MAXIMIZING YOUR PHYSICS EXAMINATION MARKS

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DO PHYSICS ONLINE
HOME PAGE
N.S.W. HIGH SCHOOL PHYSICS
HSC COURSE

http://www.physics.usyd.edu.au/teach_res/hsp/u0/home12.htm

When studying Physics "say to yourself"

→ puts you in the right "frame of mind"

Physics is Fun
Physics is Exciting
Physics is SIMPLE

SIMPLE ???

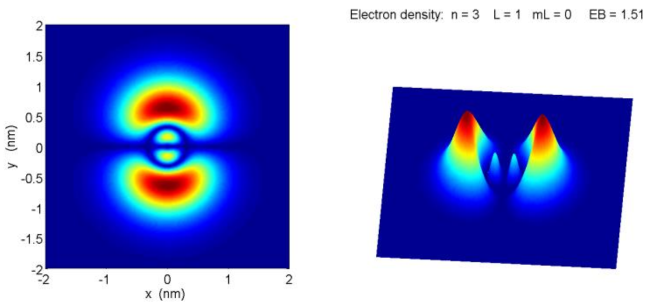
Physicists use models to explain the physical world around us

- make simplifying assumptions
- eliminate what is not important
- concentrate on only the essential ideas – what is most important

Students – focus on the "real" world

- lump too many ideas together than are related but different
- focus on "real" world – not appreciate the role of simple models
- don't differentiate between the everyday use of language and the its use in a scientific context

All of chemistry is in equations like this – you can't do physics without mathematics

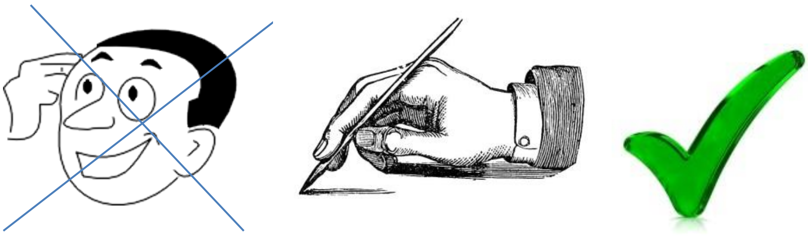


$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial \psi}{\partial r}\right)+\frac{1}{r^2\sin\theta}\frac{\partial}{\partial r}\left(\sin\theta\frac{\partial \psi}{\partial r}\right)+\frac{1}{r^2\sin^2\theta}\frac{\partial^2\psi}{\partial\phi^2}+\frac{2\mu}{\hbar^2}(E-U)\psi=0$$

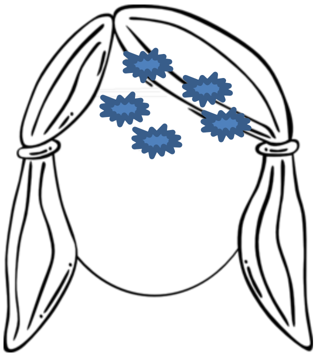
PRACTICE DOES <u>NOT</u> MAKE PERFECT – need quality practice

STUDYING PHYSICS

THINK ON PAPER WITH A PEN IN HAND AND DO NOT THINK TOO MUCH IN YOUR HEAD



- Don’t just read – use pen and paper to process information
- Summarize what you read and study → MINDMAPS (concepts maps)
- THINK, VISUALIZE and PROCESS while you are studying
- Memorize your summaries: short term and long term memories are different. **Memory is the most important process in learning**.
- Strive for understanding – it only comes slowly after lots of “memory work” and exposure. Often comes in a “flash”.
- Doing questions that have answers: Read question / process it / think about what it asking / think about what you know / consult your summaries or textbook / review and process the given answer / after a short time interval do the question like in an exam, then check (mark) your answer against the published answer.



you can process ~5 chunks of information at any one time

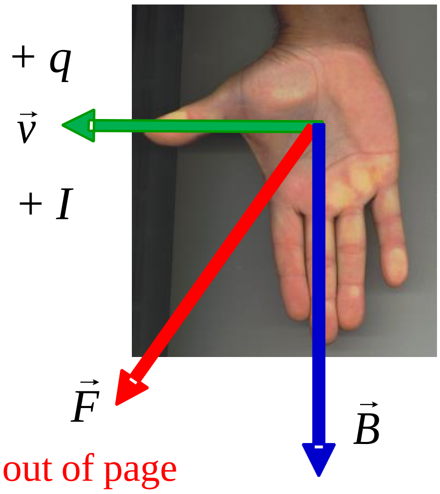
- Study sessions 40 to 60 min on physics eg doing problems, creating mindmaps
- Review sessions only about 10 minutes. These are short reflection sessions: short term memory → long term memory.
- ***Reflection***: review / reflect upon a study period a short time after the end of that study period – very beneficial in transferring knowledge to long term memory

