

Essential Physics II

英語で物理学の
エッセンス II

Lecture I: 28-09-15

Course Basics



ESSENTIAL PHYSICS 2 M 16:30 - 18:00

Instructor: Elizabeth TASKER, office 2-9-11, tasker@astro1.sci.hokudai.ac.jp

Textbook: 'Essential University Physics' with 'MasteringPhysics', Richard Wolfson / Pearson, ISBN 978-0321714381

Students must buy the textbook, complete with the 'Mastering Physics' student access code card. The book can be bought from the University COOP (Seikyou) or from amazon.co.jp.

Notices: Any important information about the course will be posted on the course website:

<http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep2>

Please check this regularly.

Homework

(1) Weekly homework problem sets will be on the 'Mastering Physics' website:
<http://www.masteringphysics.com>.

Course ID: EP22014TASKER

Student ID: Your Hokudai student ID

(2) During the semester, there will also be between 3 short news articles to read. Students must identify the main points of the article and write a 3-5 sentence summary.

(3) For the end of the semester, students will write a 250 word summary of a news article of their choice. The news article can be one previously covered in class, or one of their own choosing. This article must be submitted with their summary on 2015/01/19. It counts for 5% of the homework percentage.

Clickers: During each lecture, there will be questions on the concepts being covered. Students will answer these using clickers. This will count towards their attendance grade.

Here, it is more important to try than to get the correct answer! If you achieve more than 60% on the clickers, you will get 100% of the marks.

Slides: The slides from each lecture (in .pdf form) will be put on the course website by the Wednesday after the lecture (more probably by Tuesday morning):

<http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep2>

Attendance policy: You must attend more than 80% of the classes (less than 3 absences). If you cannot avoid missing a class, contact the instructor beforehand or at the earliest possible opportunity. If you sleep through the class, you will be marked as absent.

Course Basics

時間 Times:

Monday 4:30 - 6 pm

(Students are expected to attend all classes)

Instructor:

Elizabeth Tasker

tasker@astro1.sci.hokudai.ac.jp

T.A.:

Keitaro JIN

jin@astro1.sci.hokudai.ac.jp

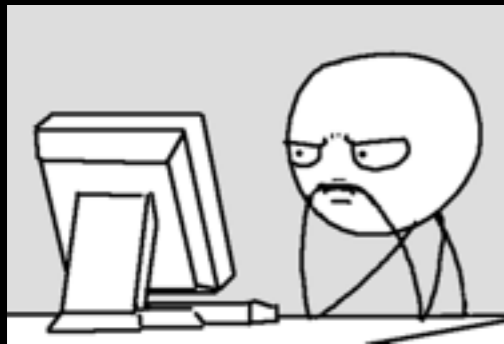
Problems?

Email me and we can arrange a time to meet!

Course Basics

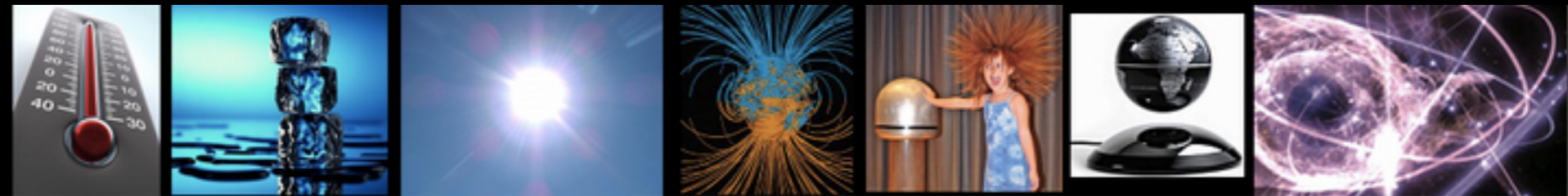
Class website

News



Check regularly!

Lecture slides



Essential Physics II

This webpage has copies of the slides used in each lecture. Any problems, please email the instructor at [tasker\(at\)astro1.sci.hokudai.ac.jp](mailto:tasker@astro1.sci.hokudai.ac.jp) or TA [jin\(at\)astro1.sci.hokudai.ac.jp](mailto:jin@astro1.sci.hokudai.ac.jp).

Course syllabus can be found [here](#).

News

Welcome to Essential Physics II!

The textbook, "Essential University Physics" (with MasteringPhysics) by Richard Wolfson / Pearson (ISBN 978-0321714381) is available from the COOP/SEIKYOU or from amazon. You will need a copy to complete the homeworks. **Please make sure it includes your student access code for 'Mastering Physics'.**

When you log onto the '[Mastering Physics](#)' site, please join the course EP22015TASKER. If you do not already have an account, please register using the student access code that came with your textbook. Homework will be posted weekly on that site. For instructions on how to register for the site, please go [here](#).

Slides

Lecture 1: [Syllabus, homework system and maths practice](#)

Video: "[Seven Minutes of Terror](#)"

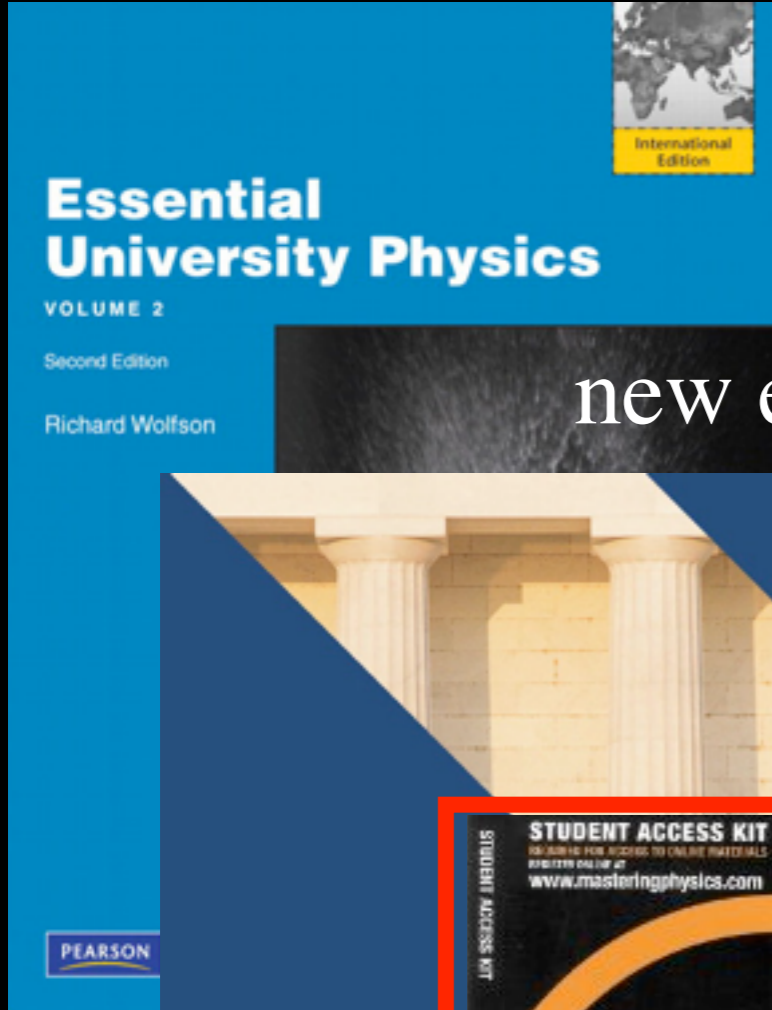
Homework article: [India's mission to Mars \(due 2015/10/05\) \(Tips on how to report on an article\)](#)

[Homework on [MasteringPhysics](#): due 2015/10/12]

<http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep2>

Course Basics

old edition



new edition

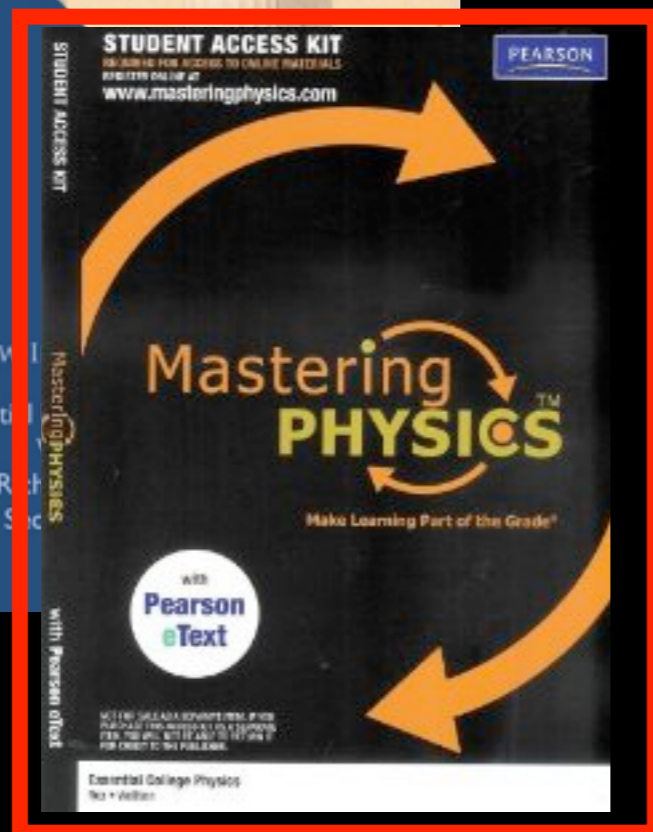


教科書 Textbook:

“Essential University Physics”
Richard Wolfson / Pearson

Volume 1 & 2

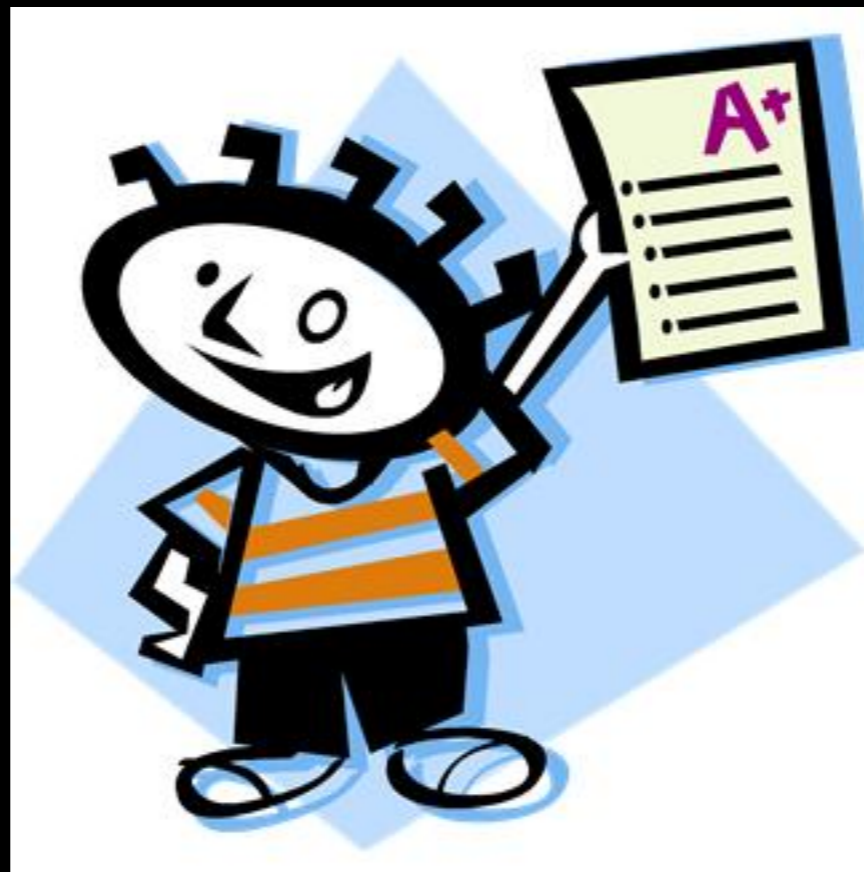
ISBN: 978-0321714381



very important!

Course Assessment

Grades



Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Homework:

Weekly problem set on the 'Mastering Physics' webpage
Due Monday 4:30 pm every week.

35%

Short (3-5 sentences) summary of science article.
~3 in semester

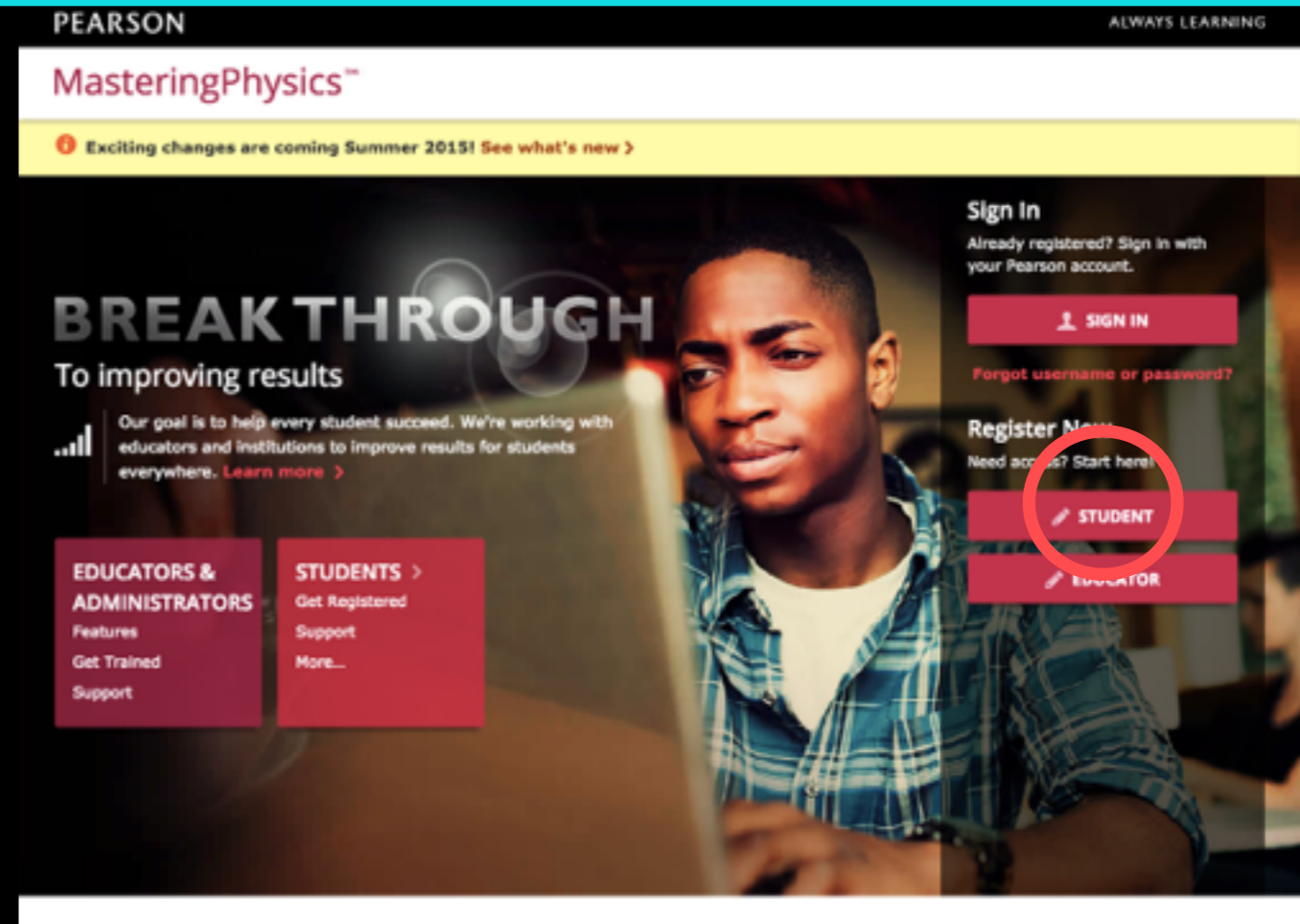
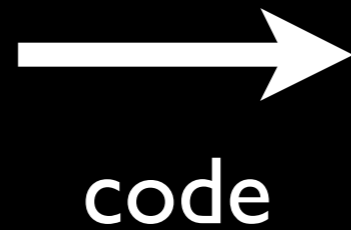
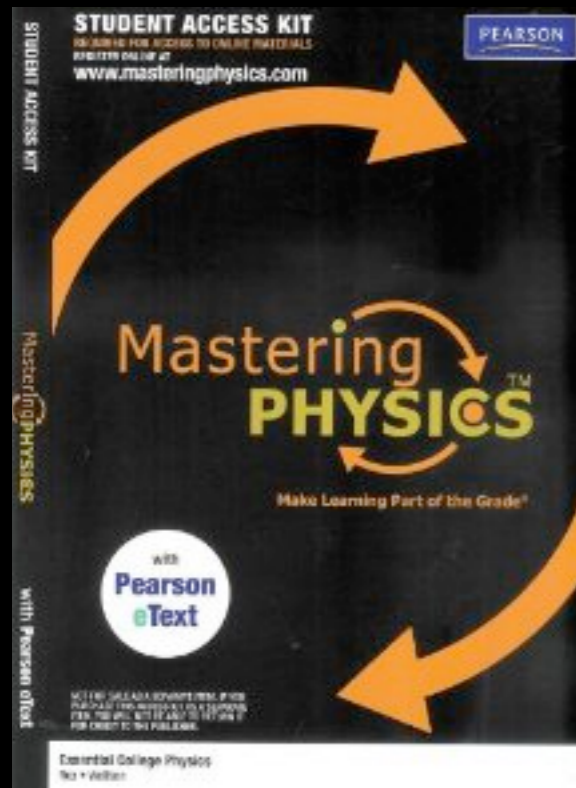
Due Monday 4:30 pm 1 week later.

5%

250 word essay on a science article.

Due January 18th 2016

Course Basics



<http://www.masteringphysics.com>

Course ID: EP22015TASKER

Student ID: Hokudai Student ID

All homework
assessments will
be here!

Course Basics

Example homework:

MasteringPHYSICS

Logged in as Elizabeth Tasker, Instructor | Help | Log Out

Converting Units

Return to Assignment 1

Item Type: Tutorial | Difficulty: 2 | Time: 17m | Contact the Publisher

Manage this Item: Standard View

Converting Units

The ability to convert from one system of units to another is important in physics. It is often impractical to measure quantities in the standard meters, kilograms, and seconds, but the laws of physics that you learn will involve constants that are defined in these units. Therefore, you may often have to convert your measured quantities into meters, kilograms, and seconds.

The following table lists metric prefixes that come up frequently in physics. Learning these prefixes will help you in the various exercises.

mega- (M)	$\times 10^6$
kilo- (k)	$\times 10^3$
centi- (c)	$\times 10^{-2}$
milli- (m)	$\times 10^{-3}$

$$1 = \frac{1000 \text{ mm}}{1 \text{ m}}$$

Part A

Suppose that you measure a pen to be 10.5 cm long. Convert this to meters.

Express your answer in meters.

10.5 cm = m

submit hints my answers show answer review part

Part B

This part will be visible after you complete previous part(s).

Part C

This part will be visible after you complete previous part(s).

Part D

This part will be visible after you complete previous part(s).

Course Assessment

Homework:

35%

Weekly problem set on the 'Mastering Physics' webpage

Due Monday 4:30 pm every week.

Short (3-5 sentences) summary of science article.

~3 in semester

Due Monday 4:30 pm 1 week later.

