

PHYS1002 Fundamentals

Module 2

Mechanics

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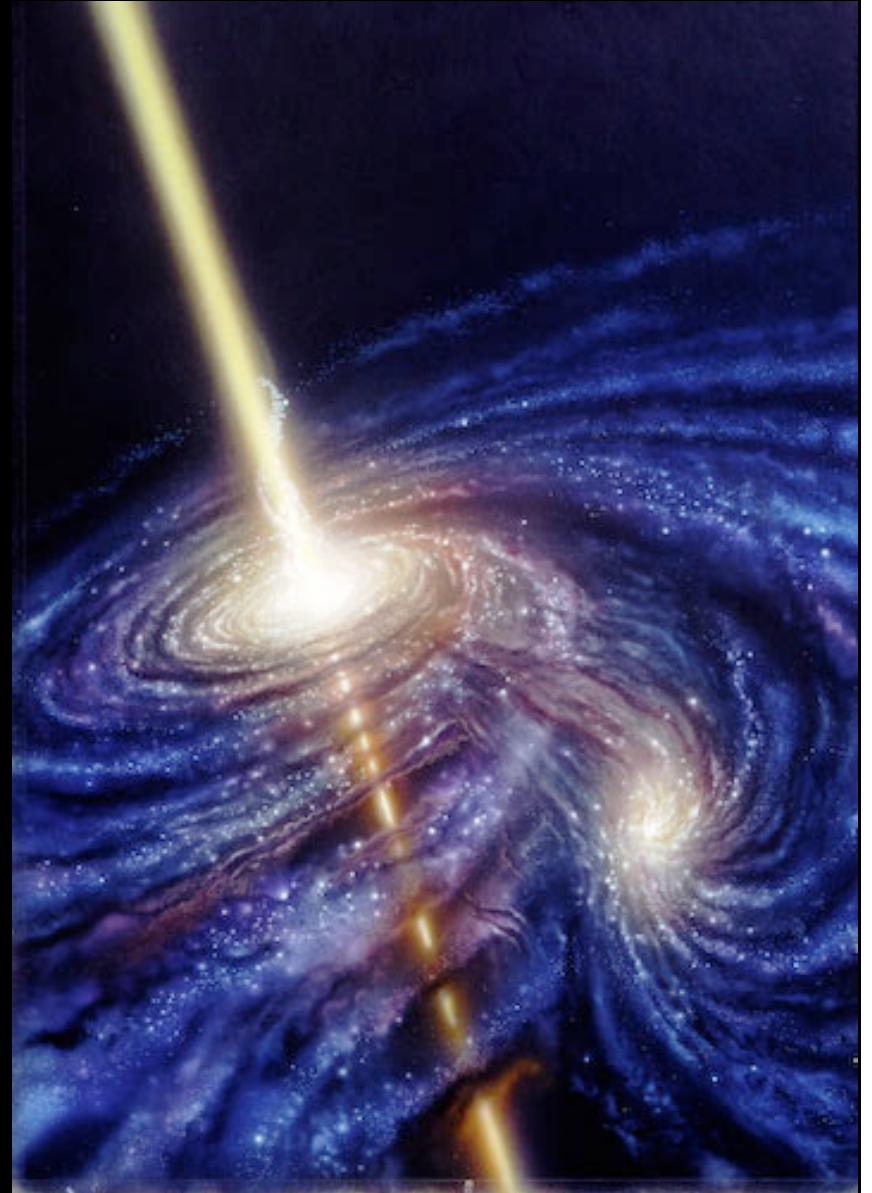
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My research:

- black holes in binary star systems
- supermassive black holes in the centres of galaxies



PHYS1002

This is the second of three modules in PHYS1002

- Language of Physics (12 lectures)
- Mechanics (13 lectures)
- Waves and Oscillations (12 lectures)

PHYS1002: Assessment

Lab skills test	10%
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Mid–semester test	10%
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End of semester exam	80%
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Assignments

Workshop tutorials	<i>all required*</i>
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Laboratory work

*Non–completion will result in a reduced grade. See Unit of Study outline for more details

ILDs

There are three Interactive Lecture Demonstrations in this module. These involve class participation, and are extremely helpful in understanding the material.

