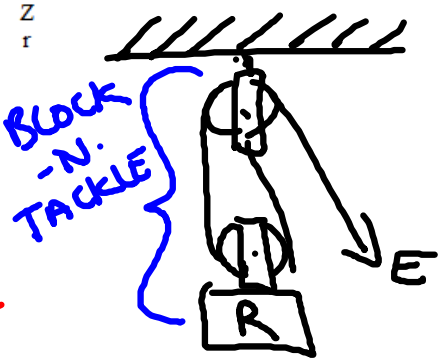


Code

A	B	C	D	E	F	I	J	L	N	O	Q	R	S	T	U	V	W	X	Z
i	e	l	o	s	h	u	x	a	b	k	t	w	y	d	g	c	n	p	r

Keeping it Simple

8. XICCBS pulley
9. RFBBC LWT LJCB wheel and axle
10. AWVCAWBT XCLWB inclined plane
11. EVZBR screw
12. NCDVO LWT QLVOCB block and tackle
13. UBLZ GEAR



In the space at the left, write the term that best completes each statement. Use the terms listed below.

block and tackle screw inclined planes pulley wheel and axle

SCREW 14. An inclined plane wrapped around a cylindrical post is a __.

WHEEL & AXLE 15. A doorknob is an example of a _____.

PULLEY 16. A grooved wheel with a rope or chain running along the groove is a _____.

INCLINED PLANE 17. Screws and wedges are types of _____.

BLOCK-N-TACKLE 18. A system of pulleys is called a _____.

Name Date Class

Directed Reading for Content Mastery

Section 3 ▪ Simple Machines

Directions: *Unscramble the five terms related to machines. The hints beside each scrambled term will help you. Write each unscrambled term in the boxes below. Use only one letter in each box. Use the circled letters to find the missing term in the equation.*

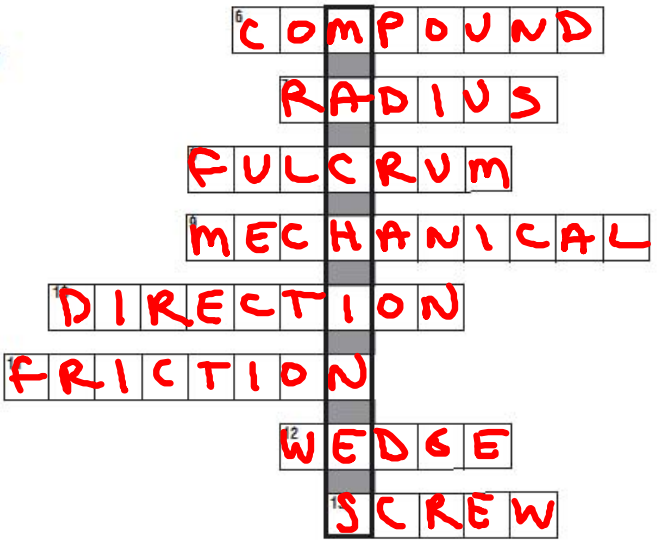
1. CEFRO — push or pull — FORCE
2. HELEW — used with an axle — WHEEL
3. FCYENFCIEI — measure of how much work put into a machine is changed to useful work put out by the machine — EFFICIENCY
4. KROW — exertion of a force through a distance — WORK
5. PODNUCMO — type of machine made up of two or more simple machines — COMPOUND

Equation: POWER = work/time $P = \frac{W}{t}$

Directions: *Solve the puzzle by writing the term that best fits each definition. You will find another term spelled vertically in the black box.*

Definitions

6. An automobile is this kind of machine.
7. distance from center of a circle to its edge
8. fixed point on which a lever rotates
9. A measure of the amount a machine multiplies a force is its _____ advantage.
10. A fixed pulley changes the_____ of a force.
11. a force that opposes motion
12. simple machines made up of two inclined planes
13. inclined plane wrapped around a cylindrical post



Meeting Individual Needs

Name Date Class

SECTION 3 Reinforcement

Simple Machines

Directions: *Match each simple machine in Column II to its description in Column I. Write the letter of the simple machine in the blank at the left.*