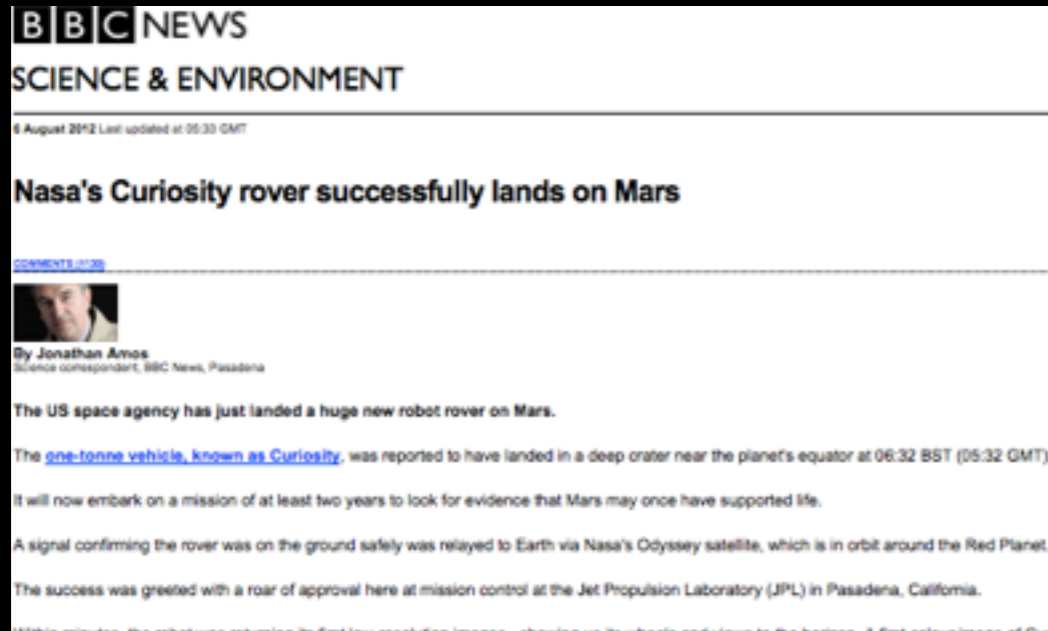
5%

250 word essay on a science article.

Due January 19th 2015

Course Basics

250 word essay



Sample Excerpts of Essay: Medical Science 1

Reflective writing is the narrative mode of analysis of the processes outlined – it explores not only what the experience was, but considers the meaning the writer attached to it at the time and subsequently, and how this meaning is likely to influence action in the future. Thus reflective writing may contribute to continued professional development in a number of ways. The process of writing reflectively may in itself be an important step in an individual's attempt to make sense of her/his practice (Coles, 2002).

In this paper, three reflective writing models namely by Gibbs (1998), David Kolb, and Jenny Moon will be discussed. Throughout the discussion, the elements of these models as well as their pros and cons will be illustrated together. The pros and cons of the different models are set in cases where there is under the supervision and without. In each case setting, pros and cons are in the context for classroom sizes of one, two and many. This is applicable for the models and the best singled out for the healthcare industry.

www.theonlinejournalwriting.com

Read a physics article
(in English) on a topic that
interests you

This can be one we have
covered in class, or a new one.

Describe its main points in
250 words.

Use your own words

Hand in BOTH essay and article

Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Clickers

clicker > 60 %



+

< 3 lectures missed



full 20 %

for 'Attendance/clickers'

.... except....!

Course Assessment



Please
do not
sleep
in class!

If you sleep, you will be
considered absent

3+ absences = fail



Course Assessment

Homework 40 % (Essay = 5%)

Attendance / clickers 20 %

Final test 40 %

Total 100 %

Pass > 60 %

Course Assessment

Final exam:

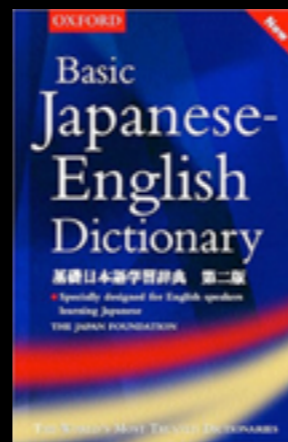
10 multiple choice questions

(A)

(B)

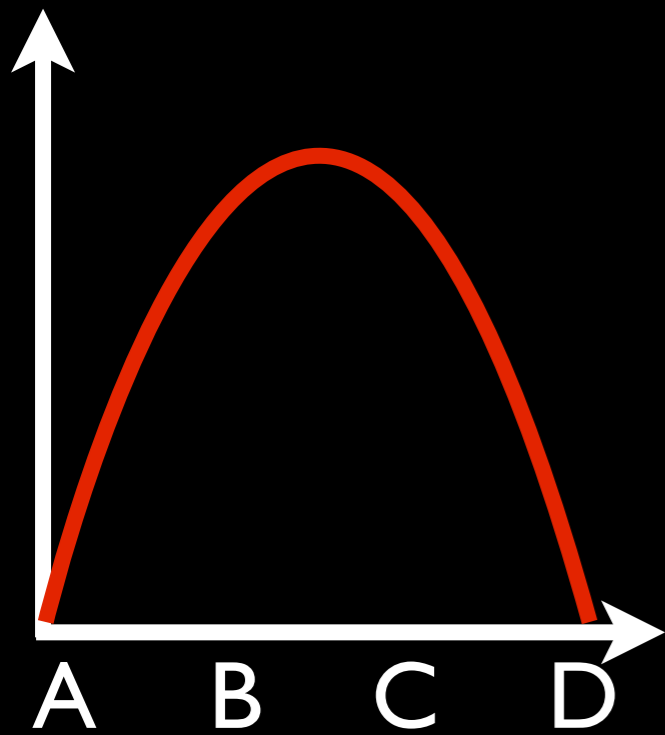
(C)

(D)



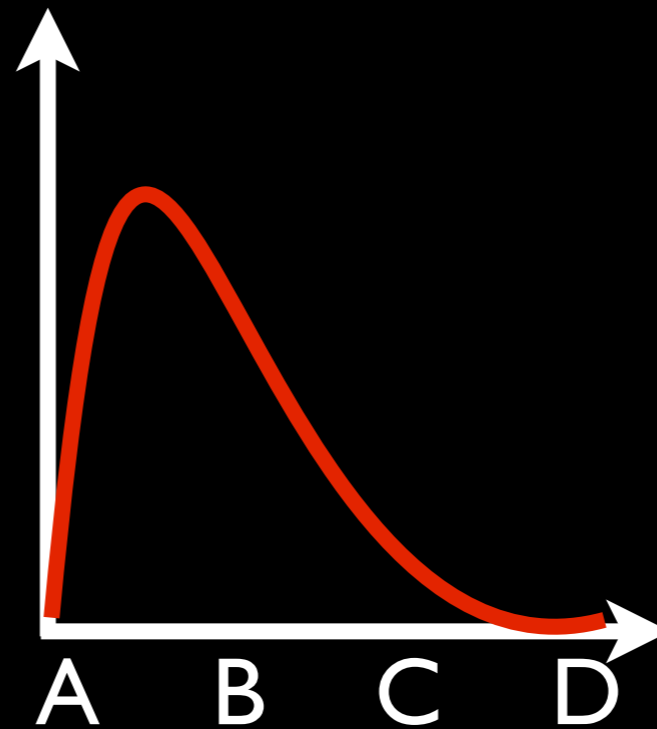
calculator and dictionary OK!

Course Assessment



Relative marking

Fixed % = A

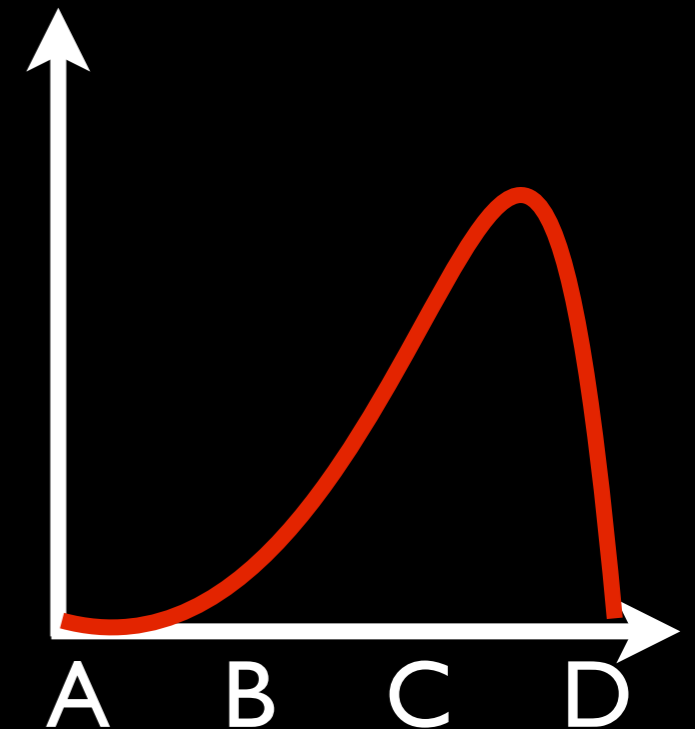


Absolute marking

Every student CAN get an A

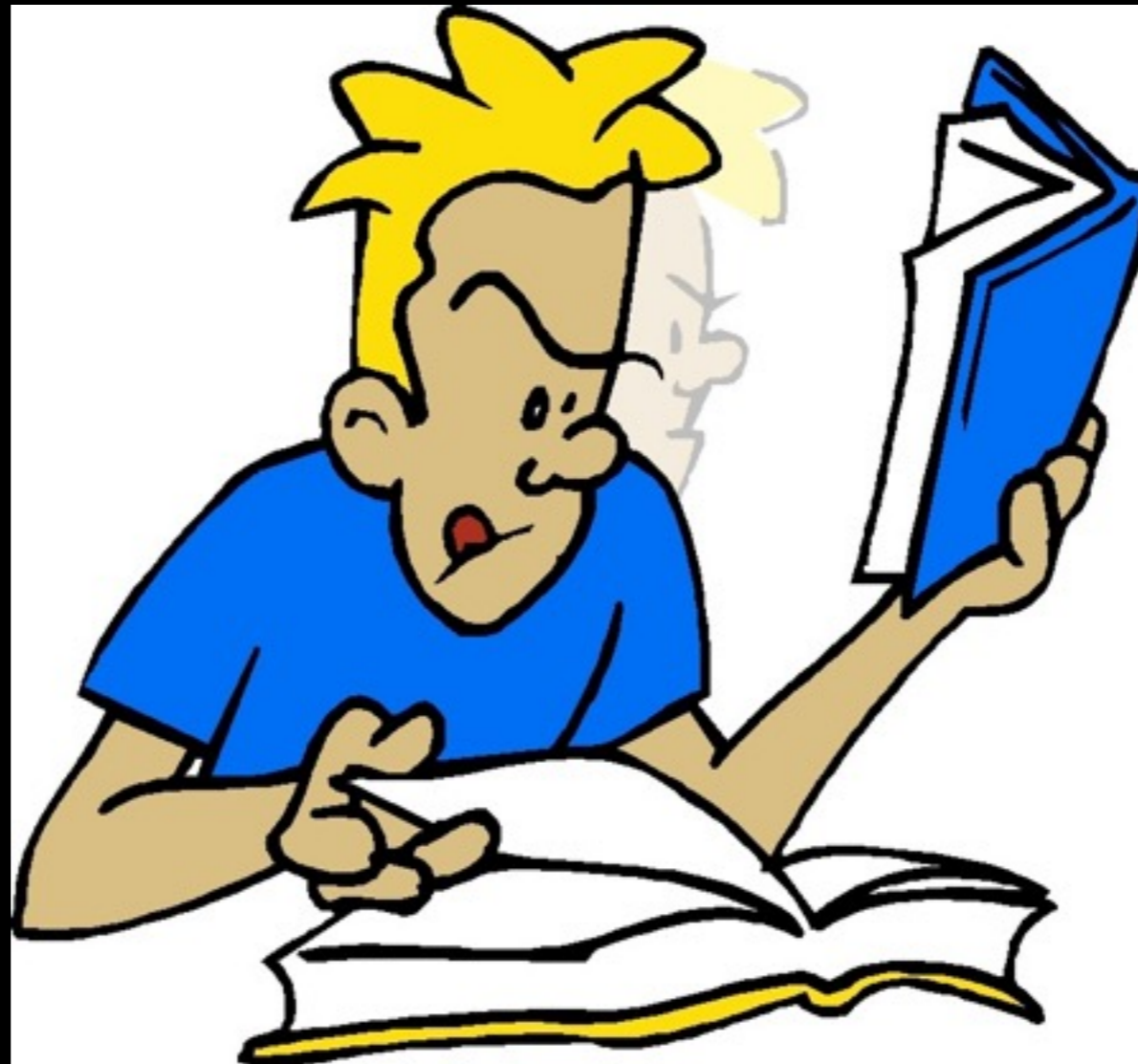
but...

Every student CAN get a D



Online Homework

How to do the 'Mastering Physics' homework



Online Homework

Homework: <http://www.masteringphysics.com>

1 assignment / week

PEARSON

ALWAYS LEARN

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- Get Trained
- Support

STUDENTS >

- Get Registered
- Support
- More...

Sign In

Already registered? Sign in with your Pearson account.

SIGN IN

[Forgot username or password?](#)

Register Now

Need access? Start here!

STUDENT

EDUCATOR



All homework assessments will be here!

Online Homework

PEARSON

ALWAYS LEARNING

MasteringPhysics®

 SIGN IN  REGISTER

BREAKTHROUGH

To improving results



STUDENTS

Get Registered

Titles Available

Features

Support

Get Involved

About Mastering

Do you have these 2 things?

Email

You'll get some important emails from your instructor at this address.

Access code or credit card

You can buy an access code packaged with your textbook or as a standalone access code kit. Or you can buy instant access with a credit card or PayPal account.

OK! Select your location

In US or Canada >

Outside US and Canada >



Online Homework

PEARSON

ALWAYS LEARNING

Register for MasteringPhysics Outside U.S. and Canada

Do you have an access code?

An access code may have been included with your textbook or in a Student Access Card/Kit available from your campus bookstore.

Your access code may look like this:

SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

If you do not have an access code, you can buy access with a credit card or PayPal account.

Yes, I have an access code

No, I need to buy access

Online Homework

PEARSON

License Agreement and Privacy Policy [Help ?](#)

By registering to use a Pearson Education online learning system, I certify that I have read and agree to the **Pearson License Agreement** and the **Pearson Privacy Policy**.

I understand that my personal information may be stored in and/or accessed from jurisdictions outside of my resident country. I consent to this storage and/or access.

The personal information that I use with a Pearson Education online learning system can include my name and contact information, my answers to questions that are part of the course, my marks on tests or other course requirements, and any comments about me made by my instructor.

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License Agreement [?](#)

Pearson Education End User License Agreement and Privacy Policy

These terms constitute an agreement between You and Pearson Education, Inc, and its direct and indirect affiliates ("Pearson"). Access or use of the website and/or service for which You seek registration constitutes acceptance of this Agreement. If You do not agree to abide by the terms and conditions of this Agreement, please do not register for or otherwise access or use this Website.

Pearson may change any of the terms in this Agreement at any time. Changes will become effective upon



Online Homework

PEARSON Steps to Register

Access Information Account Information Confirmation & Summary

Access Information * Fields are required [Video Tutorial](#) [Help](#) ?

Do you have a Pearson Education account? ?

Yes

No

[Not sure if you have an account?](#)

Access Code ?

Enter your access code.

* Access Code

- - - - -

[Switch to a single box for pasting your access code](#)

Example
SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

Cancel Next ▶

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Online Homework

PEARSON Steps to Register

Access Information Account Information Confirmation & Summary

Access Information

* Fields are required [Video Tutorial](#) [Help](#) ?

Do you have a Pearson Education account? ?

Yes

No

*** Create a Login Name**

It is recommended that you use your email address. It must be at least four characters. [See acceptable characters.](#)

Create a login name and password. Choose something that is easy to remember.

*** Create a Password**

Strength: **Good**

Create a password. It must be at least 8 characters with at least one letter and one number. [See acceptable characters.](#)

Your password cannot be the same as your login name.

*** Re-type your Password**

Not Sure

Access Code ?

Enter your access code.

*** Access Code**

- - - - -

[Switch to a single box for pasting your access code](#)

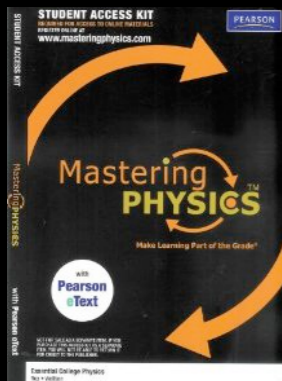
Example
SIMPLE-FRILL-TONLE-WEIRS-CHOIR-FLEES

▶

email

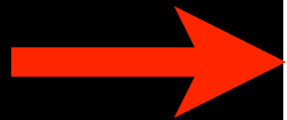


choose
password



Online Homework

name



email



Use email that
you check!

Sometimes, I may
contact you on this
email.

Account Information

MasteringPhysics for Wolfson, Essential University Physics, 2e- Bundled with eText

Personal Information

* First Name Elizabeth * Last Name Tasker

* Email Address tasker@astro.sci.hokudai.ac.jp

Enter a valid email address. [See acceptable characters.](#)
[Don't have an email address?](#)

* Re-type Your Email Address tasker@astro.sci.hokudai.ac.jp

School Location

* School Country Japan

* School Name Other

Select the name of your school from the list. If your school is not listed, select "Other" at the bottom of the list.

* Other School Name Hokkaido University

* School City Sapporo

Security Question

If you contact us, we will ask you this question to confirm your identity.

Online Homework

Account Information

MasteringPhysics for Wolfson, Essential University Physics, 2e- Bundled with eText

Personal Information

* First Name Elizabeth * Last Name Tasker

* Email Address tasker@astro.sci.hokudai.ac.jp

Enter a valid email address. [See acceptable characters.](#)
[Don't have an email address?](#)

* Re-type Your Email Address tasker@astro.sci.hokudai.ac.jp

School Location

* School Country Japan

* School Name Other

Select the name of your school from the list. If your school is not listed, select "Other" at the bottom of the list.