Dates for the ILDs:

Stream 1:

Monday 13 April
Friday 17 April
Monday 4 May

Stream 2:

Monday 13 April
Thursday 16 April
Monday 4 May

Where to go for help

- Your friends!
- eLearning site
- Physics Student Support office, Room 210
- Your tutor
- Your lecturer
- Duty tutor: 1–2 pm, Tue–Fri, Physics LT4
- Maths Learning Centre (Level 4 Carslaw)

Textbook

“College Physics” by Knight, Jones and Field (KJF)

Includes *Mastering Physics* access

We will be assigning reading from the textbook during the course.

Lecture slides and recordings are available online.

Past exams

Final exam consists of

- 6 short-answer questions (5 marks each)
- 6 long-answer questions (10 marks each)

A formula sheet is provided in the exam

Exam papers from the past few years are available through eLearning, together with worked solutions.

Answering physics problems

- Use some words!
- Draw a diagram
- Don't substitute numbers in until the end
- Make sure you have units on your answer



Module content

Knight, Jones & Field (KJF): College Physics

- Chapters 4 & 5: Force and Newton's Laws
- Chapter 6: Circular motion
- Chapters 7 & 8: Torque and equilibrium
- Chapter 9: Momentum
- Chapter 10: Energy and Work

What is Mechanics?

Kinematics describes **how** objects move

Mechanics explains **why** objects move
using the concepts of

- force
- energy
- momentum

FORCE

KJF chapters 4 & 5

Forces

What is force? (Crudely speaking)

A force is a push or a pull that can

- change the velocity of an object
- cause a distortion in the size or shape of an object

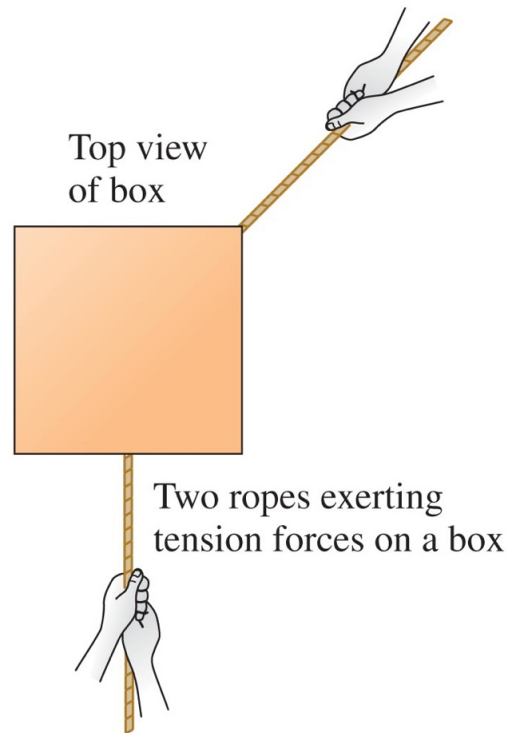
Vectors

Force is a **vector**: it has direction & magnitude.

S.I. Unit of force: newton, N (or kg m s^{-2})

