PHYS1002 Fundamentals Module 2

Mechanics

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PHYS 1002

- 3 lectures
- 3 hours lab (20% + 5%)
- 1 hour tutorial (2%)

  plus

- 3 assignments (7%)
- 5 ILDs (3%)
- Final exam (63%)

ILDs

There are three Interactive Lecture Demonstrations in this module. Together with the two in the first module, they make up 3% of your final mark.

Dates for the ILDs:

Stream 1:	**Stream 2**:
Friday 4 April	Thursday 3 April
Wednesday 9 April	Wednesday 9 April
Monday 5 May	Monday 5 May

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 WebCT, 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

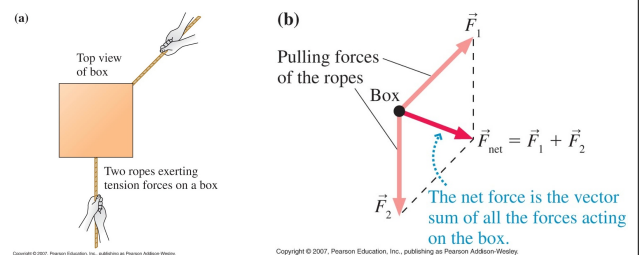• cause a distortion in the size or shape of an object

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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) Top view of box

Two ropes exerting tension forces on a box

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(b) Pulling forces of the ropes

Box

$\vec{F}_1$

$\vec{F}_{\mathrm{net}} = \vec{F}_1 + \vec{F}_2$

$\vec{F}_2$

The net force is the vector sum of all the forces acting on the box.

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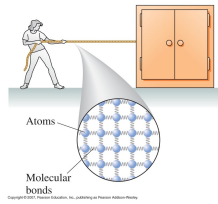
Forces in Mechanics

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)

Atoms

Molecular bonds

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.

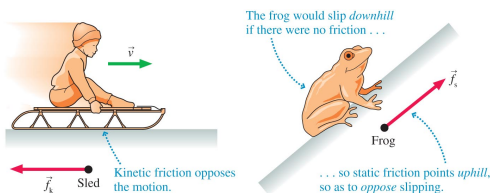The rope exerts a tension force on the sled.

Sled $\vec{T}$
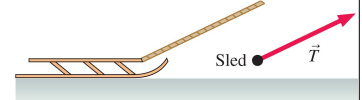
Forces: Friction

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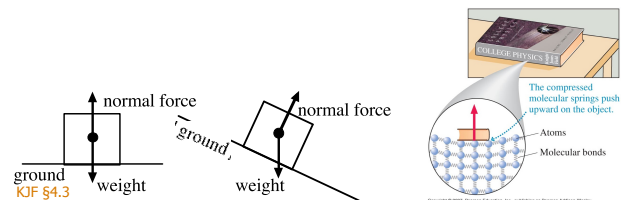
We will look at friction in more detail in Lecture 4.

$\vec{v}$

The frog would slip *downhill* if there were no friction . . .

$\vec{f}_s$

Frog

$\vec{f}_k$ Sled   Kinetic friction opposes the motion.

. . . so static friction points *uphill*, so as to *oppose* slipping.

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!)

normal force

ground   weight

$\vec{r}_{ground}$ normal force

weight

The compressed molecular springs push upward on the object.

Atoms

Molecular bonds

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