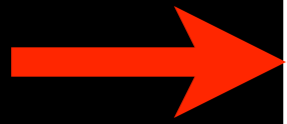
* Other School Name Hokkaido University

* School City Sapporo

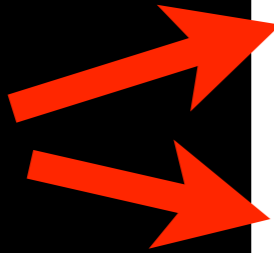
Security Question

If you contact us, we will ask you this question to confirm your identity.

name



email



Japan



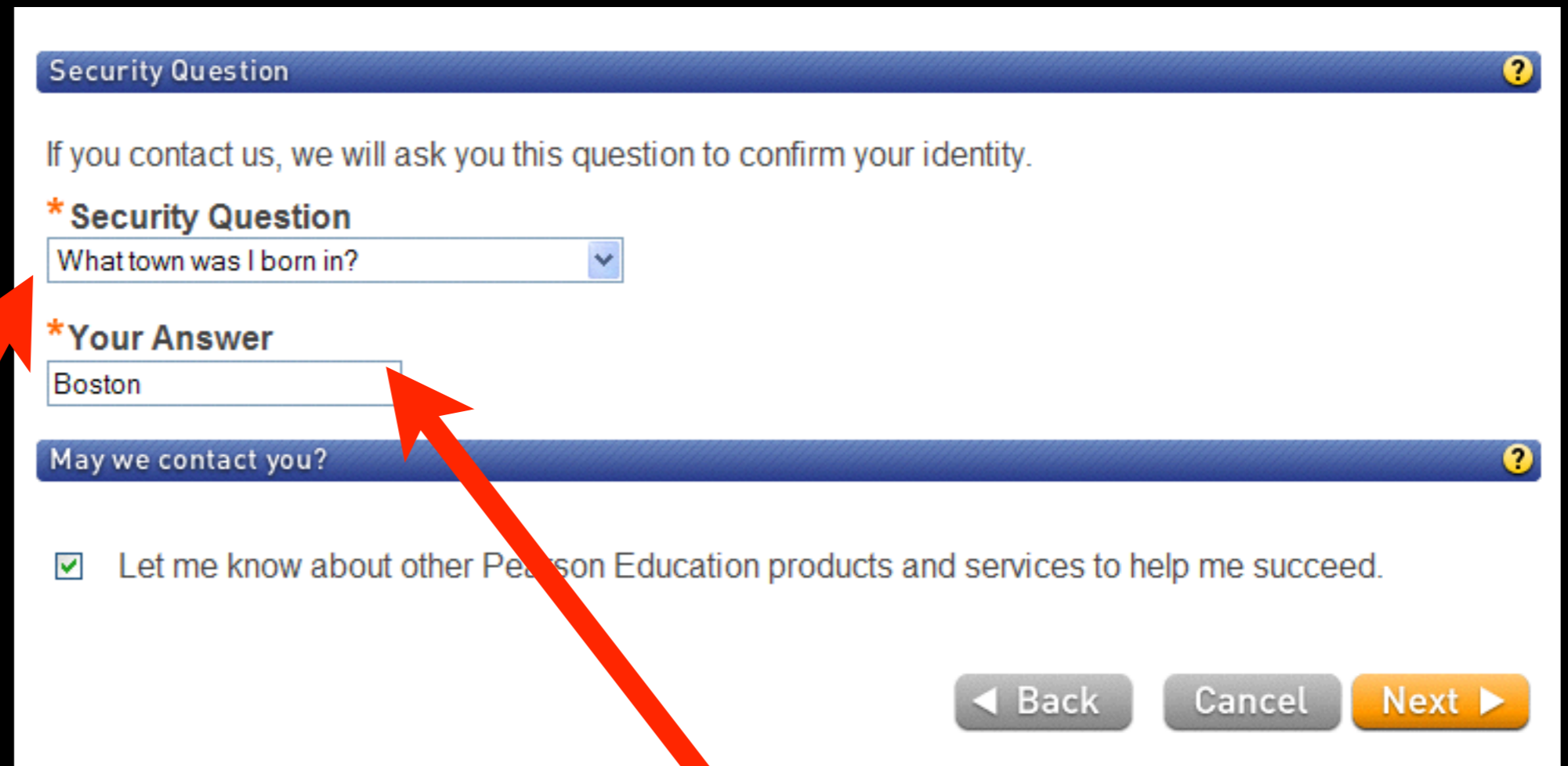
Other



Hokkaido
University



Online Homework



The screenshot shows a web form titled "Security Question" with a help icon. Below the title is the instruction: "If you contact us, we will ask you this question to confirm your identity." The form contains two main sections: "* Security Question" with a dropdown menu showing "What town was I born in?" and "* Your Answer" with a text input field containing "Boston". Below these is a section titled "May we contact you?" with a checked checkbox and the text "Let me know about other Pearson Education products and services to help me succeed." At the bottom right are three buttons: "Back", "Cancel", and "Next". Two red arrows originate from the bottom left: one points to the "What town was I born in?" dropdown, and the other points to the "Boston" text input field.

Security question
(if you lose password)

your answer

e.g. What town was I born in?

Mother's maiden (family name before marriage) name?

Online Homework

PEARSON Steps to Register

✓ Access Information ✓ Account Information ● Confirmation & Summary

Confirmation & Summary Print This Page

You have subscribed to a Pearson Education online product. Please [print this page](#) as your receipt. You will also receive a confirmation email for your records.

You now have access to... ?

MasteringPhysics

Log In Now ▶

If you need to review or edit your account information, visit your [Account Summary](#) page.

Role: Student	Account ID: 25761912
Expiration Date: Jan 1, 2011	Order ID: 48535029
Section or Module: MasteringPhysics	Login Name: physicsstudent1234

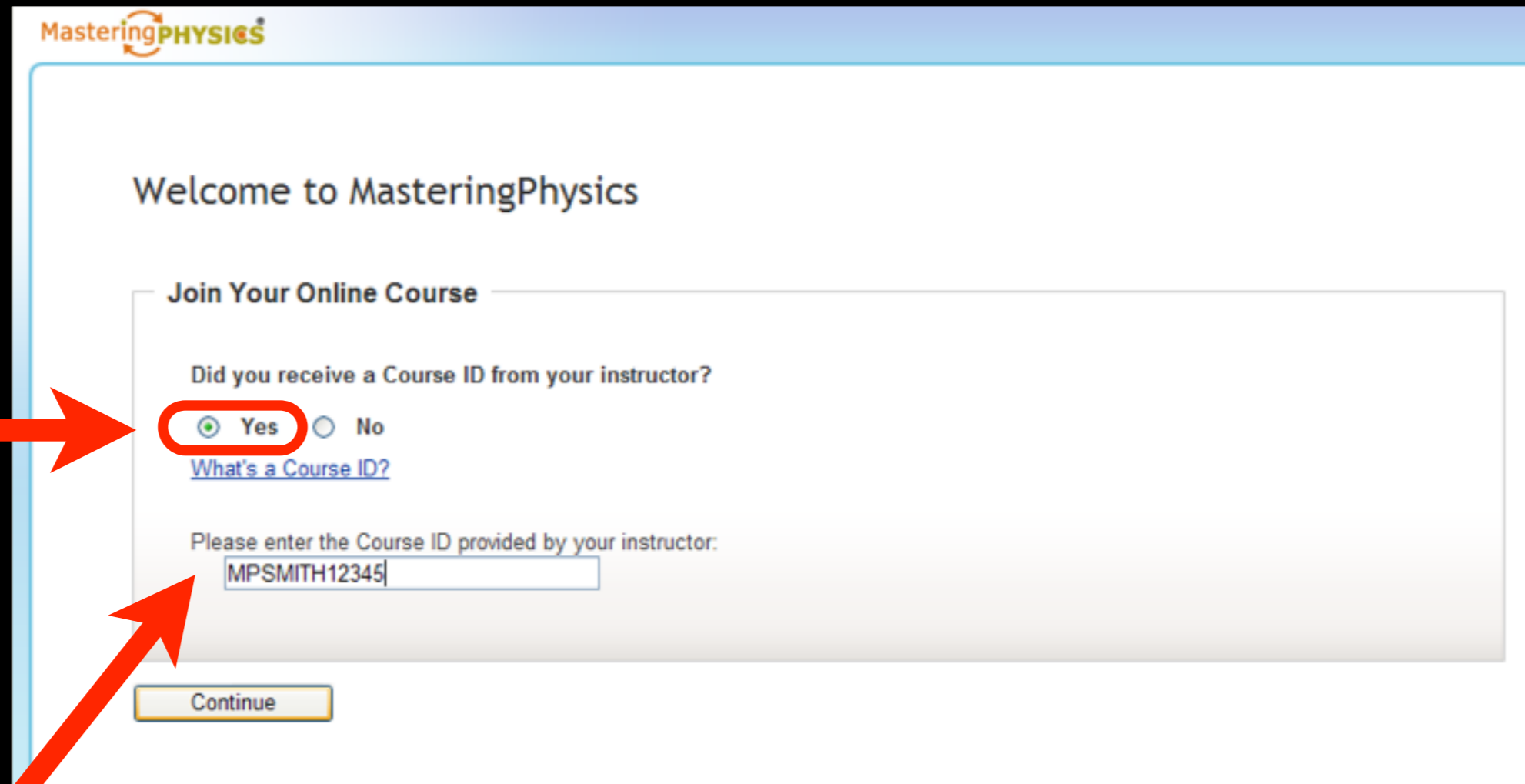
About Your Transaction ?

If you have any problems logging into or using this site, please contact [Customer Technical Support](#). If you need to review or edit your account information, visit your [Account Summary](#) page.

Transaction Date: Thu Jul 01 13:37:39 EDT 2010
Order ID: 48535029
Email Address: sara.owen@pearson.com

Online Homework

Join course:



MasteringPHYSICS

Welcome to MasteringPhysics

Join Your Online Course

Did you receive a Course ID from your instructor?

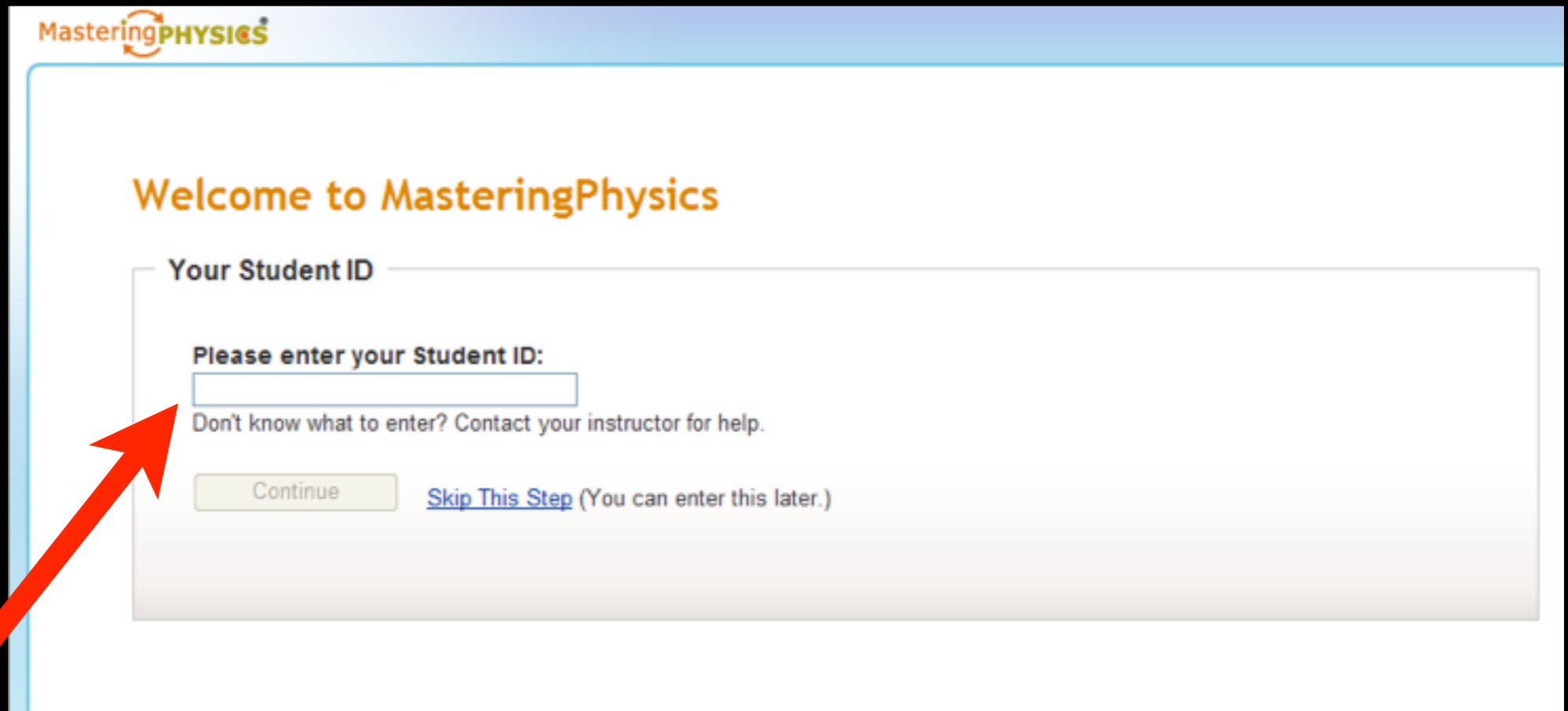
Yes No

[What's a Course ID?](#)

Please enter the Course ID provided by your instructor:

Course ID: EP22015TASKER

Online Homework



MasteringPHYSICS

Welcome to MasteringPhysics

Your Student ID

Please enter your Student ID:

Don't know what to enter? Contact your instructor for help.

[Skip This Step](#) (You can enter this later.)

Student ID: Hokudai Student ID
e.g. 02122000

Online Homework

CONGRATULATIONS!




You are registered with [masteringphysics.com](https://www.masteringphysics.com)

Online Homework

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ADMINISTRATORS**

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Get Trained
Support

STUDENTS >

Get Registered
Support
More...

Sign In

Already registered? Sign in with your Pearson account.

 **SIGN IN**

[Forgot username or password?](#)

Register Now

Need access? Start here!

 **STUDENT**

All homework assessments will be here!

Online Homework

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Sign In

Already registered? Sign in with your Pearson account.

Username

Password



email



password



[Forgot your username or password?](#)

New to MasteringPhysics? Visit our home page to register!

All homework
assessments will
be here!

Online Homework

MasteringPhysics® Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学#x...
[My Courses](#) | Course ID: EP12014TASKER | Course Ends: 08/11/14

[Course Home](#) [Assignments](#) [Scores](#)

Announcements

SUBJECT	DATE POSTED
Welcome! NEW	04/14/14 at 01:13pm

Showing 1 of 1 - [View All Announcements](#)

Course Materials

Get documents and other files posted by your instructor.

- [View Documents](#)
- [View Lectures](#)

Learn More

- [Getting Started](#)
- [How-To Video Tours](#)
- [FAQs](#)
- [Five Ways to Improve Your Grade](#)
- [Tutoring Services](#)

Course Calendar

April 2014

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28 Introduction...	29	30	1	2	3
4	5	6	7	8	9	10

[View All Assignments](#)

Online Homework

MasteringPhysics® Signed in as Elizabeth Tasker | Help | Sign Out

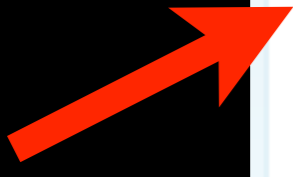
Welcome! Print | Help | Close X

Welcome to MasteringPhysics: all homework for Essential Physics I will be here.

Each week, there will be a new homework assignment. Each assignment will be due the following Monday at 4:30 pm (start of next week's lecture).

Please check here and on the webpage: <http://astro3.sci.hokudai.ac.jp/~tasker/teaching/ep1> for any announcements.

news



Online Homework

MasteringPhysics® Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学#x...
[My Courses](#) | Course ID: EP12014TASKER | Course Ends: 08/11/14

Course Home **Assignments** Scores

Announcements

SUBJECT	DATE POSTED
Welcome! NEW	04/14/14 at 01:13pm

Showing 1 of 1 - [View All Announcements](#)

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- [View Documents](#)
- [View Lectures](#)

Learn More

- [Getting Started](#)
- [How-To Video Tours](#)
- [FAQs](#)
- [Five Ways to Improve Your Grade](#)
- [Tutoring Services](#)

Course Calendar

April 2014

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6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28 Introduction...	29	30	1	2	3
4	5	6	7	8	9	10

[View All Assignments](#)

Homework

Online Homework

MasteringPhysics®

Signed in as [Elizabeth Tasker](#) | [Help](#) | [Sign Out](#)

Essential Physics I / 英語で学&#x...

[My Courses](#) ▾ | Course ID: EP12014TASKER | Course Ends: 08/11/14

[Course Home](#)

[Assignments](#)

[Scores](#)

Essential University Physics, 10th Edition
Wolfson

Assignments

TITLE	DUE DATE/TIME	ACTIONS
Introduction to MasteringPhysics	04/28/14 at 12:00pm	Print View

PEARSON

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Due date

(2 weeks because
textbook purchase
needed)

This week's homework

Online Homework

MasteringPhysics: Introduction to MasteringPhysics
session.masteringphysics.com/myct/assignment?assignmentID=2848941

Essential Physics I / 英語で学ぶ物理学のエッセンス I Signed in as Elizabeth Tasker | Help | Close

Introduction to MasteringPhysics Resources

Introduction to MasteringPhysics

Due: 12:00pm on Monday, April 28, 2014

To understand how points are awarded, read the [Grading Policy](#) for this assignment.

A Message from Your Instructor:
The purpose of the following exercises is to familiarize you with the system you will be using for the rest of your course. These exercises are not intended to teach or test your knowledge of any specific subject material. Therefore, you will not be penalized for using hints or submitting incorrect answers.

Welcome! is for 1 point(s) (full credit) Incomplete
Introduction to Numeric Answers is for 1 point(s) (full credit) Incomplete
Introduction to Numeric Answers with Units is for 1 point(s) (full credit) Incomplete
Introduction to Significant Figures is for 1 point(s) (full credit) Incomplete
Introduction to Symbolic Answers is for 1 point(s) (full credit) Incomplete
Introduction to Sorting Questions is for 1 point(s) (full credit) Incomplete
Introduction to Ranking Questions is for 1 point(s) (full credit) Incomplete
Introduction to Graphing Questions is for 1 point(s) (full credit) Incomplete
Introduction to Vector Drawing Questions is for 1 point(s) (full credit) Incomplete
Reviewing the Fundamentals is for 1 point(s) (full credit) Incomplete

Score Summary:
Your score on this assignment is 0.0%.

Questions



Online Homework

MasteringPHYSICS

Logged in as Chris Pearson | Help | Log Out


Welcome! Resources Help Close X

[Return to Introduction to MasteringPhysics](#) Previous 1 of 8 Next

Welcome! Chris Pearson

Mastering presents homework items assigned by your instructor and *works with you* to answer them. Homework items typically have an introduction, possibly figures, and one or more parts for you to answer.

Part A **Part B**



Type of help offered

- Mastering tells you immediately whether or not your answers are correct. Usually, you will have multiple chances to arrive at the correct answer. Your instructor will determine how many tries you have available.
- In many items, hints are available to help you if you get stuck. If you don't need the hints to solve the problem, you can still use them for review later on.
- If you submit an incorrect answer, Mastering often responds with specific, helpful feedback.
- Mastering is forgiving of many typos and formatting mistakes. If it can't figure out what you entered, it will let you know and give you another chance.

These exercises were chosen specifically to lead you through the key features of Mastering and are not intended to test your knowledge of any specific subject material. Therefore, on this item you will not be penalized for using hints and submitting incorrect answers. In fact, you should submit incorrect answers and use the hints to see what happens!

Part A

How many squares are in this 2×2 grid ([Part A figure](#)) ? Note that the figure link lets you know that a figure goes along with this part. This figure is available to the left.

Enter your answer as a number in the box below and then submit your answer by clicking **Submit**.

Number of squares =

[submit](#) [my answers](#) [give up](#) [review part](#)

Grading

See the help file available by clicking the **Help** tab in the top right corner, if you want to know more about how grading works. Here is the most important information you'll need.

e.g. Question

How to send an email....



Confused?

I don't understand your example.

How do I do the online homework?

What is 'homework'?

... email me!

How to send an email....

Dear Professor Tasker,

I am sorry, but I could not do question 6b of the homework.

This is because I did not understand 'conductors' in the last lecture



How to send an email....

Dear Professor Tasker,

I am sorry, but I could not do question 6b of the homework.

This is because I did not understand 'conductors' in the last lecture

I did not understand the question.

مرحبا العالم! Hallo Welt!
Hej Värld! Hello World!
Ciao Mondo
ハローワールド!
¡Holá mundo! 世界您好!
Salut le Monde!

How to send an email....

Dear Professor Tasker,

I am sorry, but I could not do question 6b of the homework.

This is because I did not understand 'conductors' in the last lecture



I did not understand the question.

I have forgotten how to use a calculator

How to send an email....

Dear Professor Tasker,

I am sorry, but I could not do question 6b of the homework.