MINDMAPS (special type of concept map)

- Summaries with minimum padding words
- Key words
- Symbols / equation / units
- Colour
- Graphs
- Images – annotated diagrams (difficult to remember words, easy to remember “dramatic images”
- Make mindmaps for each equation – summary of what the equation is telling you

Motion of charged particle in a magnetic field

$$F_B = q v_\perp B = q\left(v \sin\theta\right)B$$
$$F_B = q v B \sin\theta$$



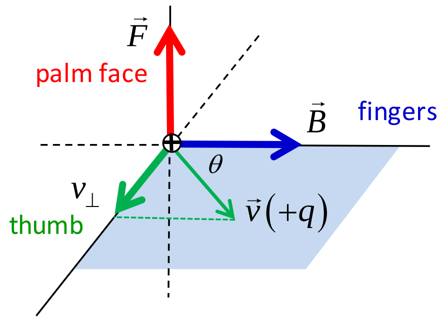
Right Hand Palm Rule

Fingers point along the direction of the B-field

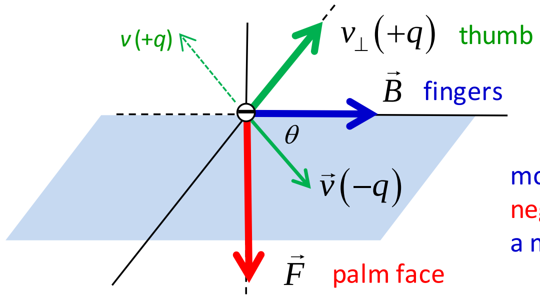
Thumb points in the direction in which ***positive*** charges would move

(negative is moving to the left, then the thumb points to the right)

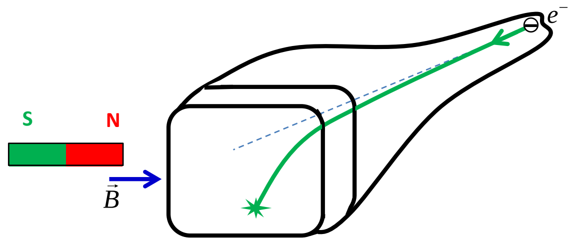
Palm gives the direction of the force on the charged particle