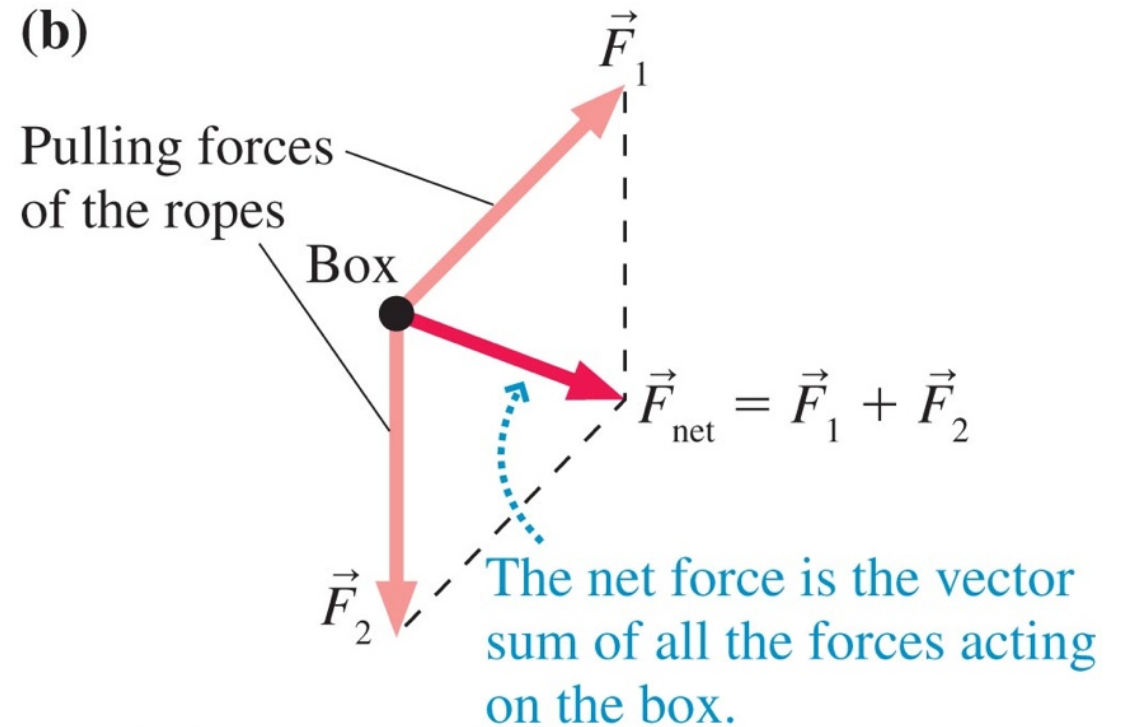
- ▶ Can be resolved into components at right angles
- ▶ Two or more forces acting on the same object are added by the rules of vector addition (**resultant** or **net** force)

(a)



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(b)

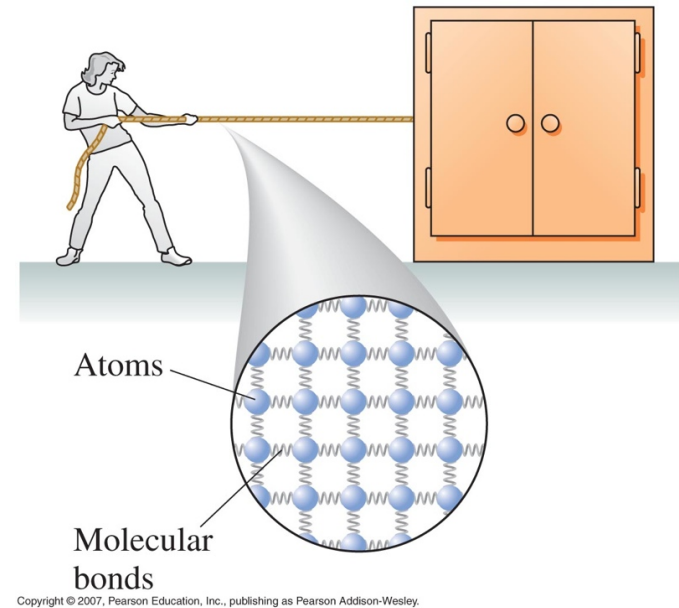


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Forces in Mechanics

Forces are either **contact**

- Pushes / Pulls
- Tension in rope
- Friction
- Normal force



(virtually all common contact forces are actually electromagnetic)

or **long-range**

- Gravity (Weight)