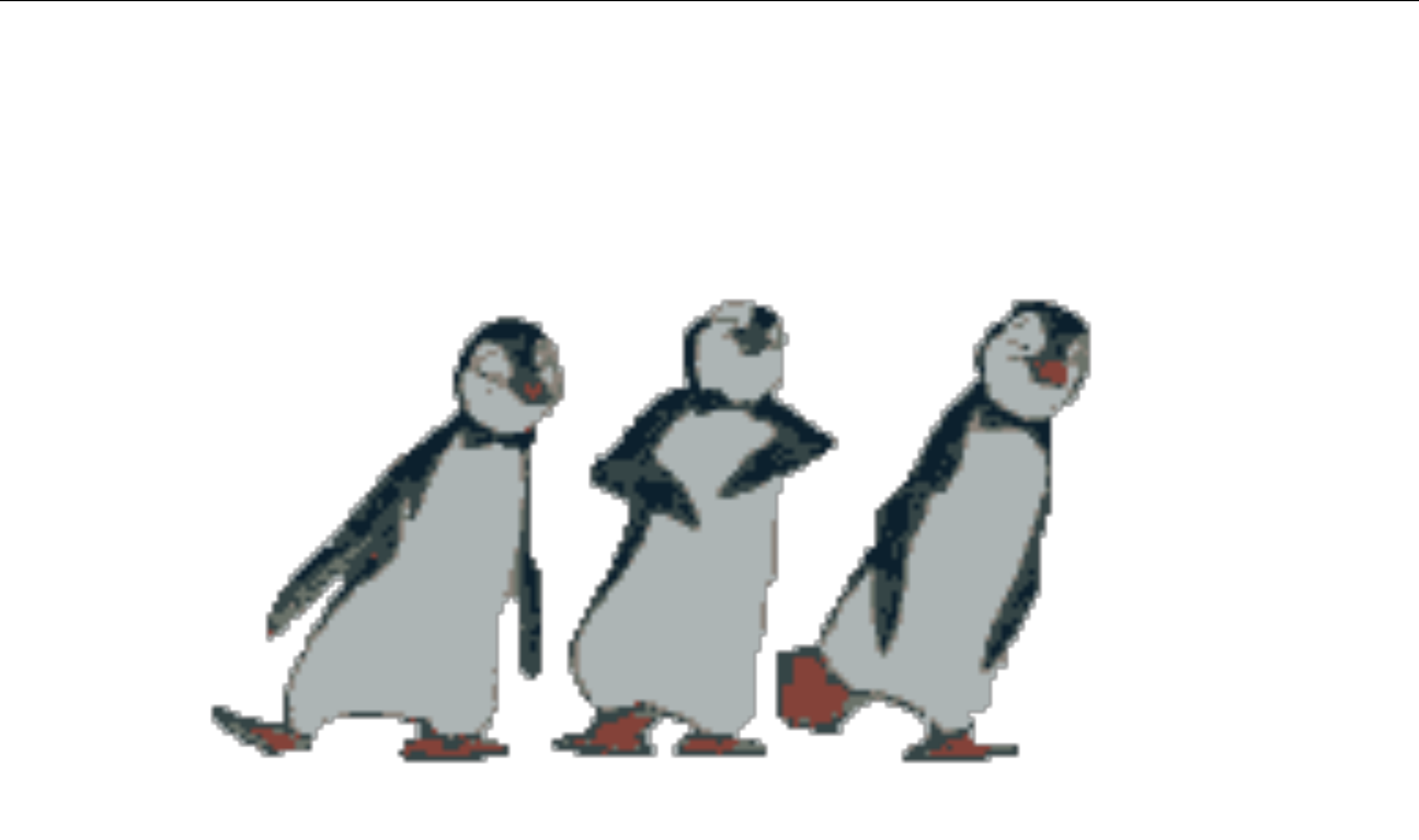
This is because I did not understand 'conductors' in the last lecture

Thank you,

Kosuke Fujii

(student ID: 02153673)

Last semester, we covered the **physics of motion**:



You walk into a restaurant:



Someone drops a cup

Motion in 1D

PE \rightarrow KE



A food fight breaks out

Projectiles

Collisions



Legs swing under table

Physical pendulum



Waiter with a tray

Equilibrium



A cup overflows

Buoyancy



Pushing a table

Friction



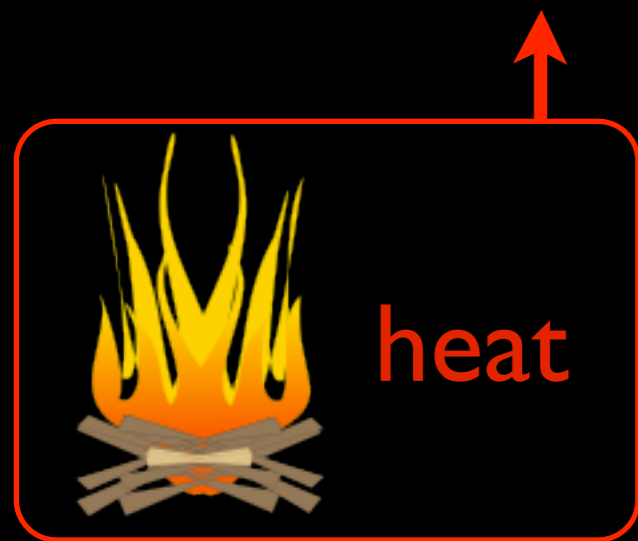
But... sometimes we stand still....



And physics still happens

Essential Physics II

Part I: Thermodynamics



What is heat & temperature?

How is it transferred (moved)?



What happens when water changes to ice?

What laws control heat energy?

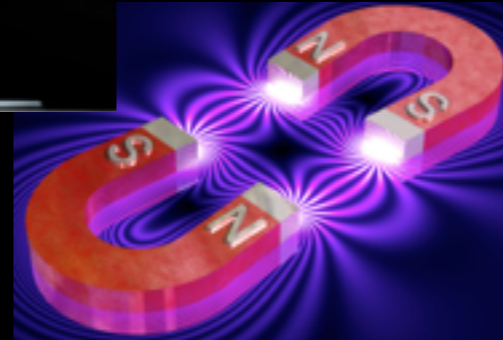


Essential Physics II

Part 2:



Electricity



& Magnetism

Gauss's Law
for electricity

Maxwell's equations
for electromagnetism

Gauss's Law
for magnetism

Faraday's Law

Ampere's Law

Essential Physics II

Part 3: Modern Physics

LIGHT IS A

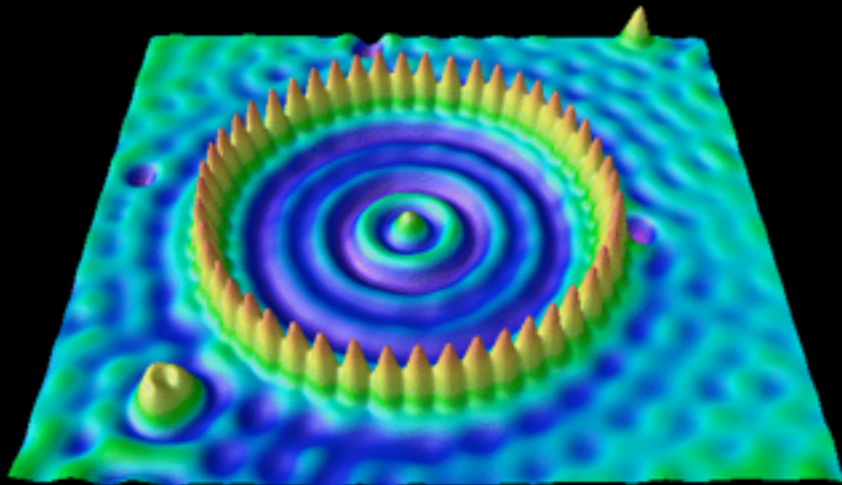
WAVE!

Wave particle duality

Essential Physics II

Part 3: Modern Physics

LIGHT IS A
WAVE!



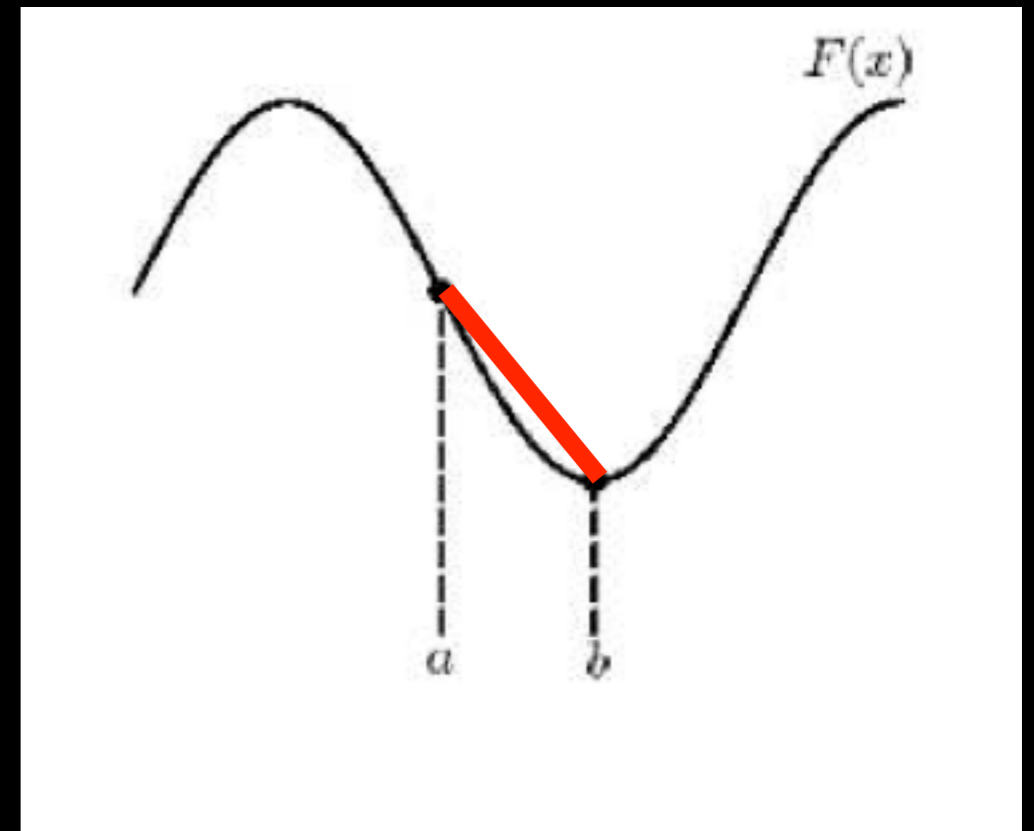
Wave particle duality

Quantum mechanics



Particle physics

Which equation gives the slope of a line drawn between the two points marked in the figure?



(a) $m = \frac{F(a) + F(b)}{a + b}$

(c) $m = \frac{a}{b}$

(b) $m = \frac{F(b) - F(a)}{b - a}$

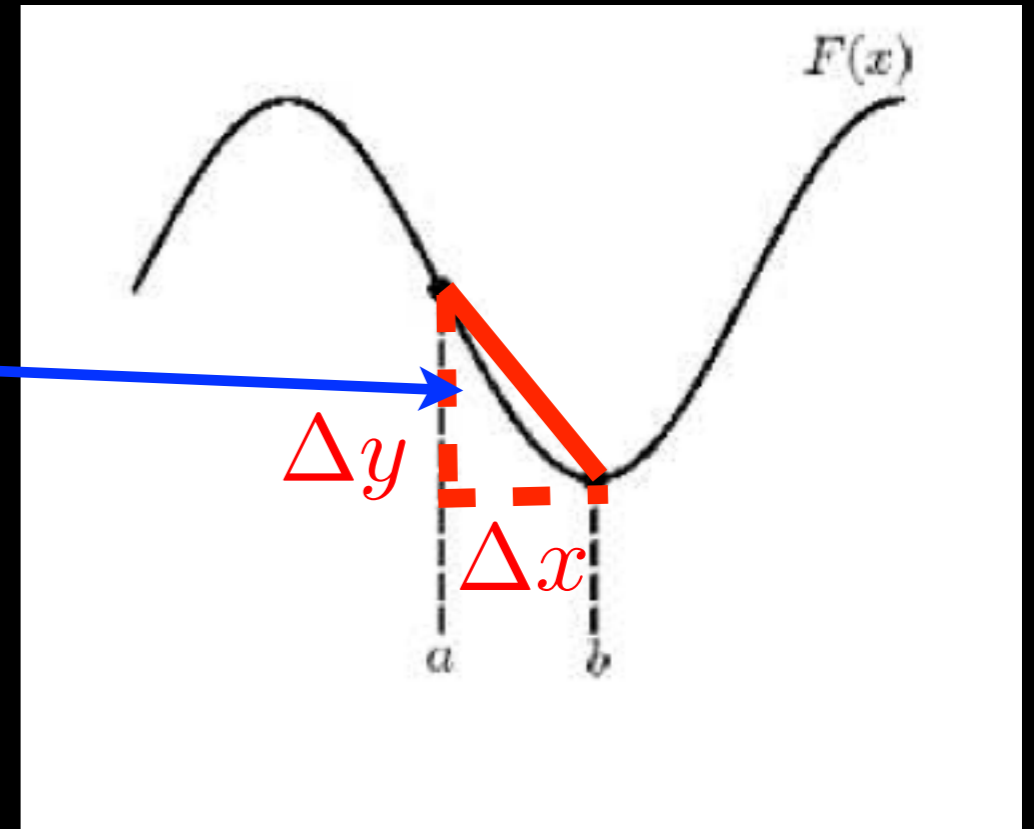
(d) $m = \frac{F(a) - F(b)}{b - a}$

gradient, m : $m = \frac{\Delta y}{\Delta x}$

gradient is negative

$$\Delta y = F(b) - F(a)$$

$$\Delta x = b - a$$



(a) $m = \frac{F(a) + F(b)}{a + b}$

(c) $m = \frac{a}{b}$

(b) $m = \frac{F(b) - F(a)}{b - a}$

(d) $m = \frac{F(a) - F(b)}{b - a}$

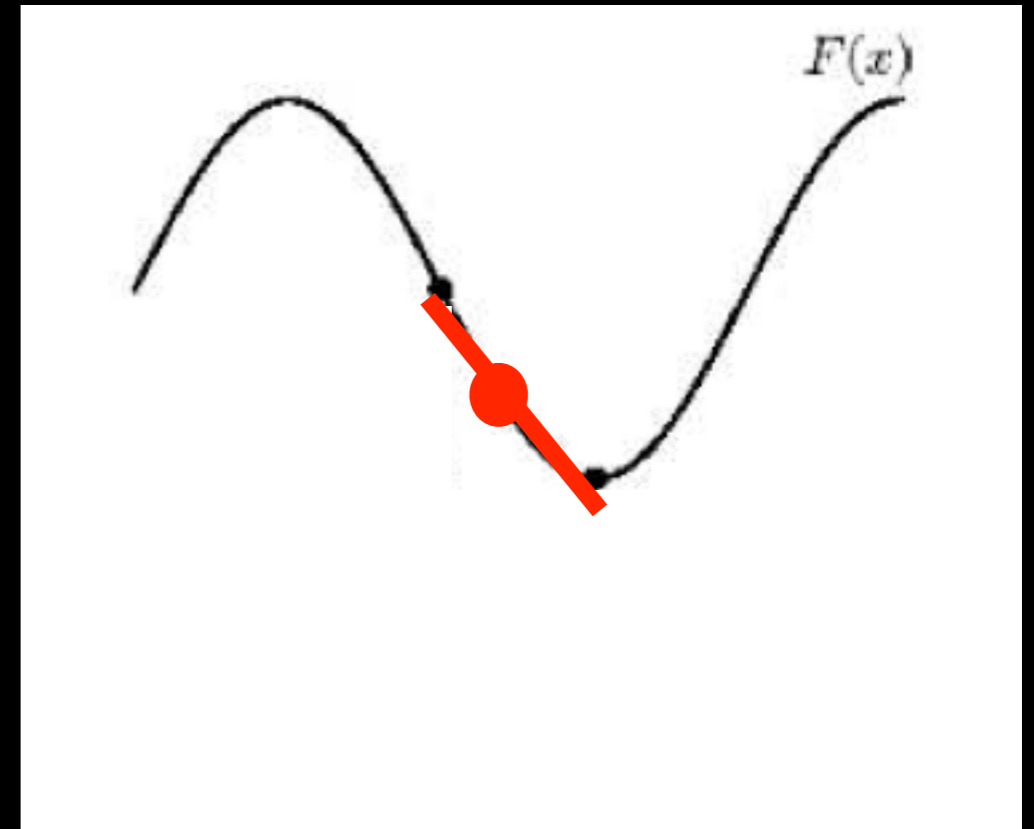
As points get closer:

average gradient (slope)