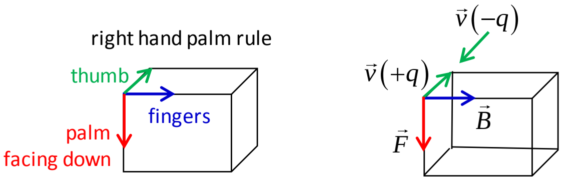


motion of a *positive* charge in a magnetic field



motion of a negative charge in a magnetic field





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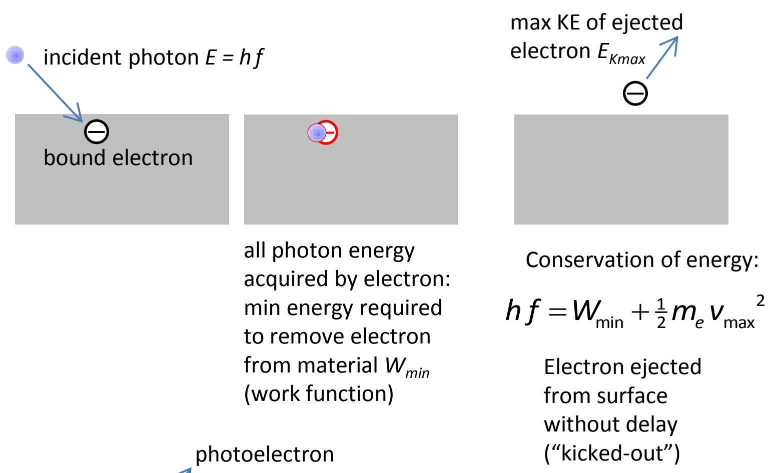
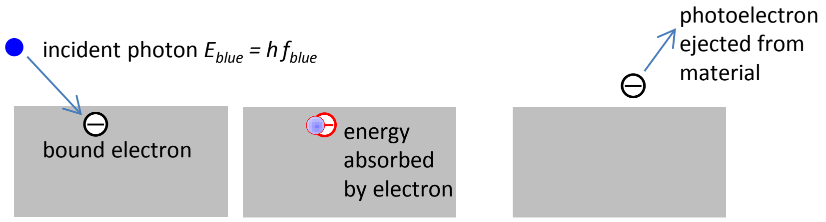
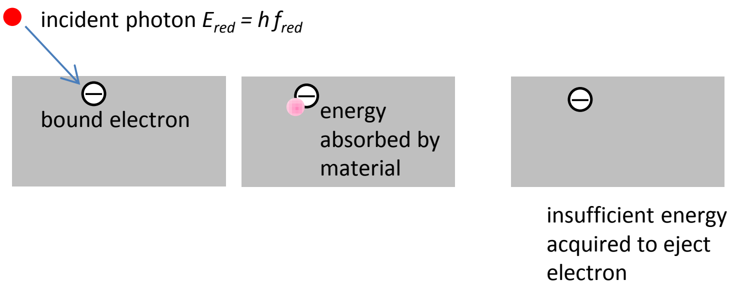
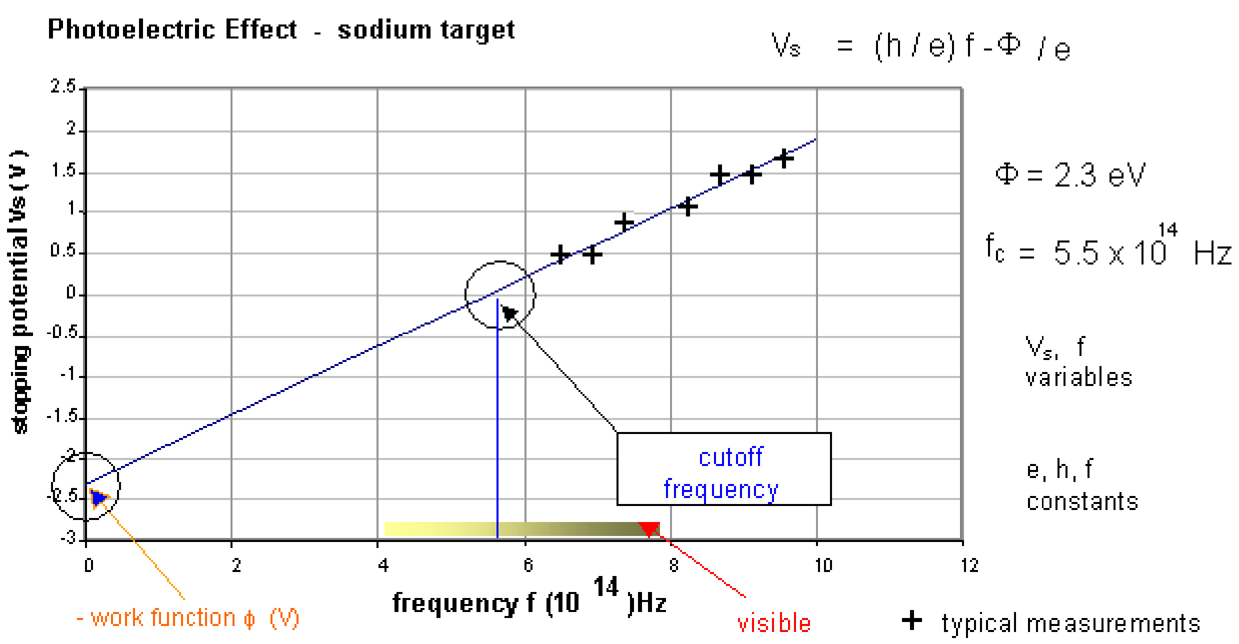
PHOTOELECTRIC EFFECT





$f_{blue} > f_{red}$ $hf_{blue} > W_{min}$ $hf_{red} < W_{min}$





Basic Mathematics

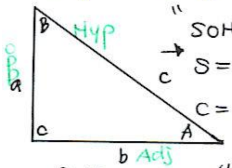
- Constants

π	3.14159
e (Euler's constant)	2.71828
1 rad	57.2958°
2π rad	360°

- Quadratic equation

$ax^2+b+c=0 \Rightarrow x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$

- Trigonometry



"SOHCAHTOA"