Column I		Column II
d	1. bar that is free to pivot about a fixed point	a. wheel and axle
e	2. an inclined plane with one or two sloping slides	b. inclined plane
f	3. grooved wheel with a rope running along the groove	c. gear
a	4. two wheels of different sizes that rotate together	d. lever
b	5. sloping surface used to raise objects	e. wedge
c	6. two wheels of different sizes with interlocking teeth along their circumferences	f. pulley
g	7. inclined plane wrapped in a spiral around a cylindrical post	g. screw

Directions: *Classify each type of simple machine as either a lever or an inclined plane by writing its name in the proper column of the table.*

8. Levers	9. Inclined planes
LEVER	INCLINED PLANE
PULLEY	WEDGE
WHEEL -N- AXLE	SCREW
GEAR	

Directions: *Calculate the ideal mechanical advantage for each of the following.*

10. A mover uses a ramp to push a stereo into the moving van. The ramp is 3 meters long and 1.5 meters high. What is the ideal mechanical advantage of this ramp?

$MA = \frac{L}{H} = \frac{3m}{1.5m} = 2$ 2x

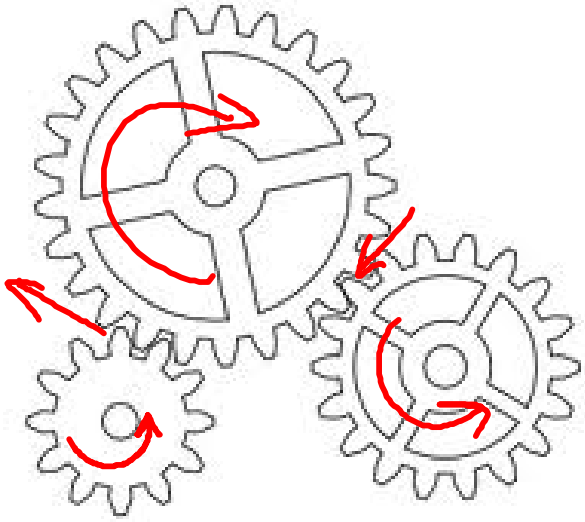
11. A painter uses a fixed pulley to raise a 1-kg can of paint a distance of 10 m.

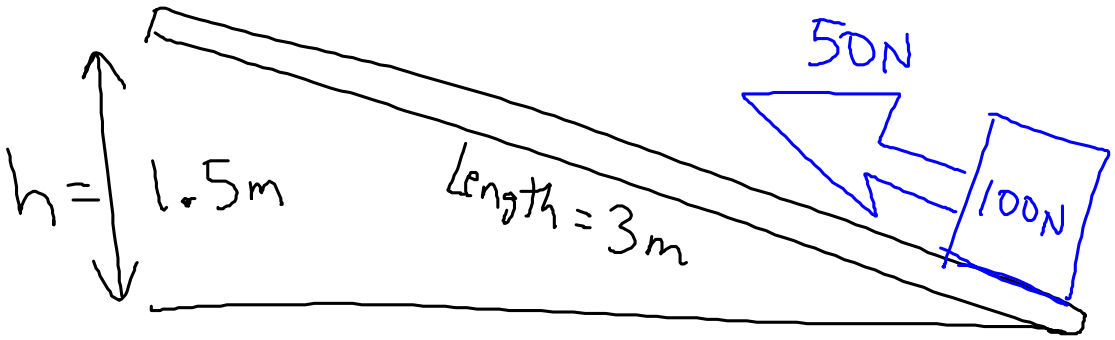
MA = 1

12. A screwdriver with a 1-cm shaft and a 4-cm handle is used to tighten a screw.

$MA = \frac{W}{A} = \frac{4cm}{1cm} = 4$

Meeting Individual Needs





$$\text{I.M.A.} = \frac{\text{LENGTH}}{\text{HEIGHT}} = \frac{3\text{m}}{1.5\text{m}} = 2$$

Name Date Class

Directed Reading for Content Mastery

Section 1 ▪ Work
Section 2 ▪ Using Machines

Directions: *In the blank, write the term from the list below that correctly completes each statement about the equations given. Terms may be used more than once.*

work **output paperwork** **input work**
time **energy**
distance **power** **force** **height of slope**