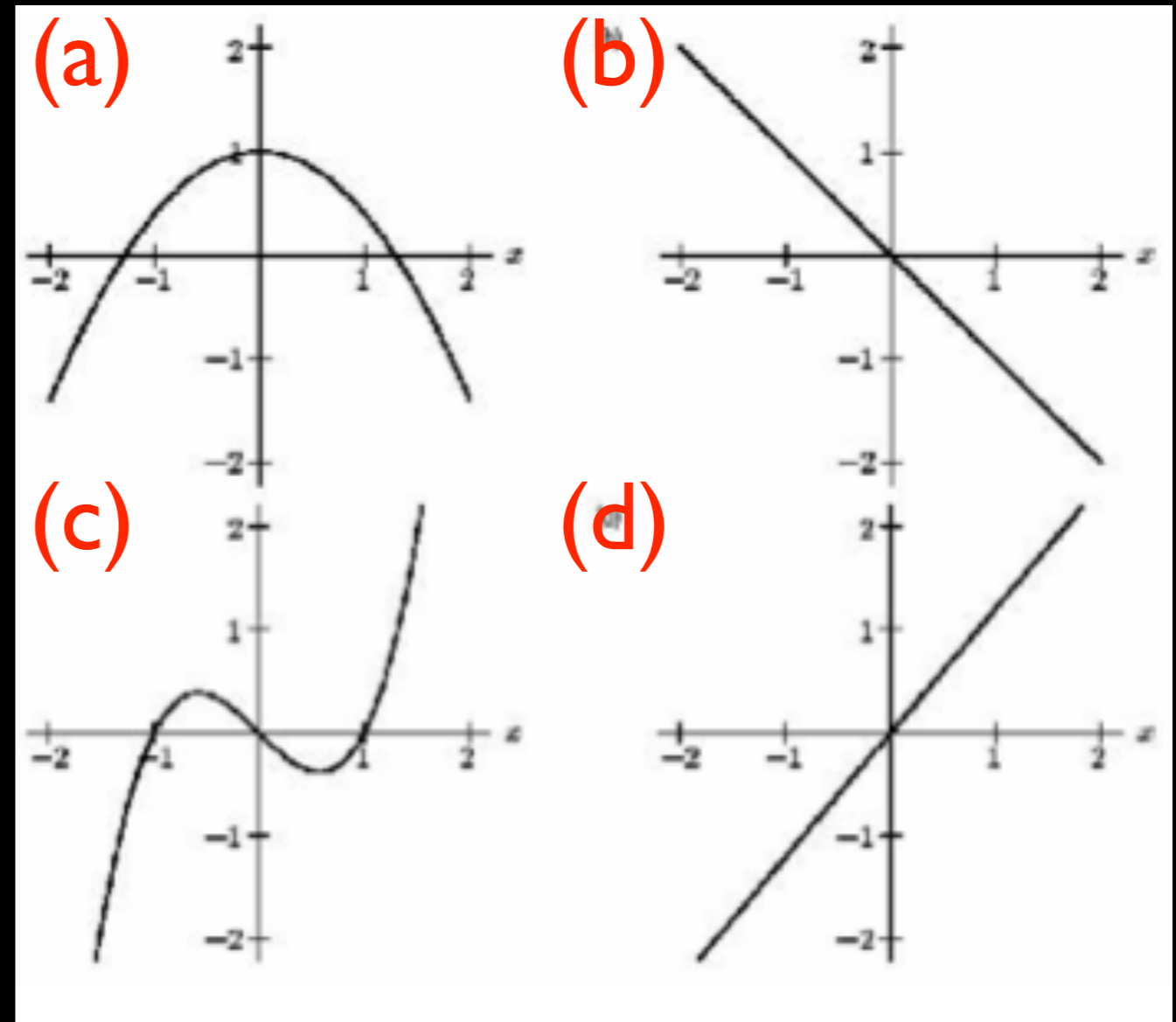
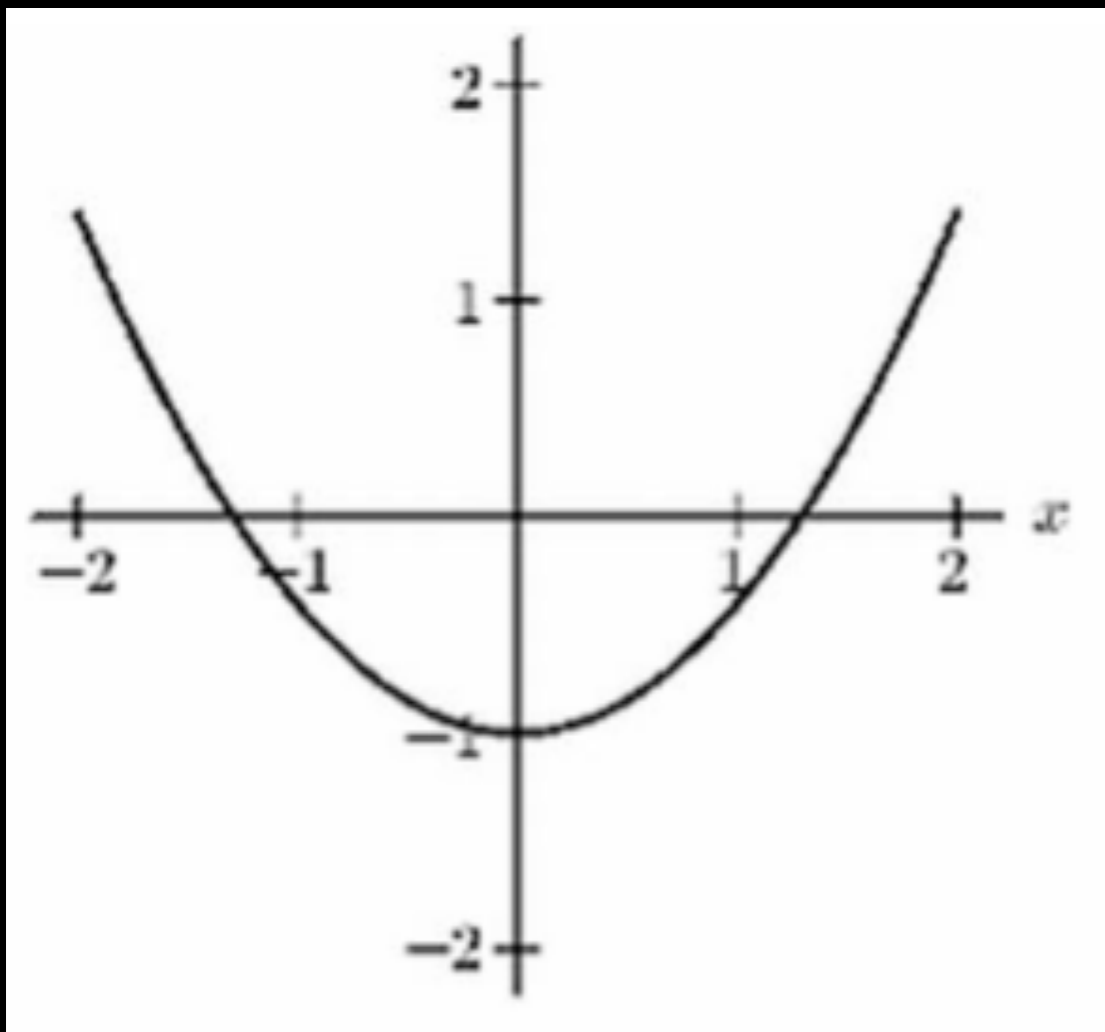


instantaneous gradient
(differential)

$$m = \frac{\Delta y}{\Delta x} = \lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx}$$



Which is a plot of the gradient?



(a)

(b)

(c)

(d)

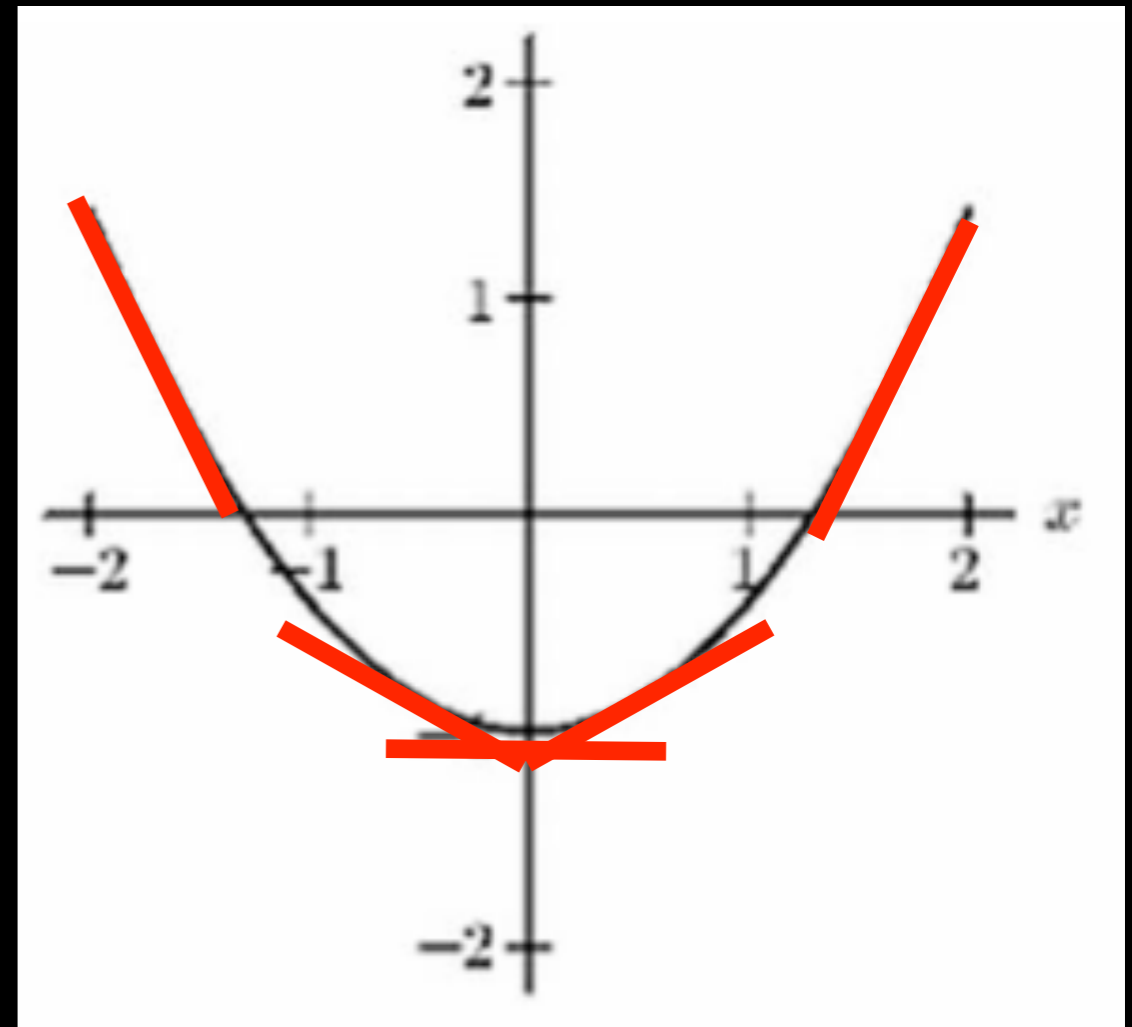
Negative gradient

Increases (it is negative, so a shallower gradient becomes more positive)

Becomes 0

Increases more

Therefore, gradient is steadily increasing



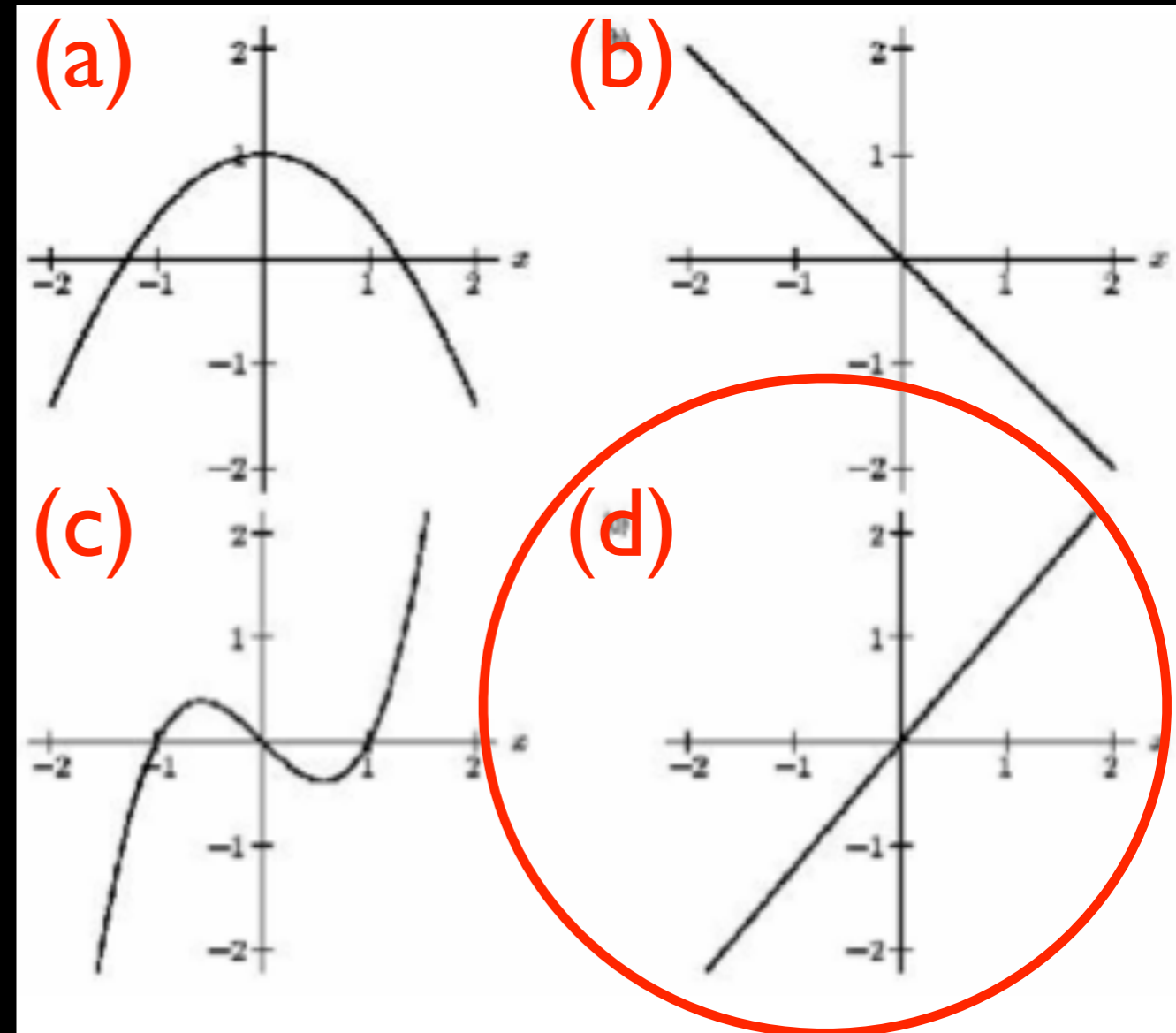
Negative gradient

Increases (it is negative, so a shallower gradient becomes more positive)

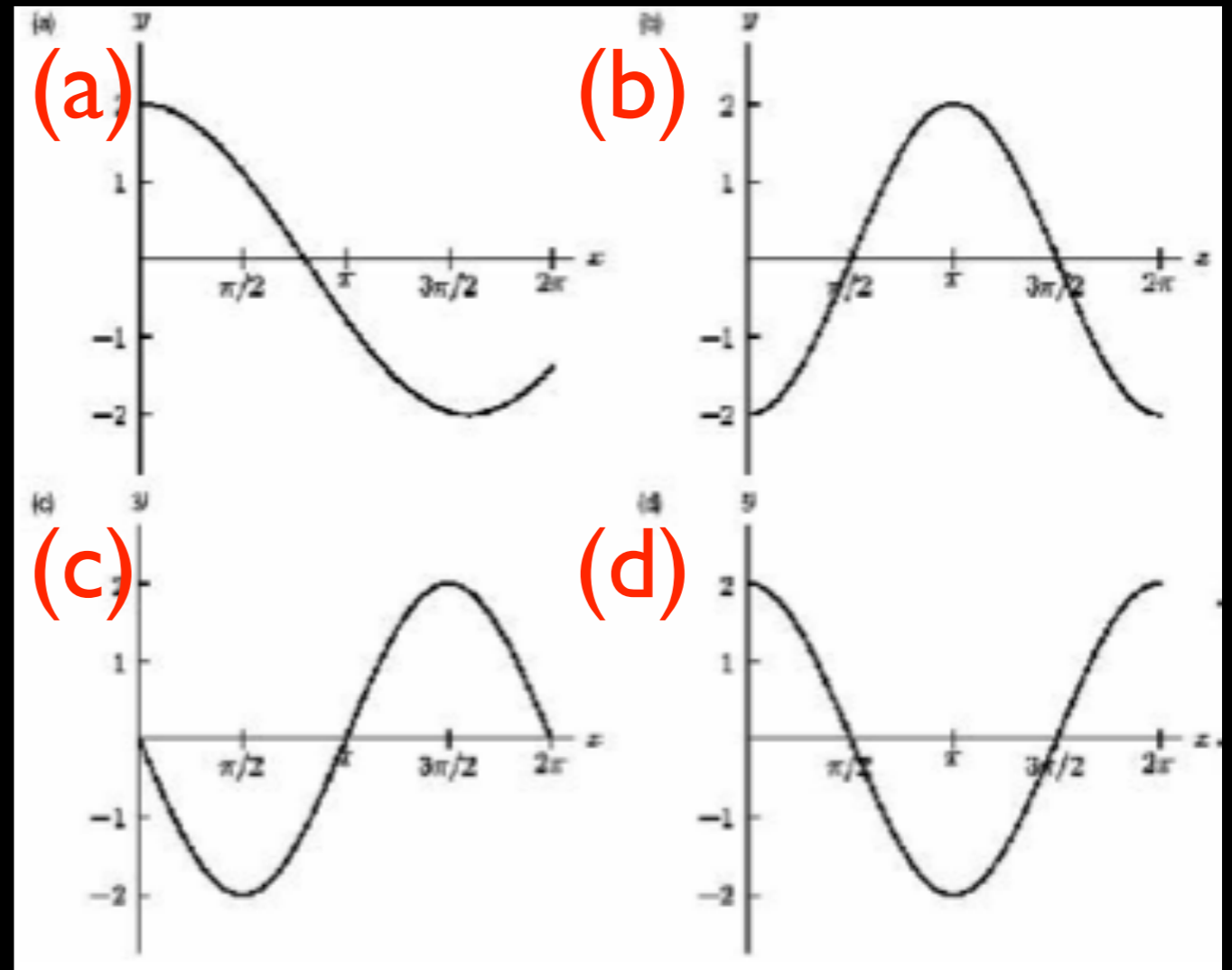
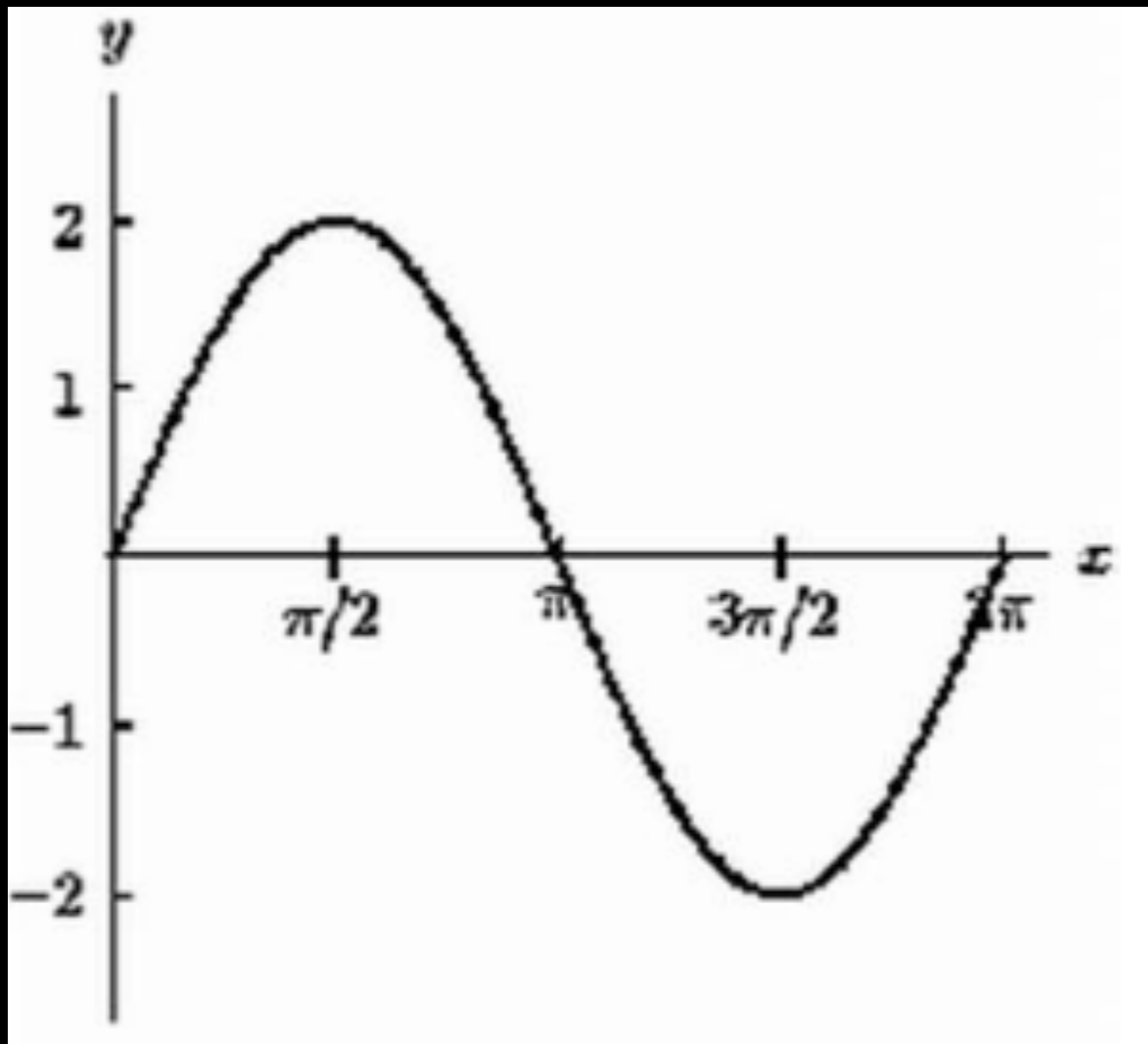
Becomes 0

Increases more

Therefore, gradient is steadily increasing



Which is a plot of the gradient?



(a)

(b)

(c)

(d)

Maths

Quiz

Gradient is positive and decreasing.