$\rightarrow S=\frac{opp}{Hyp}$ $T=\frac{opp}{Adj}$

$C=\frac{Adj}{Hyp}$

- Pythagorean theorem $c^2=a^2+b^2$
- Area of triangle $=\frac{1}{2}ab$
- $\sin A=\frac{a}{c}$, $\cos A=\frac{b}{c}$, $\tan A=\frac{a}{b}$

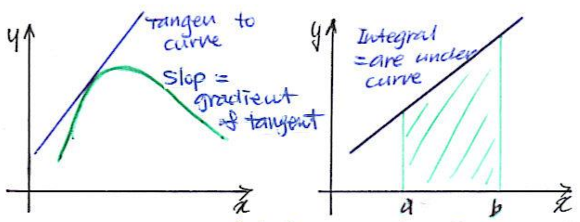
$\tan A=\frac{\sin A}{\cos A}$ $\quad \sin^2 A+\cos^2 A=1$

- Geometric formulas
  - Circumference of a circle (radius r) $C=2\pi r$
  - Area of a circle $A=\pi r^2$
  - Area of sphere $A=4\pi r^2$
  - Volum of sphere $V=(\frac{4}{3})\pi r^3$
  - Area of rectangle (sides L_1, sides L_2) $A=L_1L_2$
  - Volum of block (sides L_1, L_2 and L_3) $V=L_1L_2L_3$
  - Volum of a right cylinder (height h and radius r) $V=\pi r^2 h$

- Functions
  - $\cos(x)=\cos(-x)$
  - $\sin(x)=-\sin(x)$
  - $\sin(x+\pi/2)=\cos(x)$
  - $\cos(x+\pi/2)=-\sin(x)$
  - $a^x a^y=a^{x+y}$
  - $a^0=1$
  - $(a\,b)^x=a^x b^x$
  - $Ln(e^x)=x$
  - $Ln(e^x)=x$
  - $Ln(ab)=Ln(a)+Ln(b)$
  - $Ln(a/b)=Ln(a)-Ln(b)$
  - $Ln(1)=0$

GRAPHS & GRAPHICAL ANALYSIS

DIFFERENTIATION — INTEGRATION



A – displacement amplitude

a – acceleration

- Mathematical Relationships

*Sinusoidal functions

$y=A\sin(kx+\phi)$

$y=A\cos(kx+\phi)$

(A. k. ϕ are constant)

*y is proportional to x

$y\propto x$

$y=mx$ (m= constant)

→ The graph corresponds to a straight line passing trought the origin (0.0) with slope m.

*Power relationship

$y=Ax^n$

(A. n = constant)

*y is inversely proportional to x

$y\propto 1/x$ (m= constant)

$y=m/x$

→ Plotting y against $1/x$ gives a straight line trought the origin (0.0) w slope m

*Exponential type relationship

$y=Ae^{kx}$

$y=Ae^{-kx}$

$y=A(1-e^{-kx})$

(A. k > 0 = constant)

*Linear Relationship btw the variables x and y

$y=mx+b$ (m: slope = constant, b: intercept)

→ Straight line cutting the y-axis at the point (0. b) & the

- Drawing graphs.
  - Choice of axes
  - Scales and Origin
  - Labels & Title
  - Plotting

Language

Scientific Explanations

- Based on fundamental physical principles
  - the relevant equations
  - not just a description
- Physical phenomena
  - a number of precise steps (chain argument)
- Diagrams
  - readable, relevant details, labels

a useful diagram is the centrepiece of a good explanation.

X – distance, extension displacement

Δ – charge in quantity

θ – celsius temp. angle

λ – wave length decay constant

ρ – density resistivity

σ – electric conductivity

ϕ – flux angular velocity

ω – angular velocity, frequency

ε – electromotive force (emf)

- Derivative

(a & b → constants, u and v → functions of x)

- $da/dx=0$
- $d(au)/dx=a\,du/dx$
- $d(u+v)/dx=du/dx+dv/dx$
- $d(uv)/dx=v\cdot du/dx+u\cdot dv/dx$
- $dx^a/dx=ax^{a-1}$
- $d(\sin x)/dx=\cos x$
- $d(\cos x)/dx=-\sin x$
- $d(Ln\,x)/dx=1/x$