Meeting Individual Needs

1. In the equation $W = F \times d$
   a. W stands for WORK.
   b. F stands for FORCE.
   c. d stands for DISTANCE.

2. In the equation $W_{in} = W_{out}$
   a. W_{in} stands for WORK INPUT.
   b. W_{out} stands for WORK OUTPUT.

3. In the equation $P = W/t$
   a. P stands for POWER.
   b. W stands for WORK.
   c. t stands for TIME.

4. In the equation $P = E/t$
   a. E stands for ENERGY.
   b. t stands for TIME.

Directions: *In the words below, code letters have been substituted for letters of the alphabet. Use the following key to decode the words. In the key, the code letters are shown directly above the alphabet letter each stands for. Write the correct words on the lines provided.*

A	B	C	D	E	F	G	H	J	K	L	N	O	R	T	U	W	X	Y	Z
r	w	h	i	c	l	o	s	m	v	d	u	t	g	a	f	n	e	j	y

Prying into things

5. XWXARZ energy
6. YGNFX Joule
7. XUUGAO UGAEX effort force
8. AXHDHOTWEX UGAEX resistance force
9. JXECTWDETF TLKTWOTRX mechanical advantage
10. LDAXEODGW direction
11. WXBOGW Newton

Name Date Class

SECTION 2 Reinforcement

Using Machines

Directions: *In the space provided, define and express the term or equation for each of the following.*

1. effort force force YOU PUT onto a machine

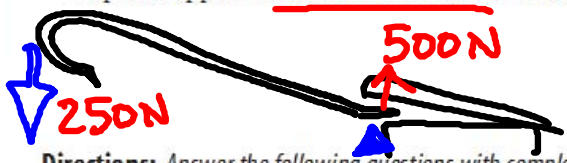
2. resistance force object machine IS lifting

3. mechanical advantage RATIO OUTPUT : INPUT
HOW MUCH MACHINE MULTIPLIES YOUR FORCE

4. efficiency HOW MUCH WORK INPUT CHANGED TO WORK OUTPUT $E = \frac{W_{out}}{W_{in}}$

Directions: *Use the information above to solve the following problem.*

5. A carpenter uses a crowbar to remove the top of a box. The top has a resistance of 500 N. The carpenter applies an effort force of 250 N. What is the mechanical advantage of the crowbar?