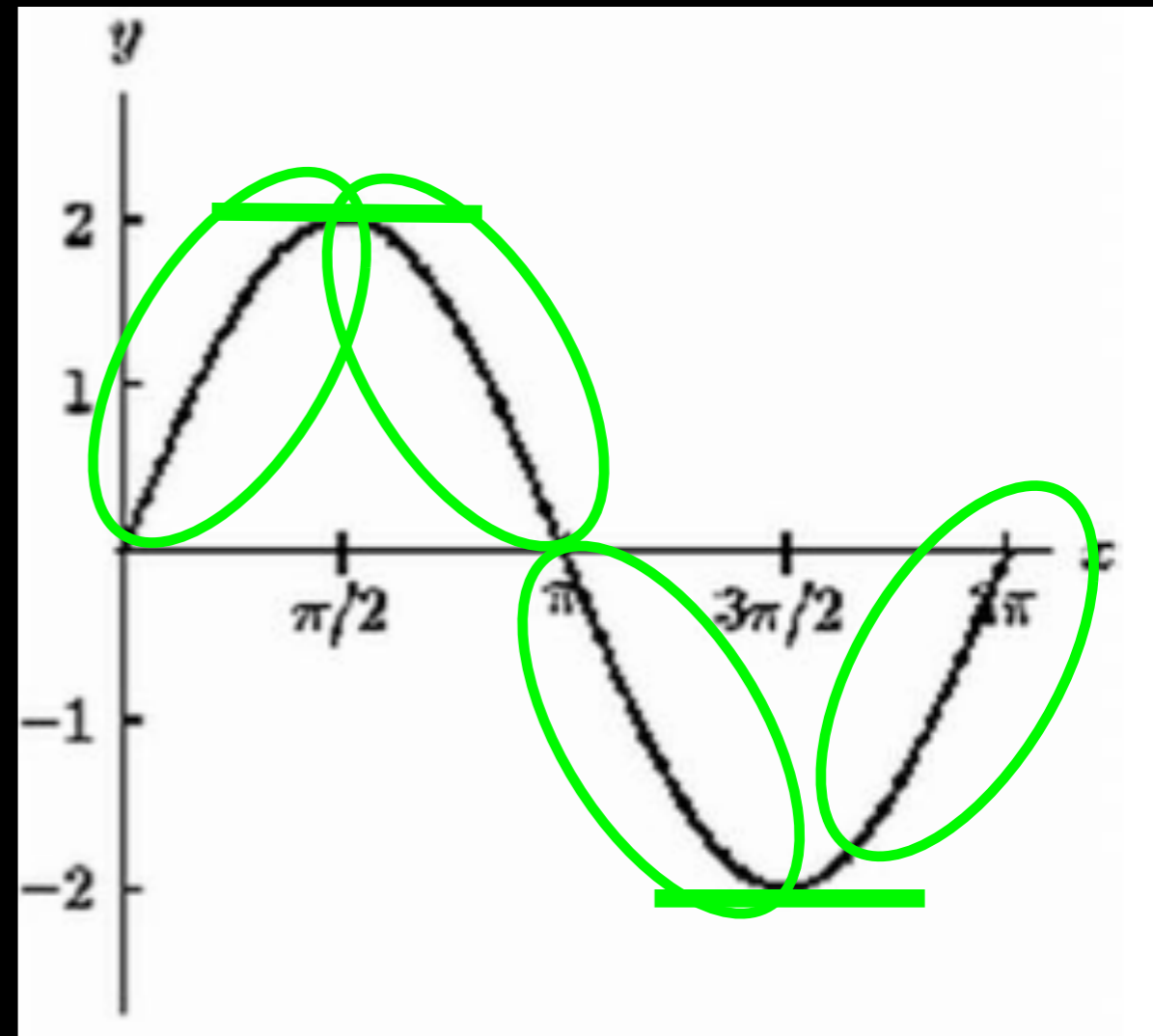
Gradient is 0 at $\pi/2$

Gradient is negative and decreasing.

Gradient is negative and increasing.

Gradient is 0 at $3\pi/2$

Gradient is positive and increasing



Gradient is positive and decreasing.

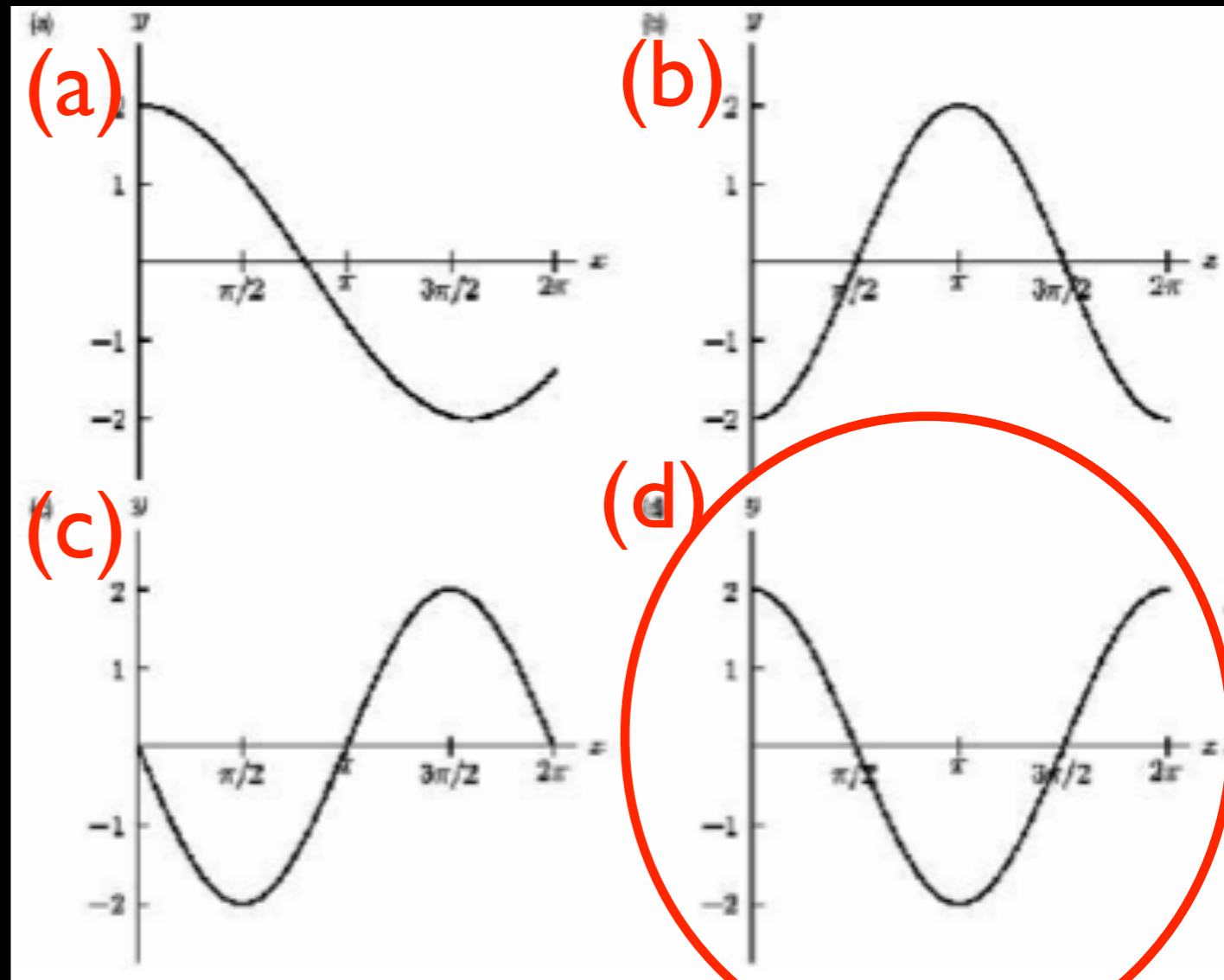
Gradient is 0 at $\pi/2$

Gradient is negative and decreasing.

Gradient is negative and increasing.

Gradient is 0 at $3\pi/2$

Gradient is positive and increasing



Find the gradient of the curve $y = 4x^2 + 2x + 7$ at $x = 3$

(a) 21

(b) 26

(c) 49

(d) not possible

$$\frac{dy}{dx} = 8x + 2$$

$$= 8(3) + 2$$

Find the gradient of the curve $y = \sin x + 3x + 5$ at $x = \pi/2$ rad.

(a) 2.55

(b) 3

(c) 8

(d) not possible

$$\begin{aligned}\frac{dy}{dx} &= \cos x + 3 \\ &= \cos\left(\frac{\pi}{2}\right) + 3 \\ &= 0 + 3\end{aligned}$$

Find the gradient of the curve $y = \sqrt{x^3 - x - 2}$ at $x = 2$

(a) 11

(b) 11/4

(c) $\sqrt{11}/22$

(d) not possible

$$\frac{dy}{dx} = \frac{1}{2} (x^3 - x - 2)^{-1/2} (3x^2 - 1)$$

$$= \frac{3x^2 - 1}{2\sqrt{x^3 - x - 2}}$$

$$= \frac{12 - 1}{2\sqrt{8 - 2 - 2}}$$

$$= \frac{11}{2\sqrt{4}} = \frac{11}{4}$$

Which is the indefinite integral of $x^2 + 7$?

(a) $\int (x^2 + 7)dx = 2x + c$ $\int x^n dx = \frac{1}{n+1}x^{n+1}$

(b) $\int (x^2 + 7)dx = \frac{1}{2}x^3 + 7x$

(c) $\int (x^2 + 7)dx = x^3 + 7x$

(d) $\int (x^2 + 7)dx = \frac{1}{3}x^3 + 7x + c$

Compute the following integral $y = \int_0^{\pi} (\cos x) dx$

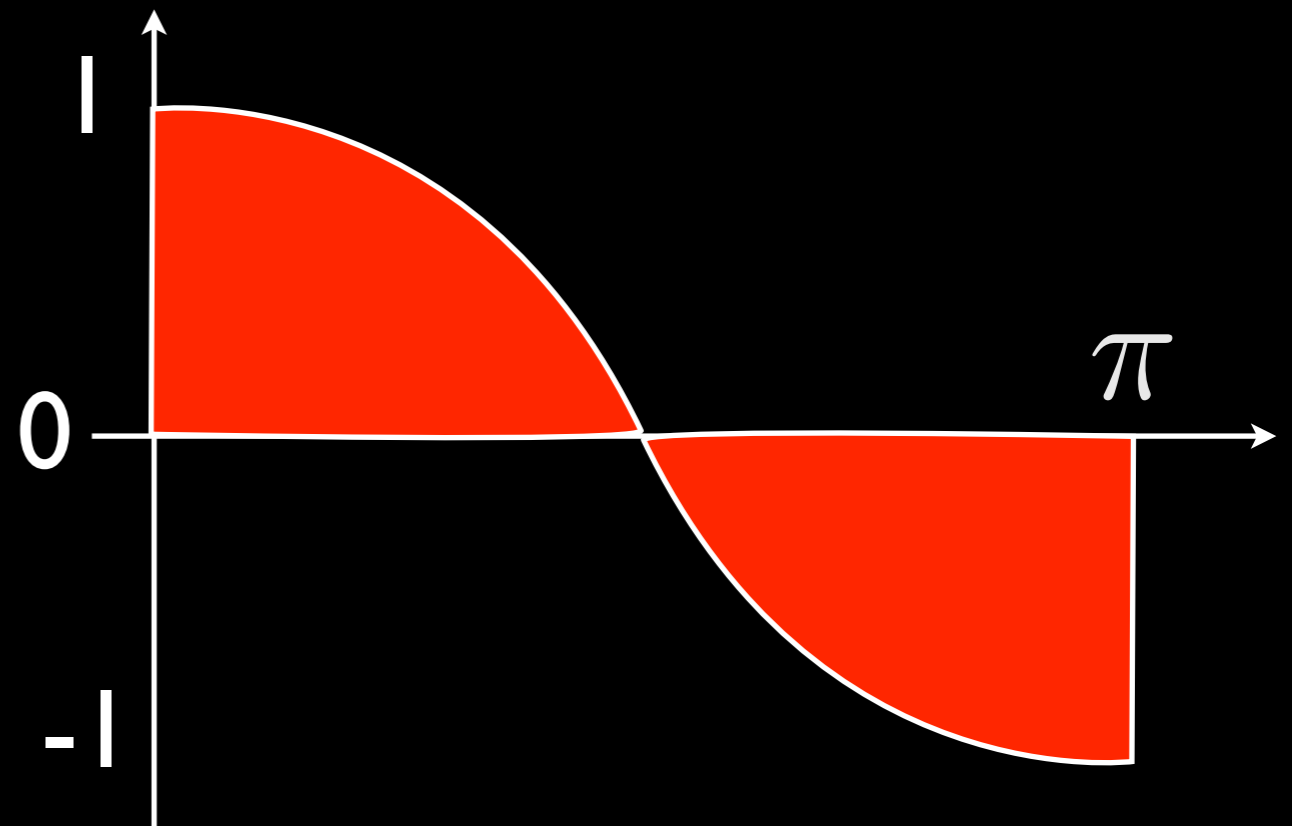
(a) $-\sin x$

(b) 1

(c) -2

(d) 0

(e) π



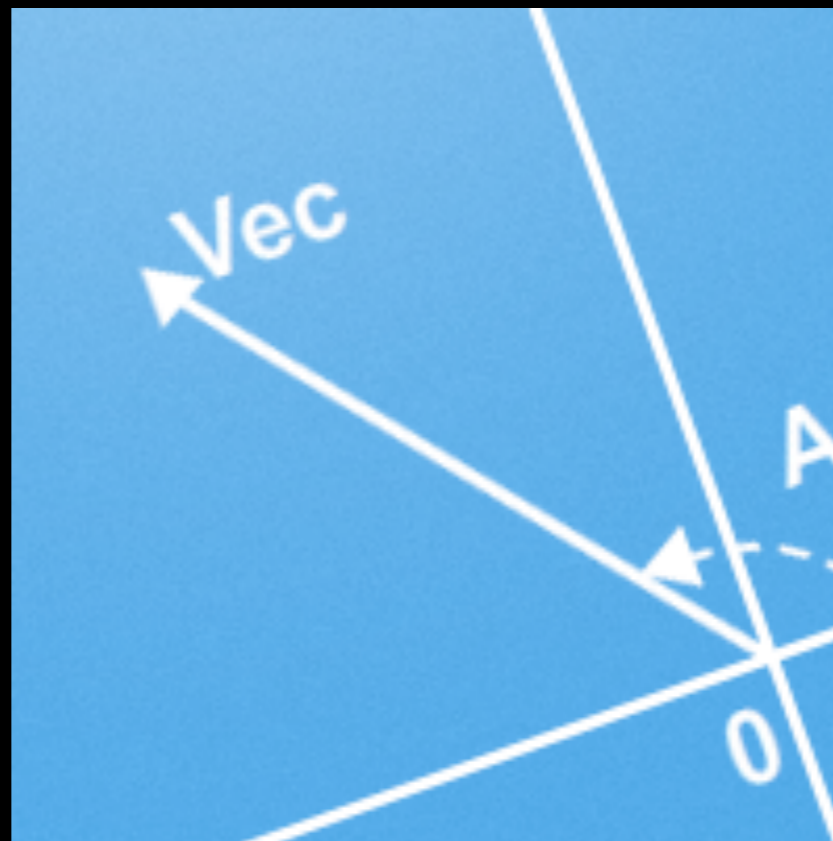
$$y = \sin \pi - \sin 0$$

$$= 0$$

Vectors

Scalars have magnitude

Vectors have magnitude and direction



Which of the following is a scalar?

(a) Acceleration

(b) Velocity

(c) Mass

(d) Force

(e) Momentum

Which of the following is a vector?

(a) Length

(b) Speed

(c) Density

(d) Age

(e) Displacement

Vectors

Quiz

Vectors \vec{A} , \vec{B} and \vec{C} have the same magnitude.

Which of the following equals zero?

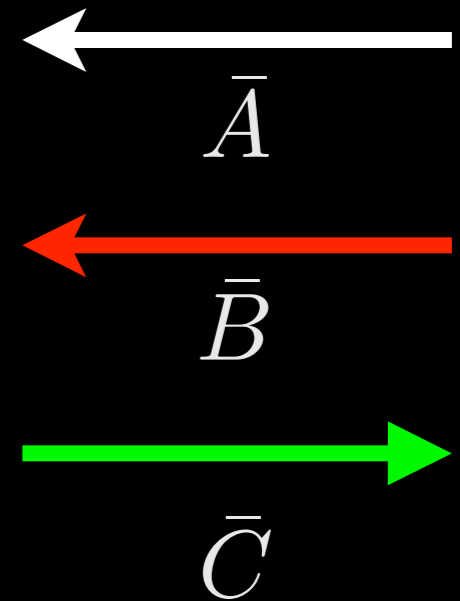
(a) $\vec{A} - \vec{B}$

(b) $\vec{B} - \vec{A}$

(c) $\vec{A} - \vec{C}$

(d) $\vec{C} - \vec{B}$

(e) (a) and (b) are both right



Vectors

Quiz

Vectors \vec{X} and \vec{Y} have the same magnitude.

Which is $\vec{X} + \vec{Y}$?

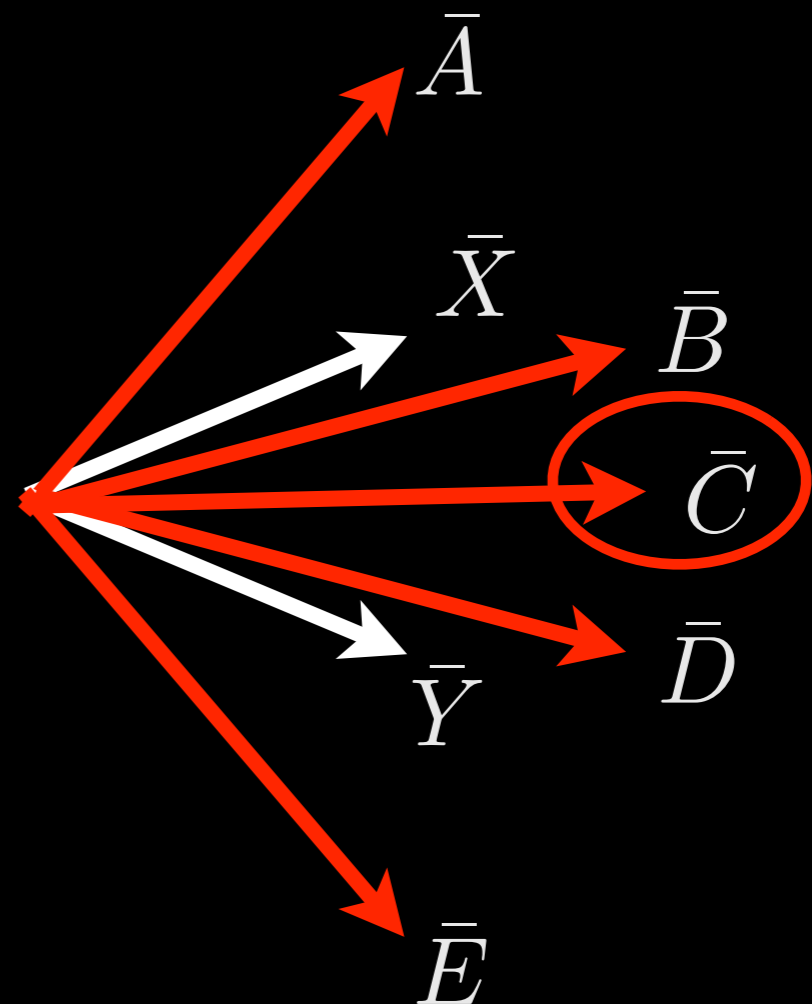
(A)

(B)

(C)

(D)

(E)