- Re

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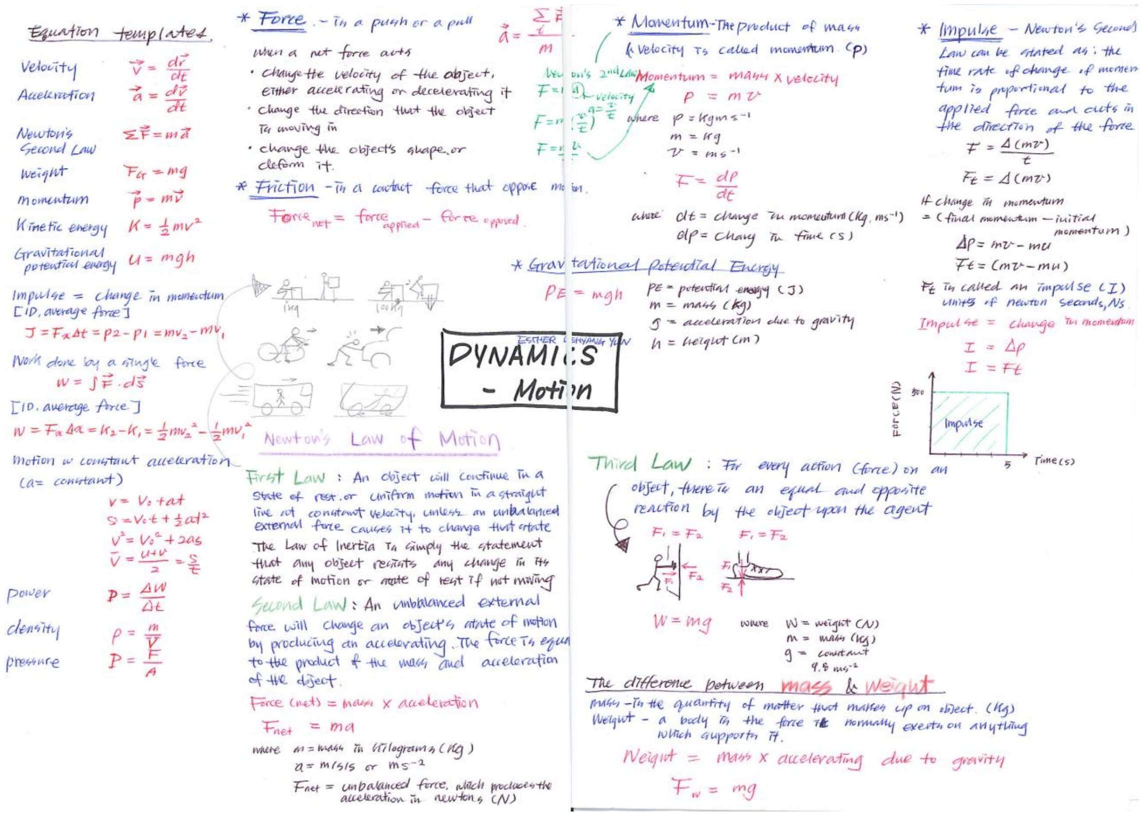


Equation templates.

Velocity $\vec{v} = \frac{d\vec{r}}{dt}$

Acceleration $\vec{a} = \frac{d\vec{v}}{dt}$

Newton's Second Law $\Sigma\vec{F} = m\vec{a}$

Weight $F_G = mg$

momentum $\vec{p} = m\vec{v}$

Kinetic energy $K = \frac{1}{2}mv^2$

Gravitational potential energy $U = mgh$

Impulse = change in momentum [1D, average force]

$J = F_x\Delta t = p_2 - p_1 = mv_2 - mv_1$

Work done by a single force

$W = \int \vec{F} \cdot d\vec{s}$

[1D. average force]

$W = F_x\Delta x = K_2 - K_1 = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2$

Motion w constant acceleration (a = constant)

$v = v_0 + at$

$s = v_0 t + \frac{1}{2}at^2$

$v^2 = v_0^2 + 2as$

$\bar{v} = \frac{u+v}{2} = \frac{s}{t}$

power $P = \frac{\Delta W}{\Delta t}$

density $\rho = \frac{m}{V}$

pressure $P = \frac{F}{A}$

*** Force** - is a push or a pull $\vec{a} = \frac{\sum_i \vec{F}}{m}$

When a net force acts

- change the velocity of the object, either accelerating or decelerating it
- change the direction that the object is moving in
- change the object's shape, or deform it.