$\frac{500N}{250N} = 2$

Directions: *Answer the following questions with complete sentences.*

6. What are two ways that machines make work easier?
- INCREASE FORCE
- CHANGE DIRECTION OF FORCE
- INCREASE SPEED

7. How does a crowbar used to remove the top of a box change the direction of the force?
YOU PUSH DOWN - BAR GOES UP

8. What is ideal mechanical advantage? EXISTS IN OUR BRAIN

Meeting Individual Needs

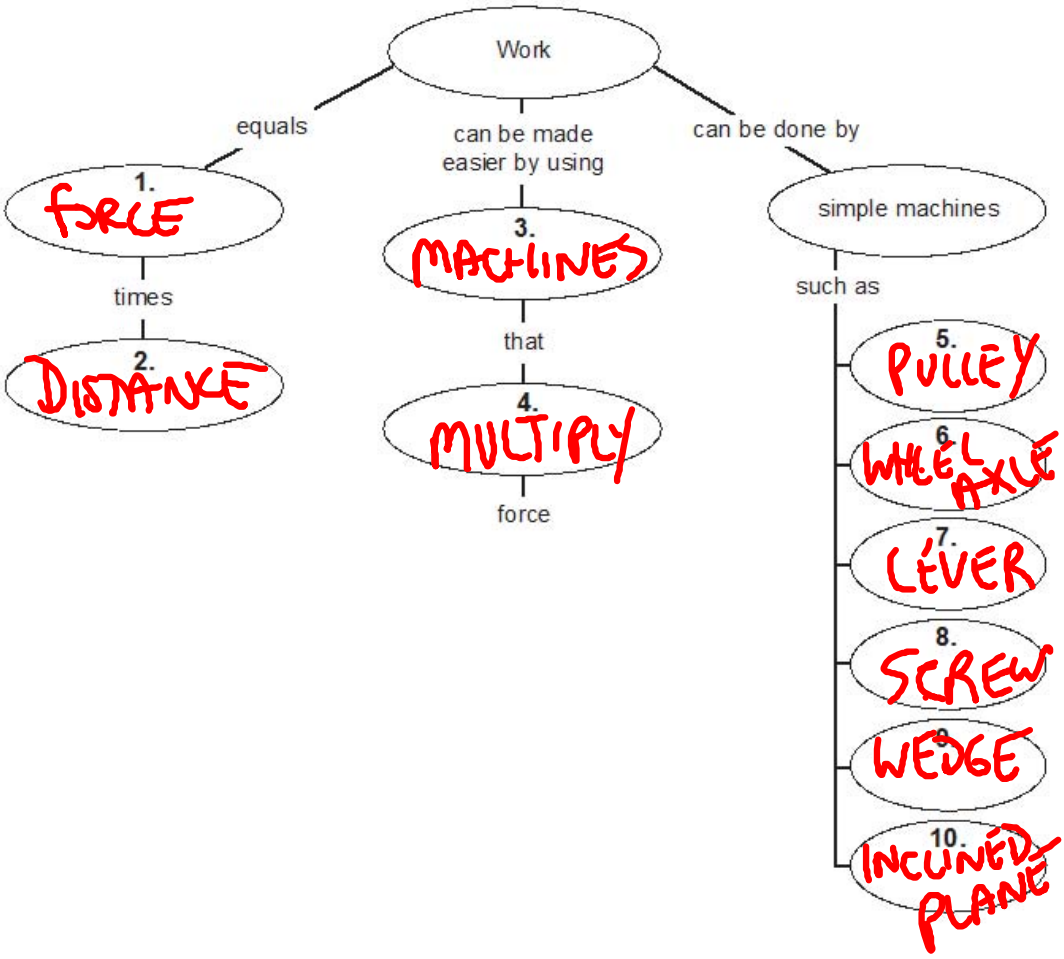
Name Date Class

Directed Reading for Content Mastery

Overview
Work and Machines

Directions: *Complete the concept map using the terms in the list below.*

machines	**multiply**	**inclined plane**	
lever	**wedge**	**pulley**	
screw	**wheel and axle**	**force**	**distance**



Meeting Individual Needs

Name Date Class

SECTION 1 Reinforcement

Work

$W = f \cdot d$

Directions: *Use the formula* work = force × distance *to calculate the answers to each of the following questions.*

1. A box is pushed 40 m by a mover. The amount of work done was 2,240 J. How much force was exerted on the box?

$d = 40\text{m}$
$W = 2240\text{ J}$
$F = ?$

$W = f \cdot d$
$\frac{(2240\text{J})}{40\text{m}} = \frac{f \cdot (40\text{m})}{40\text{m}}$
$56\text{N} = 56\frac{\text{J}}{\text{m}} = f$

2. A person expended 500 newtons to move a full wheelbarrow 30 meters. How much work was done?

$f = 500\text{N}$
$d = 30\text{m}$
$W = ?$

$W = f \cdot d$
$W = (500\text{N})(30\text{m})$
$W = 15000\text{ Nm}$
$= 15000\text{ J}$

$P = \frac{W}{t}$
$P = \frac{f \cdot d}{t}$

Directions: *Use the formula* power = work/time *to calculate the power required in each of the following.*

3. A weightlifter lifts a 1,250-N barbell 2 m in 3 s. How much power was used to lift the barbell?

$f = 1250\text{N}$
$d = 2\text{m}$
$t = 3\text{s}$

$P = \frac{f \cdot d}{t} = \frac{(1250\text{N}) \cdot (2\text{m})}{(3\text{s})}$
$P = 833.3\frac{\text{Nm}}{\text{s}}$ OR W

4. A crane lifts a 35,000-N steel girder a distance of 25 m in 45 s. How much power did the crane require to lift the girder? Write your answers in kilowatts.

