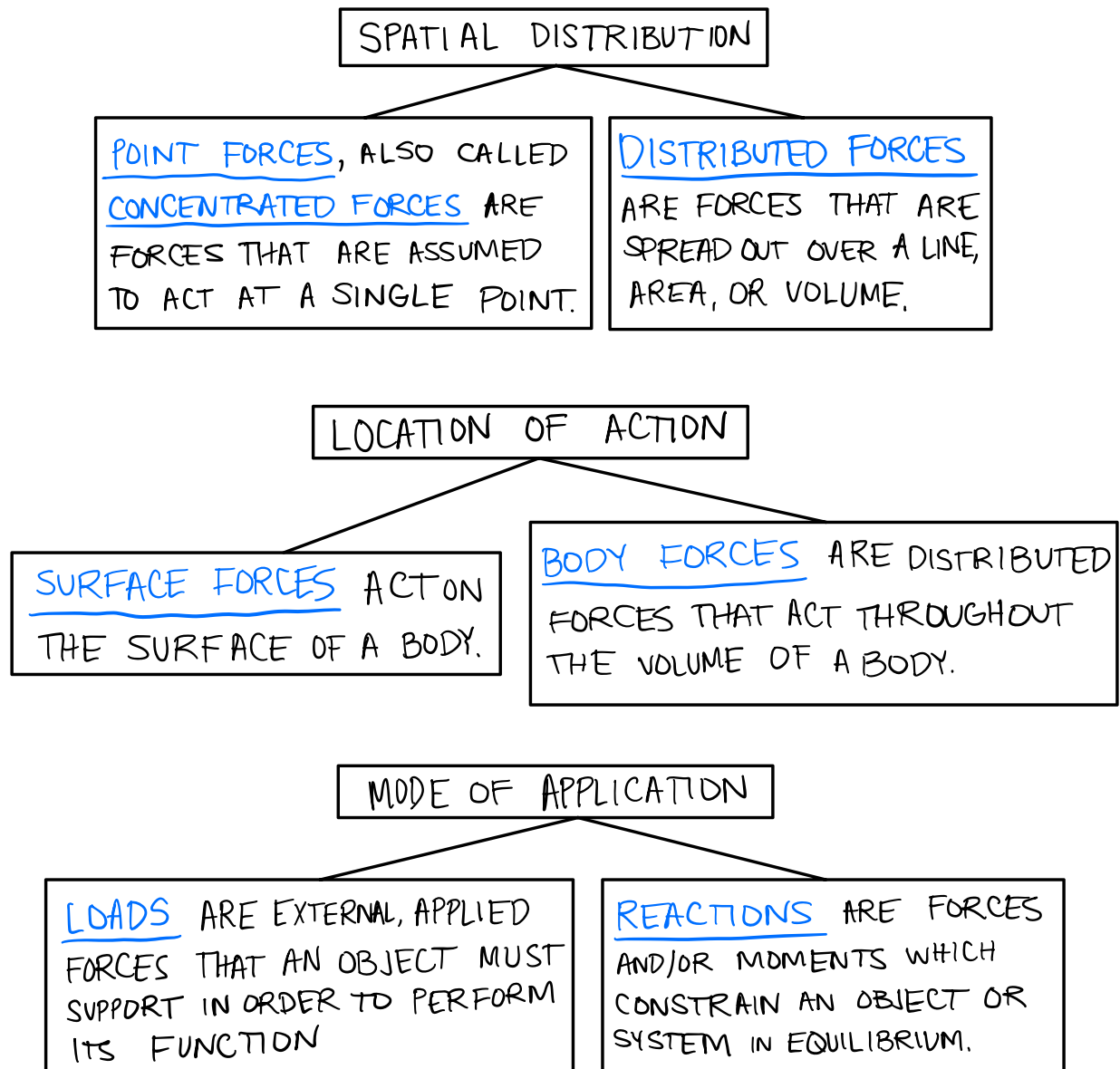


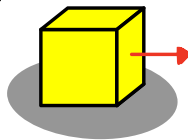
FORCES

AT ITS SIMPLEST, A FORCE IS A "PUSH OR PULL," BUT FORCES COME IN MANY DIFFERENT FORMS. LET'S CLASSIFY THEM BASED ON SOME COMMON CHARACTERISTICS.

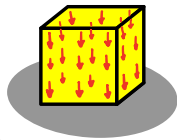


EX. CONSIDER A HEAVY CRATE BEING PULLED BY A ROPE ACROSS A ROUGH SURFACE.

THE APPLIED
LOADS ARE

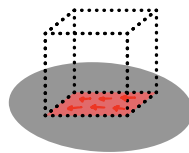


CONCENTRATED FORCE
APPLIED TO PULL THE
CRATE.

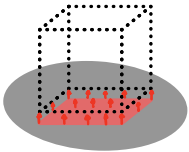


THE WEIGHT OF THE
CRATE IS A BODY FORCE.