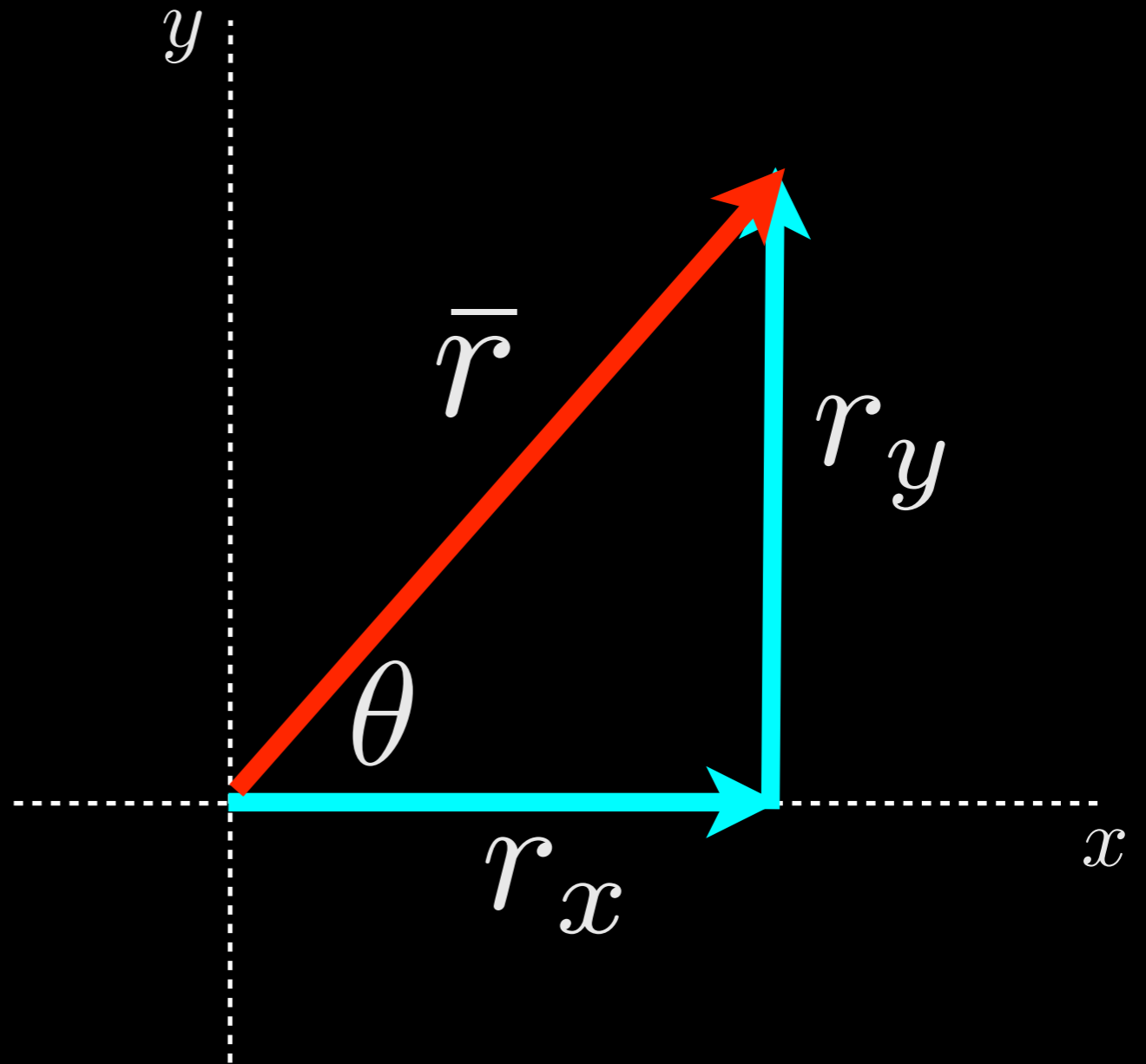
Vectors

Vector components:

$$r_x = |\bar{r}| \cos \theta$$

$$r_y = |\bar{r}| \sin \theta$$

$$\bar{r} = r_x \bar{i} + r_y \bar{j}$$



Vectors

Quiz

A_x and A_y

both have magnitudes of 5.

What is the
magnitude of \bar{A} ?

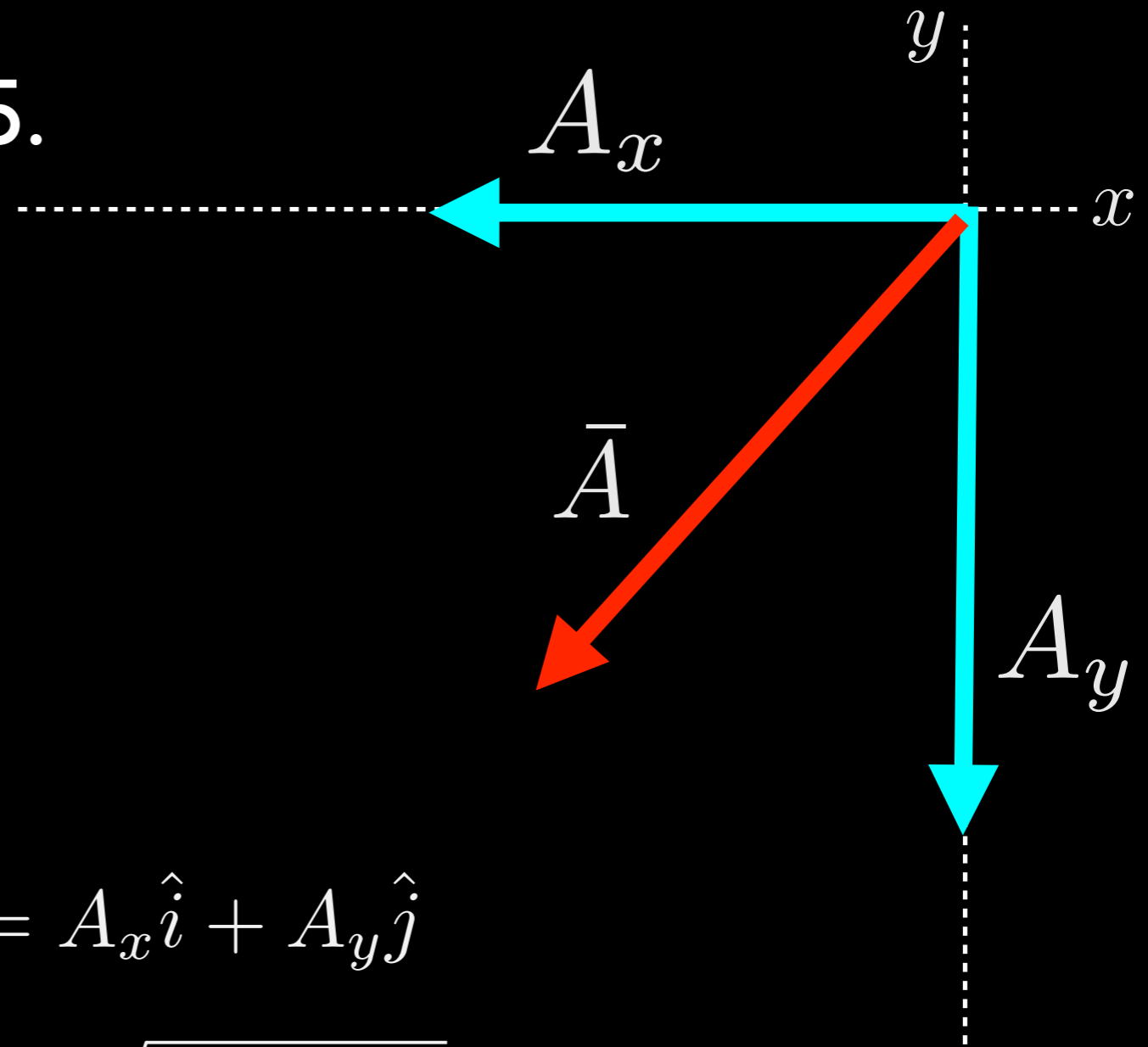
(a) $5\sqrt{2}/2$

(b) 5

(c) $\sqrt{100}$

(d) $5\sqrt{2}$

(e) $5\sqrt{3}$



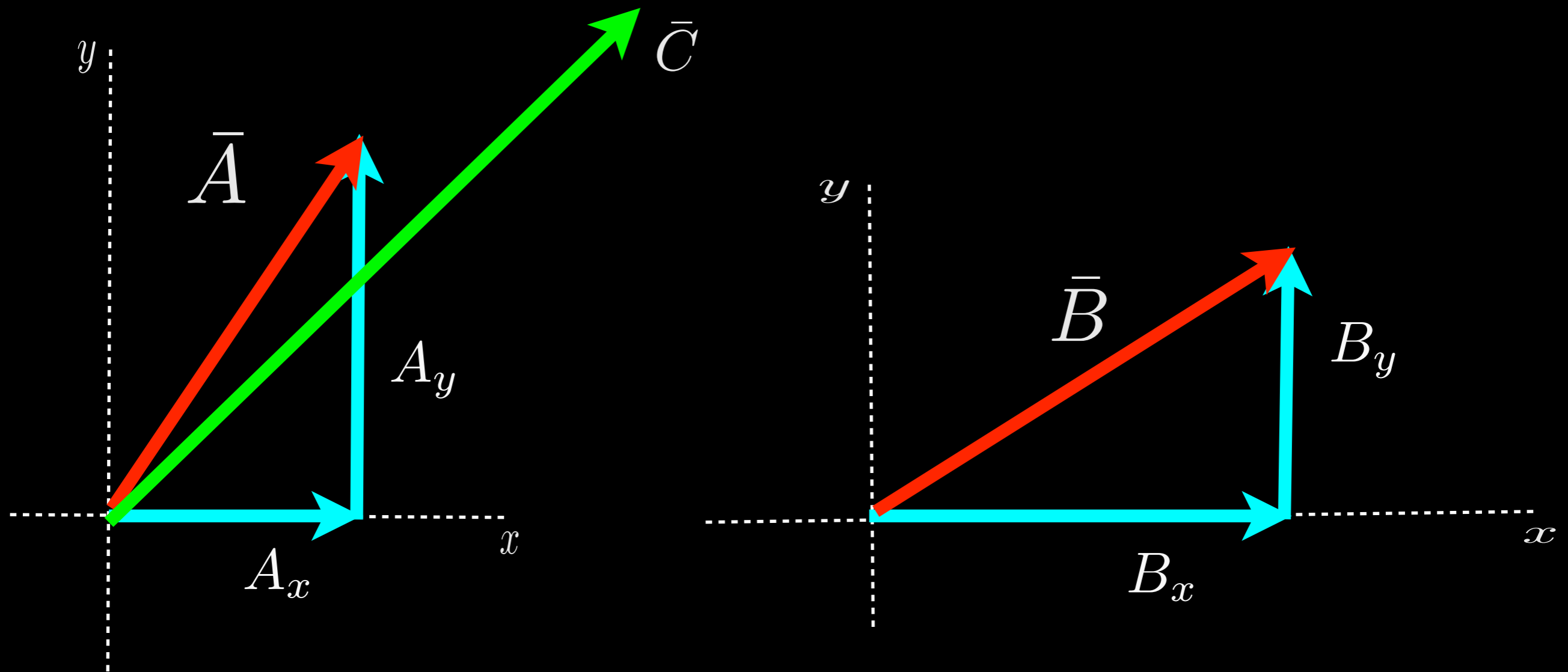
$$\bar{A} = A_x \hat{i} + A_y \hat{j}$$

$$|A| = \sqrt{A_x^2 + A_y^2}$$

$$= \sqrt{25 + 25} = \sqrt{25(2)} = 5\sqrt{2}$$

Vectors

Vector components can be used to add vectors.



$$\bar{C} = \bar{A} + \bar{B} = C_x \hat{i} + C_y \hat{j}$$

$$C_x = A_x + B_x \quad C_y = A_y + B_y$$

Vectors

Quiz

$$A_x = 3 \quad A_y = 4$$

$$B_x = 5 \quad B_y = 3$$

$$\vec{C} = \vec{A} - \vec{B}$$

What is the magnitude of the vector \vec{C} ?

(a) $|\vec{C}| = \sqrt{5}$

(b) $|\vec{C}| = 0.83$

(c) $|\vec{C}| = -1$

(d) $|\vec{C}| = -0.83$

$$\begin{aligned} C_x &= A_x - B_x \\ &= 3 - 5 = -2 \end{aligned}$$

$$\begin{aligned} C_y &= A_y - B_y \\ &= 4 - 3 = 1 \end{aligned}$$

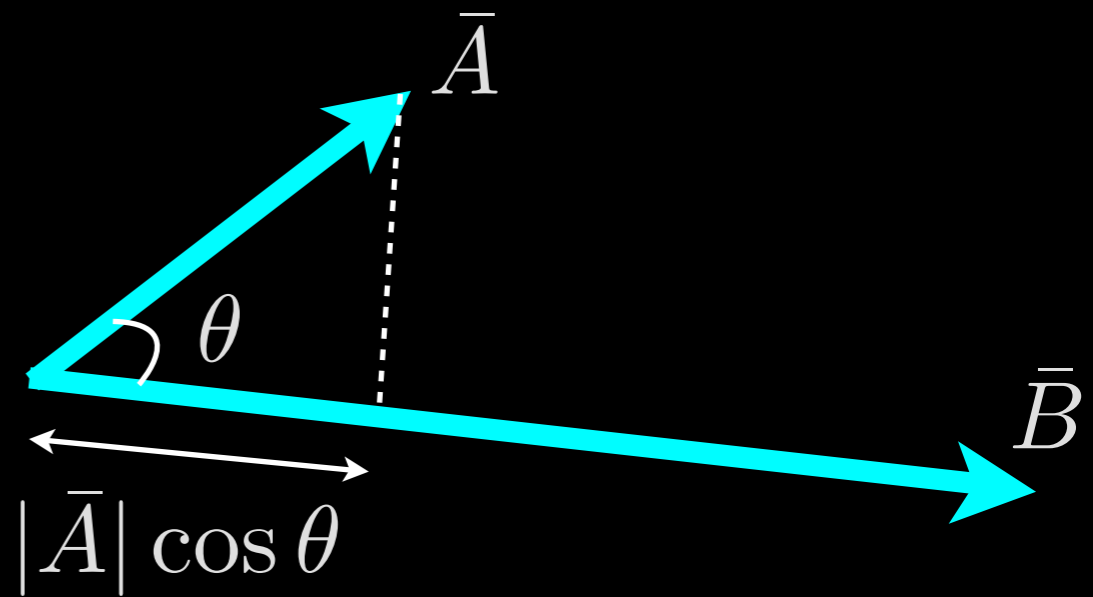
$$|\vec{C}| = \sqrt{C_x^2 + C_y^2} = \sqrt{4 + 1} = \sqrt{5}$$

Vectors

Scalar product (dot product) of 2 vectors:

$$\bar{A} \cdot \bar{B} = |\bar{A}| |\bar{B}| \cos \theta$$

$$= A_x B_x + A_y B_y + A_z B_z$$



e.g.

$$W = \bar{F} \cdot \bar{d} = |\bar{F}| |\bar{d}| \cos \theta$$

Vectors

Quiz

What is $\vec{C} \cdot \vec{D}$?