$f = 35000\text{ N}$
$d = 25\text{m}$
$t = 45\text{ s}$

$P = \frac{f \cdot d}{t} = \frac{(35000\text{N})(25\text{m})}{(45\text{ s})}$
$P = 19444.4\frac{\text{Nm}}{\text{s}}$

$19.4\text{ kW} = P = 19444\text{ W}$

Meeting Individual Needs

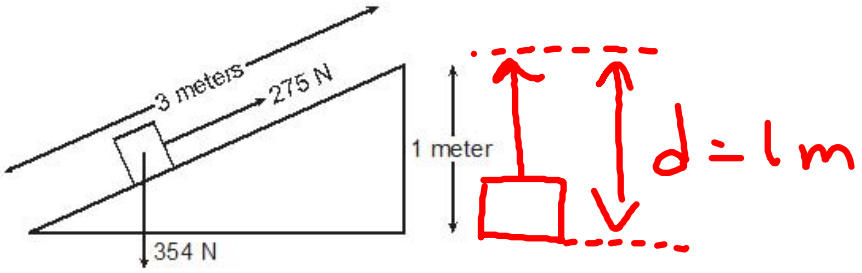
Name Date Class

SECTION 1 Enrichment

Calculating Work

Directions: *Solve the following problems.*

1. A box weighing 354 N is pushed up an inclined plane that is 3m long. A force of 275 N is required, including friction.



a. What is the work done to slide the box?

$W = (275\,N) \cdot (3\,m) = 825\,J$

b. How much work is done if the box is lifted 1 m instead?

$W = F \cdot d = (354\,N)(1\,m) = 354\,J$

c. Which method of lifting the box requires more work?

SLIDING UP RAMP

d. Which method of lifting the box would be easier?

SLIDING - LESS FORCE

2. How much power is generated if a person applies 200 N of force to move a bicycle 10 m in 5 s?

$P = \frac{W}{t} = \frac{F \cdot d}{t} = \frac{(200\,N)(10\,m)}{(5\,s)} = 400\,W$

3. A 700-watt gasoline engine and a 300-watt electric motor both do 3 J of work. Which machine can do the work faster? Explain your answer.

GAS ENGINE - MORE WATTS POWER

4. In the English system, the unit of power is the horsepower. It is based on the amount of work the average horse can do. (1 horsepower = 746 watts).

a. If a car engine is rated at 125 horsepower, how many watts of power does it produce?

93250 W

b. If a lawnmower engine is rated at 4 horsepower, how many watts of power is that?

2984 W

Meeting Individual Needs

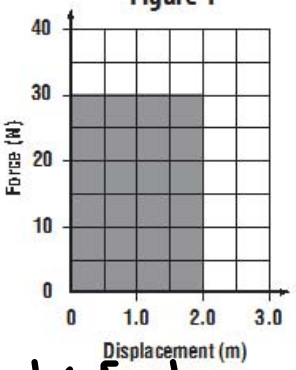
Name Date Class

SECTION 2 Enrichment

Plotting Force and Displacement

Another way of analyzing the work done by a force is to do a force-displacement graph. The graph to the right is a plot of force vs. displacement for a 30 N box being lifted 2.0 m. The shaded area under the graph (Figure 1) equals the work input. ($W_{in} = F_e \times d_e = 30\text{N} \times 2.0\text{ m} = 60\text{ J}$) Since no machine was used to lift the box, the graph of work output would be the same. ($W_{out} = F_r \times d_r = 30\text{N} \times 2.0\text{ m} = 60\text{ J}$)

Figure 1

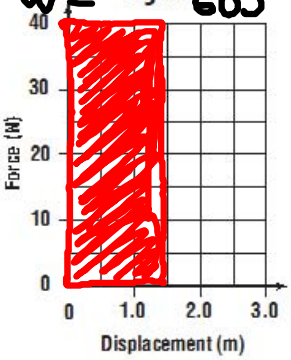


Directions: *Solve the following problems using force-displacement graphs.*

1. Draw a force-displacement graph in Figure 2 showing the work input and the work output when a box of books that needs a force of 40 N is lifted 1.5 m.

W=f·d
W=40N·1.5m
W=60J

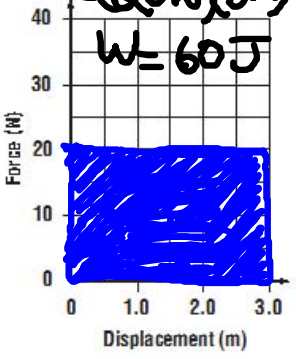
Figure 2



2. Draw a force-displacement graph in Figure 3 showing the work input and the work output for the same box if the books are lifted by a pulley system with an IMA of 2.

