

Monday: Test 2

Covers: Ch 6.3 - 6.7
Ch 7.2 (efficiency)

Ch 8.1 → 8.6

lectures 18 - 28

HW 5 - 7

Bring: Calculator

Given: Formulas on exam

Study: 2021 Test 2
2022 Test 2

Chapter 6

Know: energy, energy conservation, meaning of kinetic and potential energy

Example 1 Quiz 1

1 Bullet

A 0.010 kg bullet is fired vertically. It leaves the ground with speed 100 m/s.

- How do the bullet's kinetic and potential energies change while the bullet ascends?
- Determine the potential energy of the bullet at its highest point. Ignore friction and air resistance.
- Determine the maximum height that the bullet reaches above the ground.

Answer: a) As it ascends \rightarrow speed decreases
height increases.

$KE = \frac{1}{2} \times \text{mass} \times (\text{speed})^2$ will decrease \Rightarrow KE decreases

$PE = \text{mass} \times 9.8 \times \text{height}$ will increase \Rightarrow PE increases

b) At all times

$$E = KE + PE$$

is constant

	KE	PE	E
launch	50J	+ 0J	= 50J
highest	0J	+ 50J	= 50J

} same

At launch height = 0m

$$PE = 0.010 \text{ kg} \times 9.8 \text{ m/s}^2 \times 0 \text{ m} = 0 \text{ J}$$

$$KE = \frac{1}{2} \times 0.010 \text{ kg} \times (100 \text{ m/s})^2 = 50 \text{ J}$$

$$\Rightarrow E = 50 \text{ J} + 0 \text{ J} = 50 \text{ J}$$

At highest point speed = 0

$$KE = \frac{1}{2} \times 0.010 \text{ kg} \times 0^2 = 0 \text{ J} \Rightarrow PE = 50 \text{ J}$$

c) $PE = \text{mass} \times 9.8 \text{ m/s}^2 \times \text{height}$

$$50 \text{ J} = 0.010 \text{ kg} \times 9.8 \text{ m/s}^2 \times \text{height}$$

$$50 \text{ J} = 0.098 \text{ kg m/s}^2 \times \text{height}$$

$$\frac{50 \text{ J}}{0.098 \text{ kg m/s}^2} = \text{height} \Rightarrow$$

$$\text{height} = 510 \text{ m}$$

Quiz 2 60% - 100%

2 Energy produced by LEDs

Two light sources produce light with the indicated powers and for the indicated durations. Which bulb delivers the most energy for the duration that it is on? Explain your answer.

LED	Power	Duration On
Red LED	3.0 W	15 min
Green LED	10.0 W	4.0 min

Answer $\text{Power} = \frac{\text{Energy}}{\text{Time}} \Rightarrow \text{Energy} = \text{Power} \times \underbrace{\text{time}}_{\text{seconds}}$

Red: $\text{time} = 15 \text{ min} \times \frac{60 \text{ s}}{\text{min}} = 900 \text{ s}$

$\text{energy} = 3.0 \text{ W} \times 900 \text{ s} = 2700 \text{ J} \leftarrow \text{larger (more)}$

Green: $\text{time} = 4 \text{ min} \times 60 \text{ s} = 240 \text{ s}$

$\text{energy} = 10.0 \text{ W} \times 240 \text{ s} = 2400 \text{ J}$

Thus the red delivers more energy.

Quiz 3 70% - 100%

Chapter 7

Know efficiency

3 Light bulb efficiency

A light bulb consumes 60 J of electrical energy each second. This is converted into light (useful energy) with efficiency 0.15. Determine the light energy produced each second.

Answer efficiency = $\frac{\text{useful output}}{\text{input}}$

$$\begin{aligned} \Rightarrow \text{useful output} &= \text{input} \times \text{efficiency} \\ &= 60 \text{ J} \times 0.15 \\ &= 8.0 \text{ J} \end{aligned}$$

Quiz 4 ~~50% - 80%~~

Electricity + Magnetism

- Know *
- * rules for forces between electric charges.
 - * electric forces and atoms
 - * currents
 - * rules relating currents to charge flow
 - * forces that currents exert on each other.
 - * & magnetic fields.

Quiz 5 50% - 80%

4 Sodium Ions

A neutral sodium atom has 11 protons and 12 neutrons. Sodium atoms form positively charged ions by each losing one electron. A small amount of sodium chloride (Salt) contains 6.0×10^{20} sodium ions. Determine the charge of all of the sodium ions in this sample.

Answer: Each sodium ion has 11 protons and 10 electrons. Thus the sodium ion has the same charge as a proton.

$$\text{charge 1 sodium ion} = 1.6 \times 10^{-19} \text{ C}$$

$$\text{Total charge} = \text{number of ions} \times \text{charge one ion}$$

$$= 6.0 \times 10^{20} \times 1.6 \times 10^{-19} \text{ C}$$

$$= 9.6 \times 10^1 \text{ C} = 96 \text{ C.}$$

Quiz 6 76%

Quiz 7