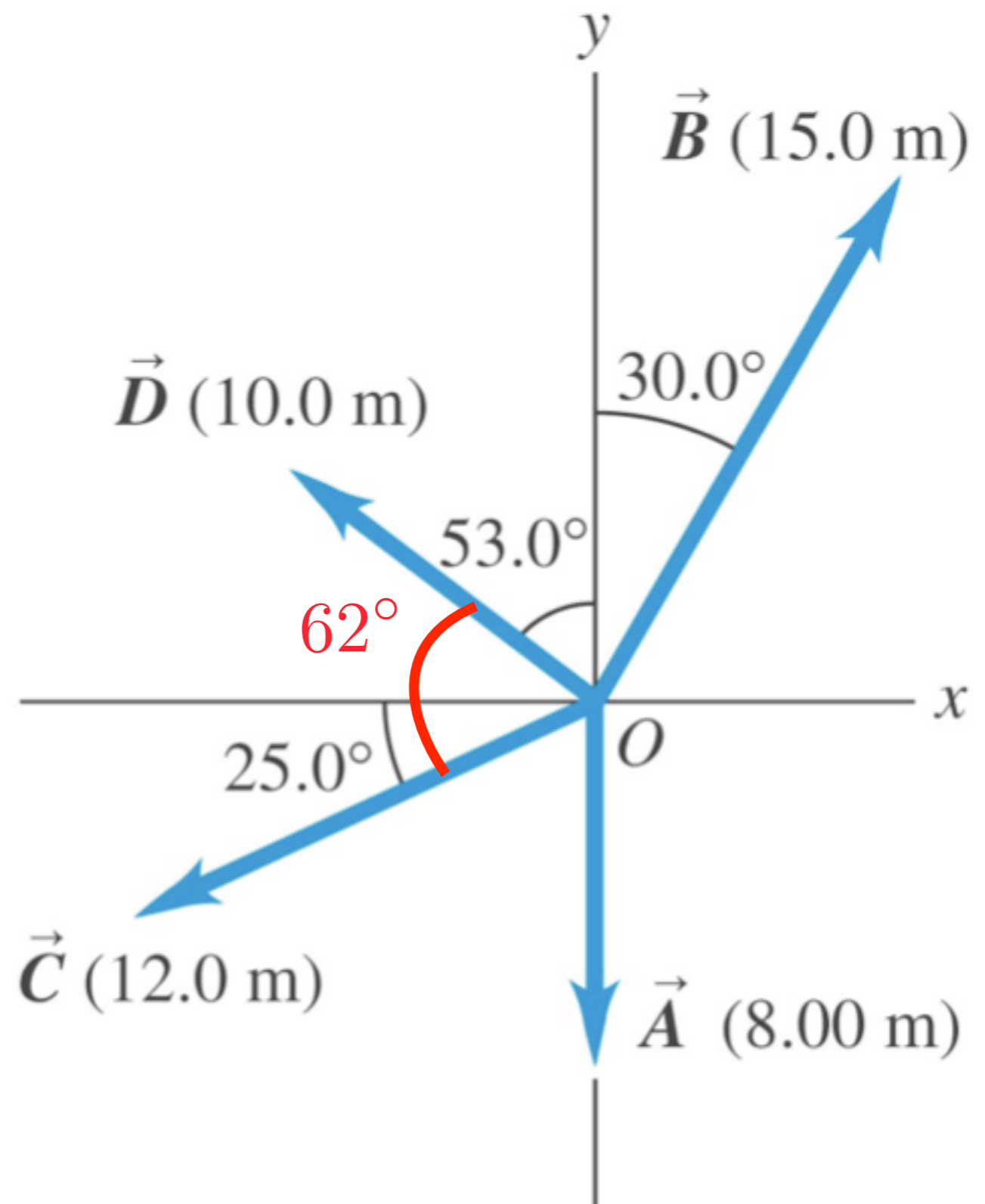
(a) $(120\text{m}^2) \cos 78.0^\circ$

(b) $(120\text{m}^2) \sin 78.0^\circ$

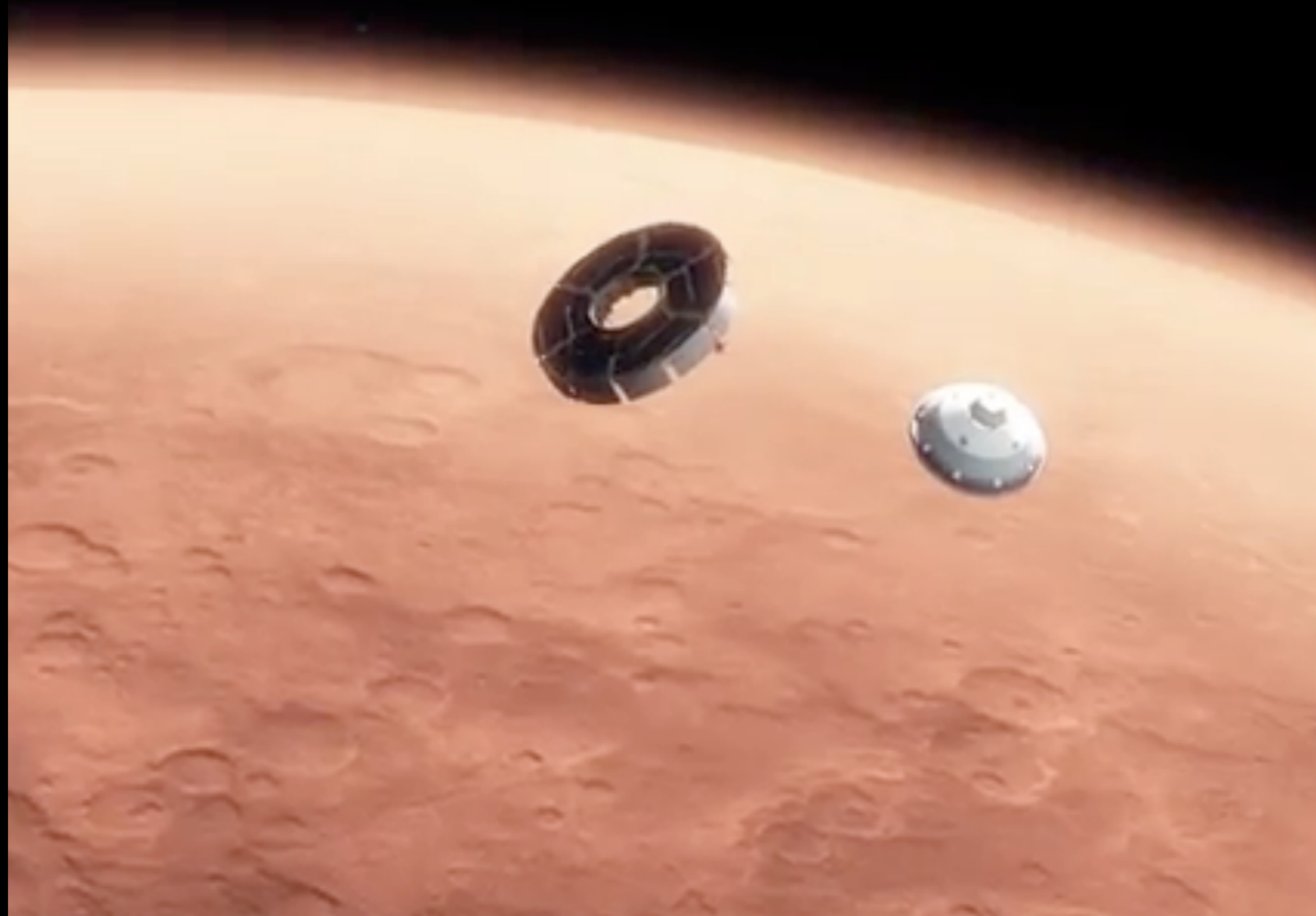
(c) $(120\text{m}^2) \cos 62.0^\circ$

(d) $(120\text{m}^2) \sin 62.0^\circ$

(e) none of these



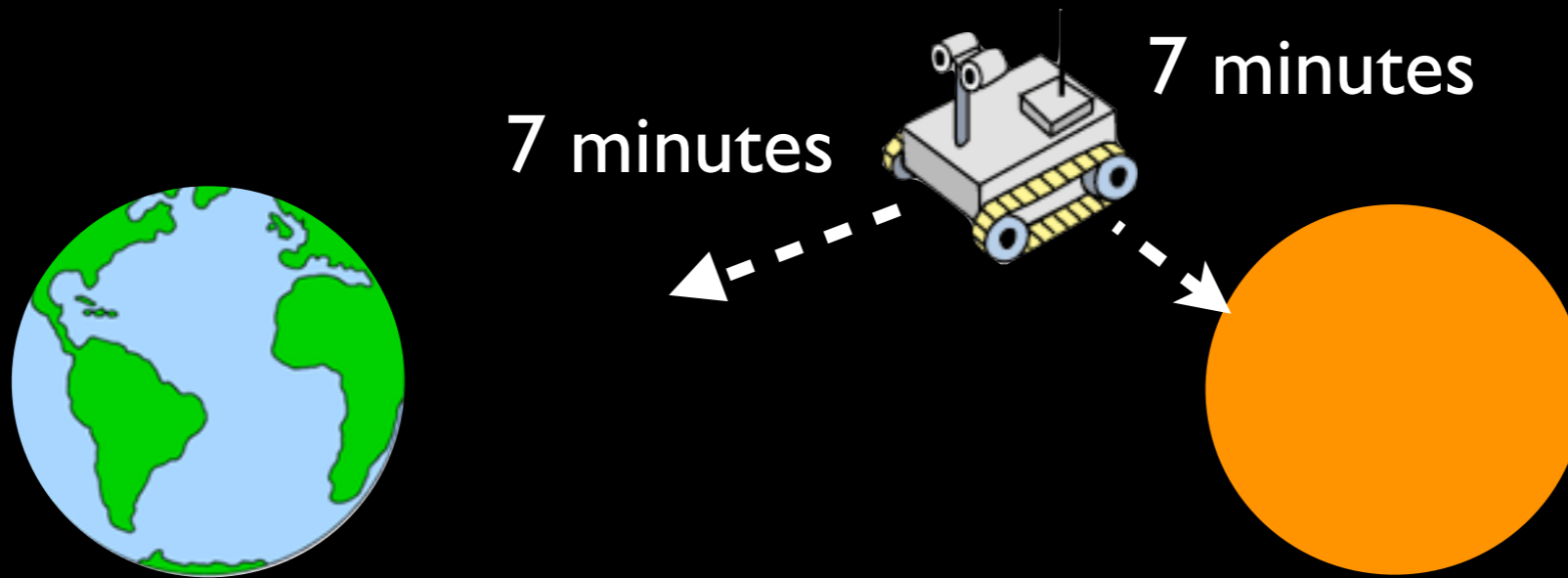
Mars Rover



Landing a robot on Mars
(August 2012)

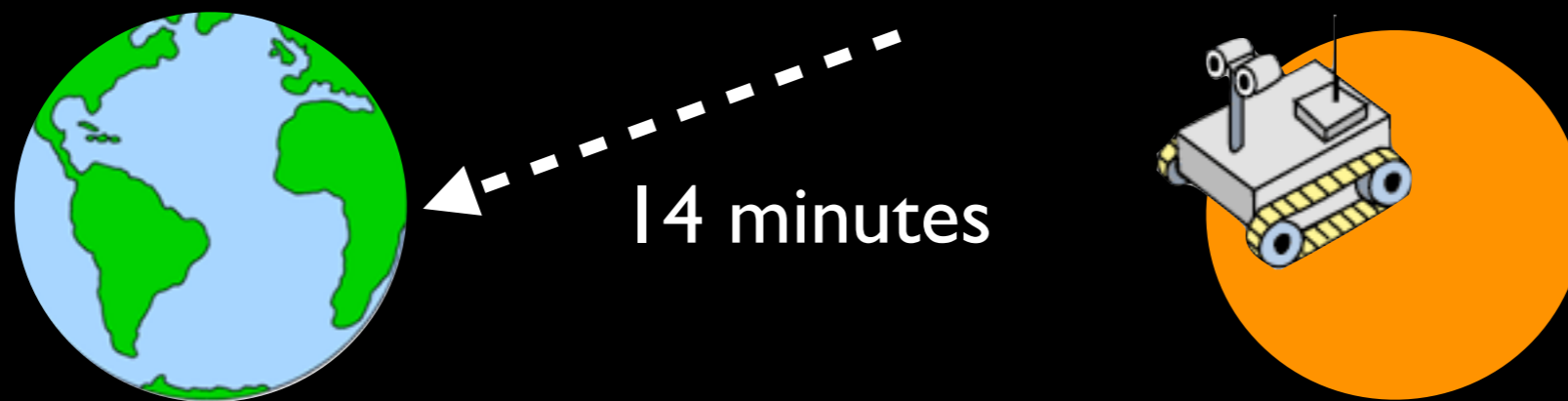
Mars Rover

Why is it impossible to correct problems during the Rover landing?



Mars Rover

Why is it impossible to correct problems during the Rover landing?



When NASA received the signal that the rover had begun its descent, it had already been on Mars for 7 minutes

Why is it impossible to correct problems during the Rover landing?



- (a) It takes too long to send a signal to the rover
- (b) The machinery needed was too heavy for the rover
- (c) Nothing can be done: gravity is in control
- (d) Rover cannot respond quickly in extreme conditions

Why is landing on Mars called “the 7 minutes of terror”?

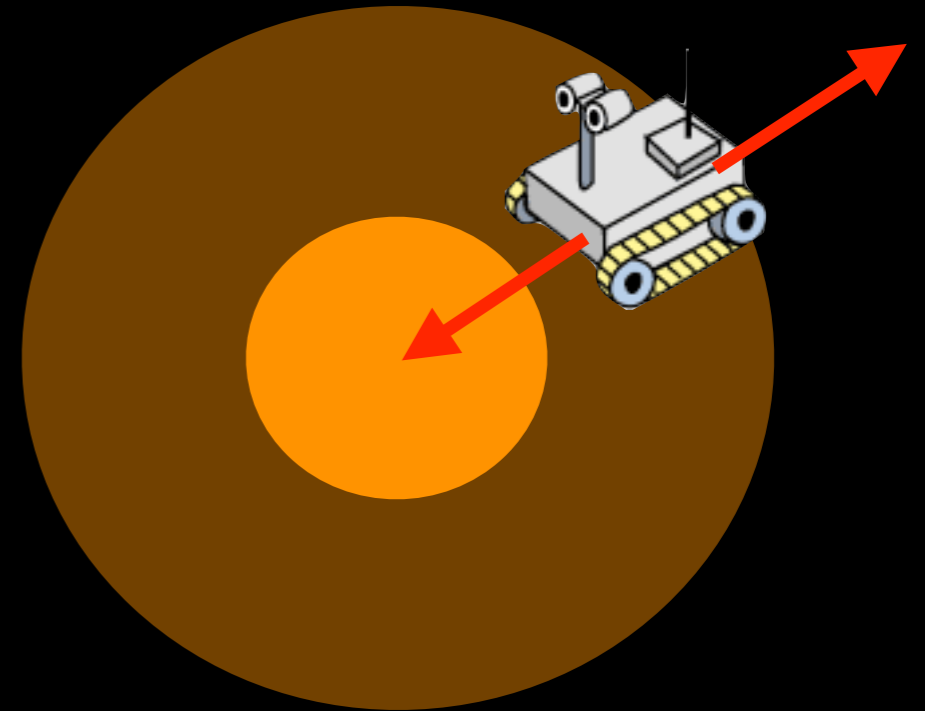
- (a) It takes 7 minutes to land
- (b) The rover must decelerate from 13,000 mph to 0 in that time
- (c) If any part doesn't work, the rover dies.
- (d) The computer must do this all automatically
- (e) All of the above

Why does the rover's heat shield reach 1600 degrees?



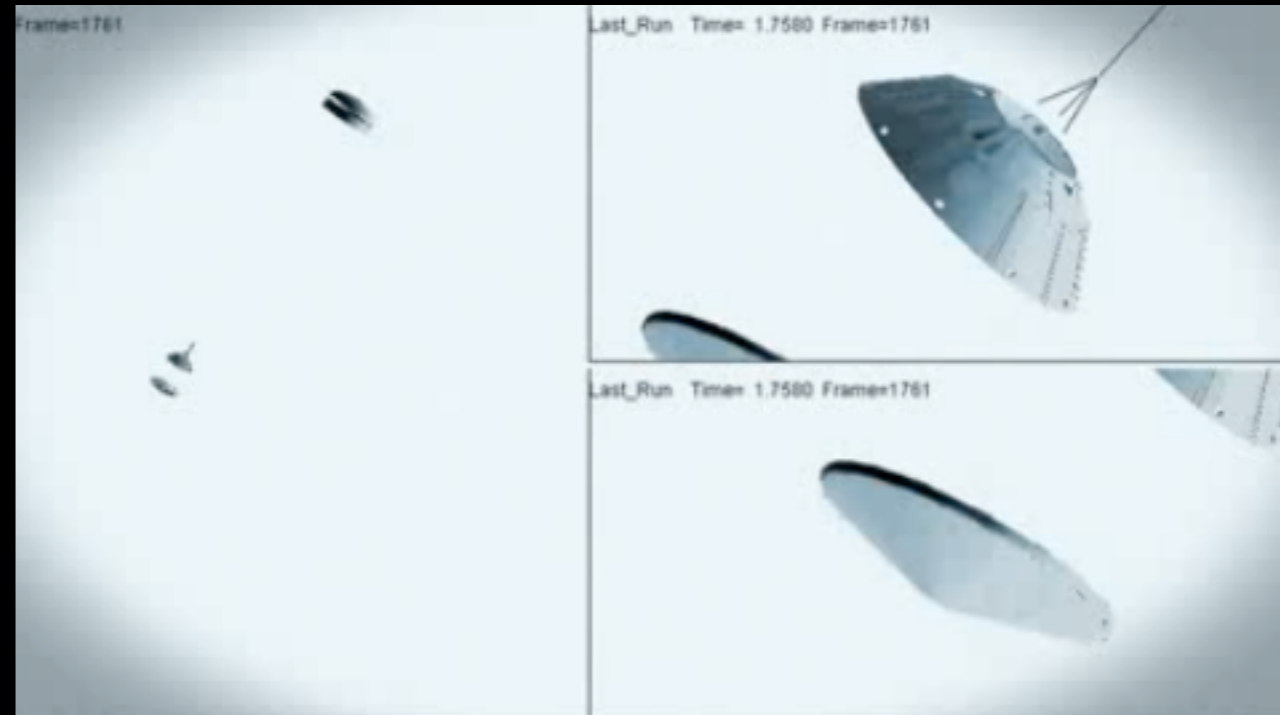
- (a) Mars is very hot
- (b) Air resistance is converted into heat
- (c) The rover's rockets heat it
- (d) The rover collides with the surface

Mars's atmosphere is....



- (a) So thin it can be ignored
- (b) Able to slow the rover down for a safe landing
- (c) Thick enough to harm the rover, but too thin to slow the rover to the right speed.
- (d) Too thin to harm the rover, but thick enough that a parachute isn't needed.

Why must the heat shield be removed?



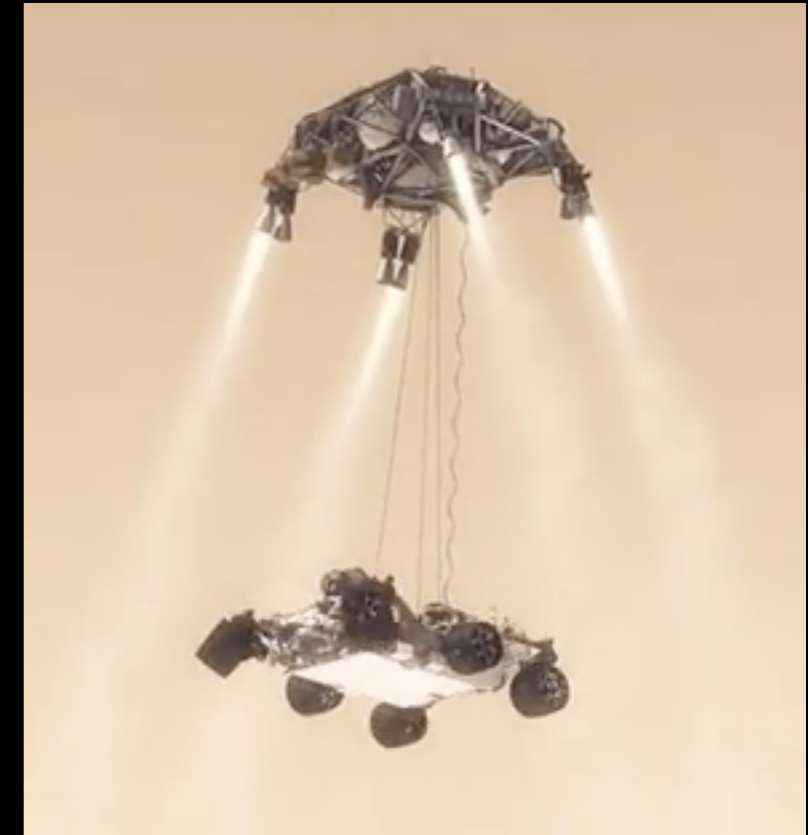
- (a) It's too heavy and will cause the rover to crash
- (b) It's blocking the radar, which needs to take accurate measurements for a safe landing.**
- (c) It's been melted during the landing
- (d) It's a way of removing the parachute

Why does the rover fly sideways just before landing?



- (a) To avoid hitting the parachute when the rockets are launched
- (b) Because the landing site was not safe
- (c) The rockets are not balanced; causes the rover to turn
- (d) The rover needed to turn on its side before landing

Why is the rover lowered with the 'sky crane' onto the surface?



- (a) A harder impact would destroy the rover
- (b) The heat from the rockets would destroy the rover
- (c) The rockets would make a giant dust cloud if they land
- (d) The rockets would make a big hole and trap the rover

Homework!

SCIENTIFIC AMERICAN™

Permanent Address: <https://www.scientificamerican.com/article/india-spacecraft-successfully-arrives-at-mars/>
Source: Nature

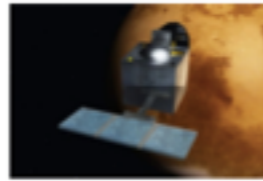
India Spacecraft Successfully Arrives at Mars

The Mangalyaan probe, the country's first mission to another world, has entered the Red Planet's orbit

Feature

See 24, 2014 | By Sanjay Kumar and Nature magazine |

India joined the distinguished club of Mars explorers on 24 September, as its Mangalyaan probe maneuvered into the red planet's orbit according to plan. Until then, only the United States, the former Soviet Union and the European Space Agency had conducted missions that successfully reached Mars. India's space program is the first to do so on its first attempt.



Artist rendering of the Mars Orbiter Mission (MOM), internally called Mangalyaan (Sanskrit: मङ्गल्यन्, English: Man-craft) is a Mars orbiter that was successfully launched on 24 November 2013 by the Indian Space Research Organisation (ISRO). Credit: NASA/ESA/ESA/Agencia Espacial Europea

"History has been created today," declared Indian Prime Minister Narendra Modi at the Indian Space Research Organisation (ISRO) mission control room in Bangalore. "The odds were stacked against us but we have prevailed and have achieved the near impossible," he added.

As the news of the probe's successful insertion into orbit poured in, the ISRO control room erupted into thunderous applause, with scientists shaking hands, hugging and distributing sweets.

Mangalyaan, known formally as the Mars Orbiter Mission (MOM), has been hailed as one of the least expensive interplanetary endeavors in recent history, costing \$75 million — less than the price of producing space-based Hollywood film *Gravity*, as Modi has pointed out.

But former ISRO chairman G. Madhavan Nair warns that if ISRO were to launch a mission of similar to one of NASA's in scope and depth, it would end up spending many times more.

Science and security

Mangalyaan carries five instruments to study the planet's geology and evolution, and to look for methane, a signature of life. Some observers however view its scientific objectives with caution. "Some of this is hyped up and overstretched," says Amitabha Ghosh, an India-born planetary geologist based in Washington DC. "I am sceptical that MOM will be able to dwell decisively on present or past life on Mars."

Ghosh says that MOM is unlikely to supply data comparable in breadth or quality to those generated by other recent missions. He finds it unlikely that MOM will add anything significant to our understanding of Martian topography, for instance, given that NASA's Mars Global Surveyor has already taken 640 million elevation measurements and mapped the planet in detail.

Read article on the Indian mission to Mars!

3 - 5 sentence summary stating:

WHAT happened

HOW was it done

WHY is it exciting?

Example
on
website

due next week

Buy textbook!

Register for EP2 on 'Mastering Physics'

due 2015/10/15

Complete 'Introduction to Mastering Physics'