W=f·d
W=(20N)(3m)
W=60J

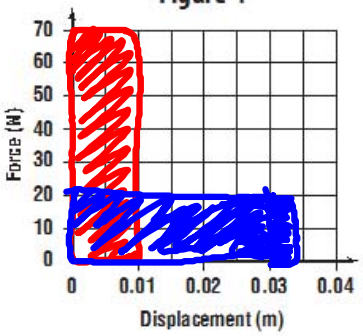
Figure 3



3. A force of 70 N is required to remove a bottle cap without using an opener. Draw a force-displacement graph in Figure 4 for the work output when the bottle cap is moved 1 cm.

1 cm = 0.01 m

Figure 4



4. Draw a force-displacement graph in Figure 4 for work input on the same bottle cap being removed by an opener resulting in an IMA of 3.5.

MA = 3.5

FORCE ÷ 3.5 = 20N

DISTANCE × 3.5 = .035

Name _____ Date _____ Class _____

Note-taking Worksheet

Work and Machines

Section 1 Work

A. _____—transfer of energy that occurs when a force makes an object move

1. For work to occur, an object must _____.
2. The motion of the object must be in the _____ as the applied force on the object.

B. Work and energy are related, since energy is always _____ from the object doing the work to the object on which the work is done.

C. Work is done on an object only when a _____ is being applied to the object and the object moves.

D. Calculating work—work equals force (in newtons) times _____

E. _____—amount of work done in a certain amount of time; rate at which work is done

1. _____—power equals work divided by time.
2. Power is measured in _____ (W).
3. Since work and energy are _____, power also can be calculated—power equals energy divided by time.

Section 2 Using Machines

A. Device that makes doing work easier is a _____.

B. Machines _____ applied force and/or _____ direction of applied force to make work easier.

1. Same amount of work can be done by applying a small force over a long distance as can be done applying a large force over a short distance, since work equals _____ times _____.
2. Increasing _____ reduces the amount of force needed to do the work.
3. Some machines change the _____ of the applied force to do the work.

C. Machines help move things that _____ being moved.

1. Force applied to machine is _____.
2. _____—force applied by machine to overcome resistance

Meeting Individual Needs

Name _____ Date _____ Class _____

Note-taking Worksheet (continued)

3. Amount of energy the machine transfers to the object cannot be _____ than the amount of energy transferred to the machine.
   a. Some energy transferred is changed to _____ due to friction.
   b. An ideal machine with no _____ would have the same input work and output work.

D. _____ (MA) is the number of times a machine multiplies the effort force. It is calculated by MA equals resistance force divided by effort force.

E. _____—measure of how much of the work put into a machine is changed into useful output work by the machine

1. _____ efficiency—efficiency equals (output work divided by input work) times 100%.
2. Efficiency of a machine is always _____ than 100%.
3. _____ can make machines more efficient by reducing friction.

Meeting Individual Needs

Section 3 Simple Machines

A. A machine that does work with only one movement is a _____.

B. _____—bar that is free to pivot about a fixed point called the fulcrum

1. _____ arm is part of the lever on which effort force is applied.
2. _____ arm is part of the lever that exerts the resistance force.
3. Three classes of levers based on _____ of effort force, resistance force, and fulcrum
   a. _____ lever—fulcrum is located between the effort and resistance forces; multiplies and changes direction of force
   b. _____ lever—resistance force is located between the effort force and fulcrum; always multiplies force
   c. _____ lever—effort force is between the resistance force and fulcrum; doesn't multiply force but does increase distance over which force is applied
4. Calculating ideal mechanical advantage (IMA) of a lever—IMA equals length of _____ arm divided by length of output arm.

Name Date Class

Note-taking Worksheet (continued)

C. Grooved wheel with a rope, simple chain, or cable running along the groove is a _____, which is a modified first-class lever.

1. A _____ pulley is attached to something that doesn't move; force is not multiplied but direction is changed; IMA = 1.
2. A _____ pulley has one end of the rope fixed and the wheel free to move; multiplies force; IMA = 2.
3. _____—system of pulleys consisting of fixed and movable pulleys; IMA = number of ropes supporting resistance weight

D. _____—machine with two wheels of different sizes rotating together; modified lever form

1. IMA = radius of wheel _____ by the radius of axle
2. _____ are a modified form of the wheel and axle.

E. _____—sloping surface that reduces the amount of force required to do work

1. IMA = length of slope (effort distance) _____ by height of slope (resistance distance)
2. _____ is required if a ramp is longer and less steep.