Fundamental Forces

(not examinable)

Present theory says that all known forces can be shown to be due to three fundamental forces in nature:

- **Gravitational** — between masses
- **Electroweak** (electromagnetic+weak nuclear) — between charges
- **Strong nuclear force** — between particles in nucleus

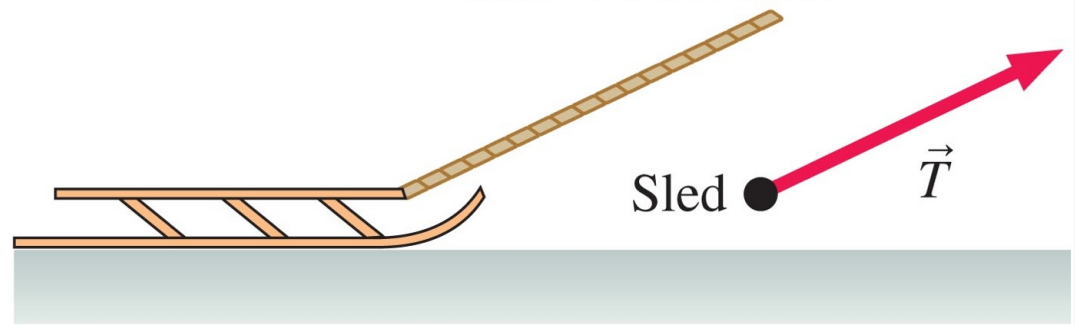
Forces: Tension

If a string of negligible mass and stiffness ("ideal string") is pulled tight, both ends of the string pull back with a force called **tension**.

Tension always pulls inwards along the direction of the string.

The forces at both ends of the string are always the same magnitude. The tension is the same all the way along the string.

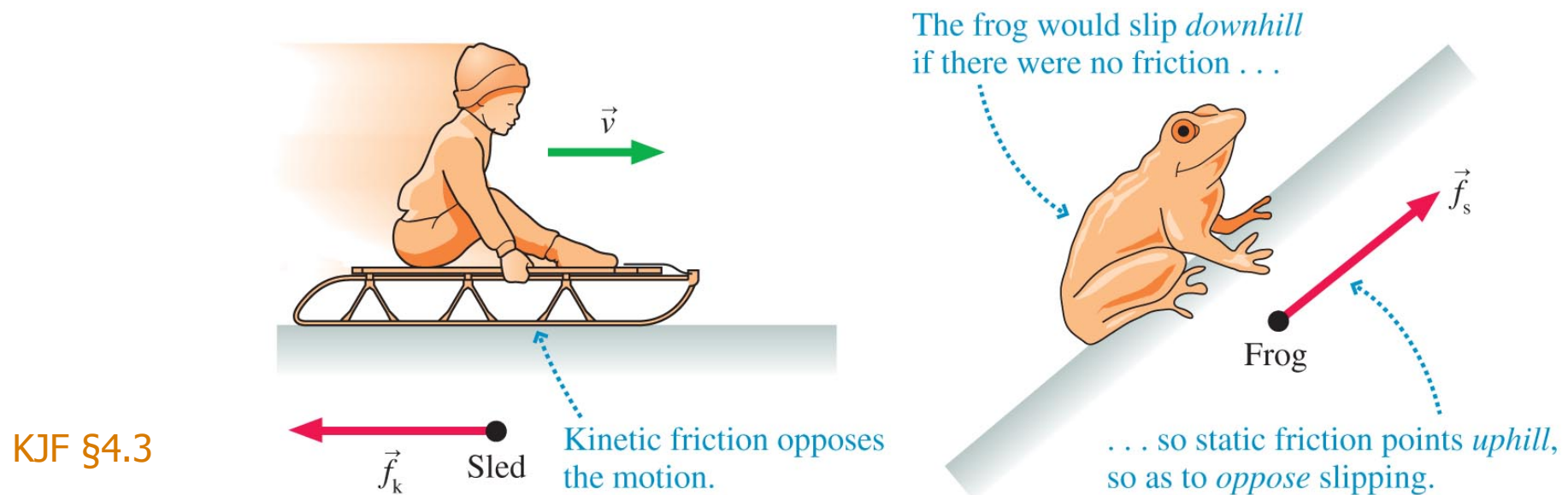
The rope exerts a tension force on the sled.