THE REACTION
FORCES ARE



FRICTION IS A DISTRIBUTED
FORCE THAT ACTS **TANGENTIAL** TO THE SURFACE
BETWEEN TWO OBJECTS IN CONTACT.



THE NORMAL FORCE IS A DISTRIBUTED
FORCE THAT ACTS **NORMAL** (PERPENDICULAR)
TO THE SURFACE BETWEEN TWO OBJECTS
IN CONTACT.

FOR SIMPLICITY IN ANALYSIS, WE WILL OFTEN MODEL
DISTRIBUTED FORCES AS EQUIVALENT CONCENTRATED FORCES.
MORE ON THAT LATER IN THE COURSE.

PROBLEM SOLVING

THIS MAY BE THE FIRST COURSE YOU'VE TAKEN WHERE YOU NEED TO DECIDE ON YOUR OWN HOW TO APPROACH A PROBLEM. OFTEN, THERE ARE MANY POSSIBLE WAYS TO SOLVE PROBLEMS IN THIS COURSE, BUT NOT ALL OF THEM WILL BE EQUALLY AS EASY. YOU CAN'T SIMPLY MEMORIZE FORMULAS TO PLUG-AND-CHUG. BEFORE YOU BEGIN A PROBLEM, YOU NEED A PLAN OR STRATEGY.

FORCES, MOMENTS, EQUILIBRIUM, FREE-BODY DIAGRAM, AND OTHER PHYSICS AND MATH-RELATED CONCEPTS ARE TOOLS IN YOUR ENGINEERING ANALYSIS TOOLBOX. TO SOLVE PROBLEMS IN THIS COURSE, YOU'LL NEED TO ACQUIRE SOME NEW TOOLS, AND LEARN WHICH TOOLS ARE BEST FOR DIFFERENT TASKS. THIS TAKES TIME AND PRACTICE.

IF YOU FIND YOURSELF SAYING THINGS LIKE:

"I DON'T KNOW WHERE TO START THIS PROBLEM."

"IT LOOKS SO EASY WHEN YOU DO IT."

"IF I JUST KNEW WHICH EQUATION TO USE, I COULD SOLVE IT."

THEN YOU PROBABLY NEED TO SPEND MORE TIME ON THE PLANNING STEP. CHOOSING A PLAN OR STRATEGY GETS EASIER WITH EXPERIENCE. HERE ARE SOME TIPS TO HELP YOU GET STARTED:

- GET FLUENT WITH YOUR ALGEBRA AND TRIGONOMETRY SKILLS.
- ALWAYS KEEP TRACK OF YOUR UNITS, AND CHECK THAT THEY ARE CONSISTENT.
- PRACTICE, PRACTICE, PRACTICE! START WITH EASIER PROBLEMS TO BUILD YOUR SKILLS.
- STUDY WORKED OUT SOLUTIONS. HOWEVER, DON'T ASSUME THAT JUST BECAUSE YOU UNDERSTAND HOW SOMEONE ELSE SOLVED A PROBLEM THAT YOU'LL BE ABLE TO DO THE SAME ON AN EXAM.
- SOLVE PROBLEMS USING MULTIPLE STRATEGIES. CHECK THAT THE RESULTS ARE THE SAME, AND THINK ABOUT WHY ONE METHOD WAS EASIER THAN ANOTHER.
- DRAW NEAT, CLEARLY LABELED DIAGRAMS.
- WHEN CONFUSED, IDENTIFY WHAT IS CONFUSING YOU AND ASK QUESTIONS!

MANY OF THE PROBLEMS IN THIS CLASS REQUIRE YOU TO USE EQUILIBRIUM TO SOLVE FOR UNKNOWNNS. THE GENERAL PROCEDURE FOR SOLVING EQUILIBRIUM PROBLEMS IS:

1. READ AND UNDERSTAND THE PROBLEM.
2. IDENTIFY WHAT IS GIVEN AND WHAT YOU NEED TO FIND.
3. STOP, THINK, AND FORMULATE A PLAN.
4. DRAW A FREE-BODY DIAGRAM (FBD).
5. APPLY YOUR STRATEGY TO SOLVE FOR UNKNOWNNS.
 - (a) WRITE EQUATIONS OF EQUILIBRIUM BASED ON THE FBD
 - (b) CHECK IF:
$$\text{NUMBER OF EQUATIONS} = \text{NUMBER OF UNKNOWNNS}$$

(IF IT DOESN'T, YOU'RE MISSING SOMETHING)
 - (c) SOLVE FOR UNKNOWNNS.
6. CHECK THAT YOUR ANSWER MAKES SENSE.

USING THESE STEPS DOES NOT GUARANTEE THAT YOU'LL GET THE RIGHT ANSWER, BUT ARE INTENDED FOR YOU TO USE AS A GUIDE WHEN FORMULATING A STRATEGY TO SOLVE A PROBLEM.