F. _____—inclined plane wrapped in a spiral around a cylindrical post

G. Inclined plane with one or two sloping sides is a _____.

H. _____—uses a combination of two or more simple machines

Meeting Individual Needs

Name Date Class

Chapter Review

Work and Machines

Part A. Vocabulary Review

Directions: *Identify each statement as* **true** *or* **false**. *Replace the italicized term in false statements with the term that makes them correct.*

F 1. A device that does work with only one movement is a *compound* machine.
SIMPLE

F 2. The number of times a machine multiplies the effort force is the *resistance force* of the machine.
MA

T 3. A grooved wheel with a rope or chain running through the groove is a *pulley*.

F 4. A wheel with teeth along its circumference is a *pulley*.
GEAR

F 5. A sloping surface used to raise objects is a *wedge*.
INCLINED PLANE

T 6. A screw is an *inclined plane* wrapped in a spiral around a cylindrical post.

T 7. A wheel and axle is a simple machine consisting of *two wheels* of different sizes that rotate together.

F 8. An inclined plane with two or more sloping sides is a *screw*.
WEDGE

F 9. The mechanical advantage of a fixed pulley is always *two*.
ONE (CHANGE DIRECTION ONLY)

F 10. A machine made up of two or more simple machines is a(n) *ideal* machine.
COMPOUND

T 11. The mechanical advantage of a block and tackle is equal to the *number of ropes* used to raise the object.

T 12. *Power* is the rate at which work is done.

T 13. A measure of how well a machine operates is its *efficiency*.

Assessment

Name Date Class

Chapter Review (continued)

Part B. Concept Review

Directions: *In the blank at the left, write the name of the simple machine represented by each example.*

INCLINED PLANE 1. staircase

SCREW 2. spiral staircase

LEVER 3. crowbar

WHEEL-N-AXLE 4. bicycle pedals

WEDGE 5. knife

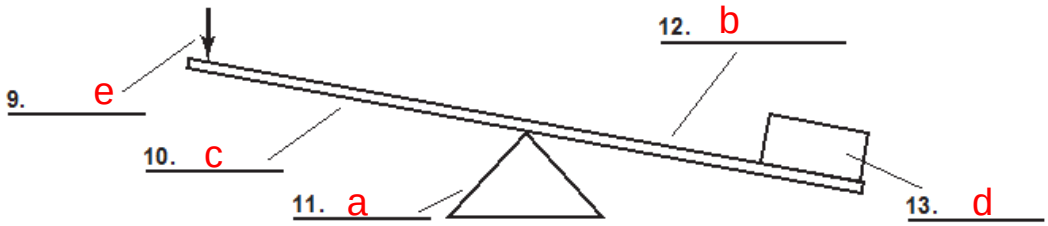
WHEEL-N-AXLE 6. screwdriver

PULLEY 7. block and tackle

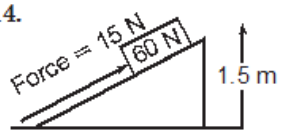
INCLINED PLANE 8. ramp

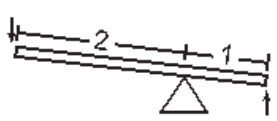
Directions: *In the spaces provided, label the following diagram by writing the letter of the term that correctly identifies each part.*

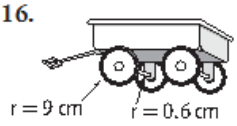
a. fulcrum **b.** output arm **c.** input arm **d.** resistance force **e.** effort force



Directions: *Calculate the ideal mechanical advantage for each of the machines shown. Write your answers in the spaces provided.*

14.


15.


16.


14. MA=4

15. MA=2

16. MA=15

Directions: *Answer the following question using complete sentences.*

17. What is the difference between ideal mechanical advantage and actual mechanical advantage?

IMA doesnt take friction in to consideration. Real machines have friction and waste energy so real MA is less than IMA

Assessment