Forces: Friction

Friction is a force exerted by a surface. It is always **parallel** to the surface, and always opposes the direction of motion of slippage of the surface making contact.

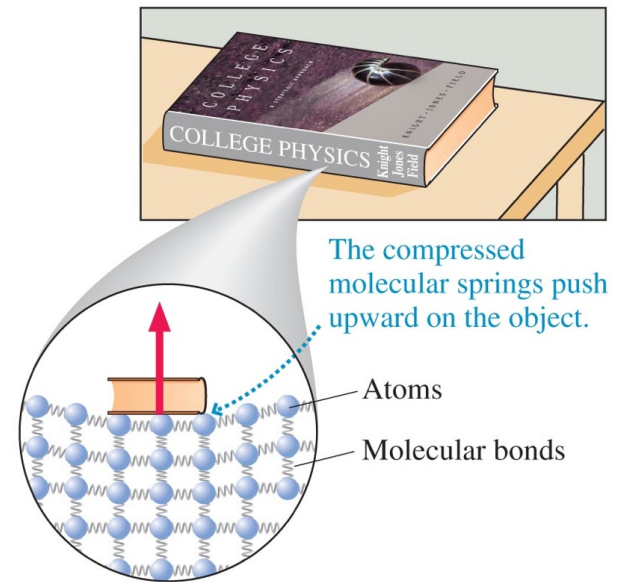
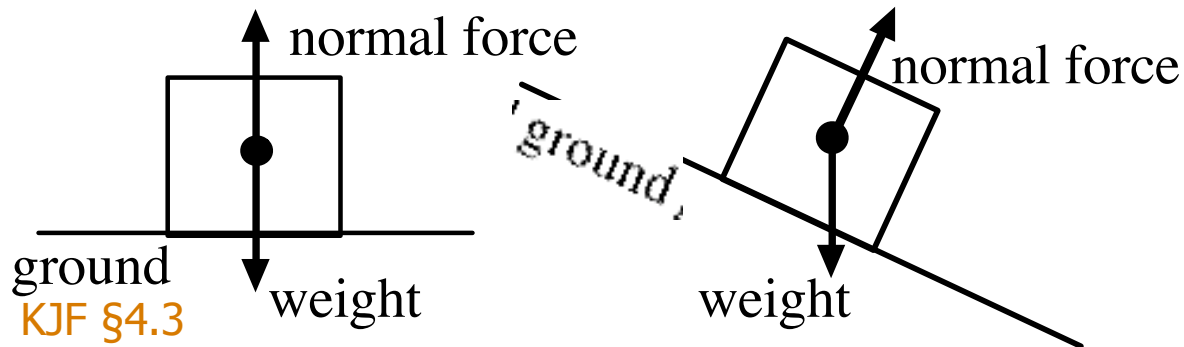
We will look at friction in more detail in Lecture 4.



Forces: Normal force

If one pushes against a planar surface, the planar surface pushes back with a force perpendicular (“normal”) to that surface.

Normal force always adjusts itself exactly to cancel motion through the surface (unless surface breaks!)



Forces: Weight and Mass

Weight is a force,

∴ the S.I. unit of weight is newtons (N).

Weight is the force exerted on a body by gravity.

Weight is a vector.

What is **mass**?

Mass is the “quantity of matter” in a body, “how much stuff”.

The S.I. unit of mass is kilograms (kg).

Mass is a **scalar**.

NEXT LECTURE

Newton's first and second laws.

Read: KJF §4.3 and 4.4