Newton's 2nd Law

$F = m\,a$ (velocity)

$F = m\left(\frac{v}{t}\right)$ $a = \frac{v}{t}$

$F = \frac{mv}{t}$

*** Friction** - is a contact force that oppose motion.

$Force_{net} = force_{applied} - force_{opposed}$

1kg 100kg

ESTHER CHYANG YUN

DYNAMICS - Motion

Newton's Law of Motion

First Law: An object will continue in a state of rest, or uniform motion in a straight line at constant velocity, unless an unbalanced external force causes it to change that state. The Law of Inertia is simply the statement that any object resists any change in its state of motion or state of rest if not moving.

Second Law: An unbalanced external force will change an object's state of motion by producing an accelerating. The force is equal to the product of the mass and acceleration of the object.

Force (net) = mass x acceleration

$F_{net} = ma$

where m = mass in kilograms (kg)

a = m/s/s or ms^{-2}

F_{net} = unbalanced force, which produces the acceleration in newtons (N)

*** Momentum** - The product of mass & velocity is called momentum (p)

Momentum = mass x velocity

$p = mv$

where $p = kgms^{-1}$

$m = kg$

$v = ms^{-1}$

$F = \frac{dp}{dt}$

where dt = change in momentum (kg. ms^{-1})

dp = chang in time (s)

*** Gravitational Potential Energy**

$PE = mgh$

PE = potential energy (J)

m = mass (kg)

g = acceleration due to gravity

h = height (m)

*** Impulse** - Newton's Second Law can be stated as: the time rate of change of momentum is proportional to the applied force and acts in the direction of the force

$F = \frac{\Delta(mv)}{t}$

$Ft = \Delta(mv)$

If change in momentum = (final momentum - initial momentum)

$\Delta p = mv - mu$

$Ft = (mv - mu)$

Ft is called an impulse (I) units of newton seconds, Ns

Impulse = change in momentum

$I = \Delta p$

$I = Ft$

Third Law: For every action (force) on an object, there is an equal and opposite reaction by the object upon the agent

$F_1 = F_2$ $F_1 = F_2$

$W = mg$ where W = weight (N)

m = mass (kg)

g = constant $9.8\ ms^{-2}$

The difference between mass & weight

mass - is the quantity of matter that makes up an object. (kg)

Weight - a body is the force it normally exerts on anything which supports it.

Weight = mass x accelerating due to gravity

$F_w = mg$

Equation of uniform accelerated motion – one dimension

$$v = v_0 + a\,t$$

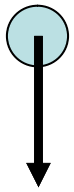
$$(x - x_0) = v_0\,t + \tfrac{1}{2}a\,t^2$$

$$v^2 = v_0^2 + 2a\,(x - x_0)$$

$$\bar{v} = \frac{u+v}{2} = \frac{s}{t}$$

$t = 0 \quad v = v_o \quad x = x_0$

an object in free fall (ignoring dissipative forces) has a constant acceleration



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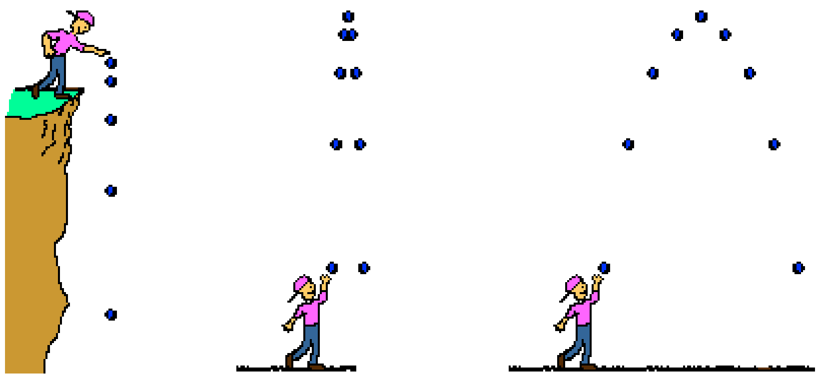
Need to define a reference frame (origin, coordinate system)

y can replace ***x*** when the motion is in the **vertical** direction

For projectile motion can use subscripts for the independent quantities in the horizontal (x) and vertical (y) directions

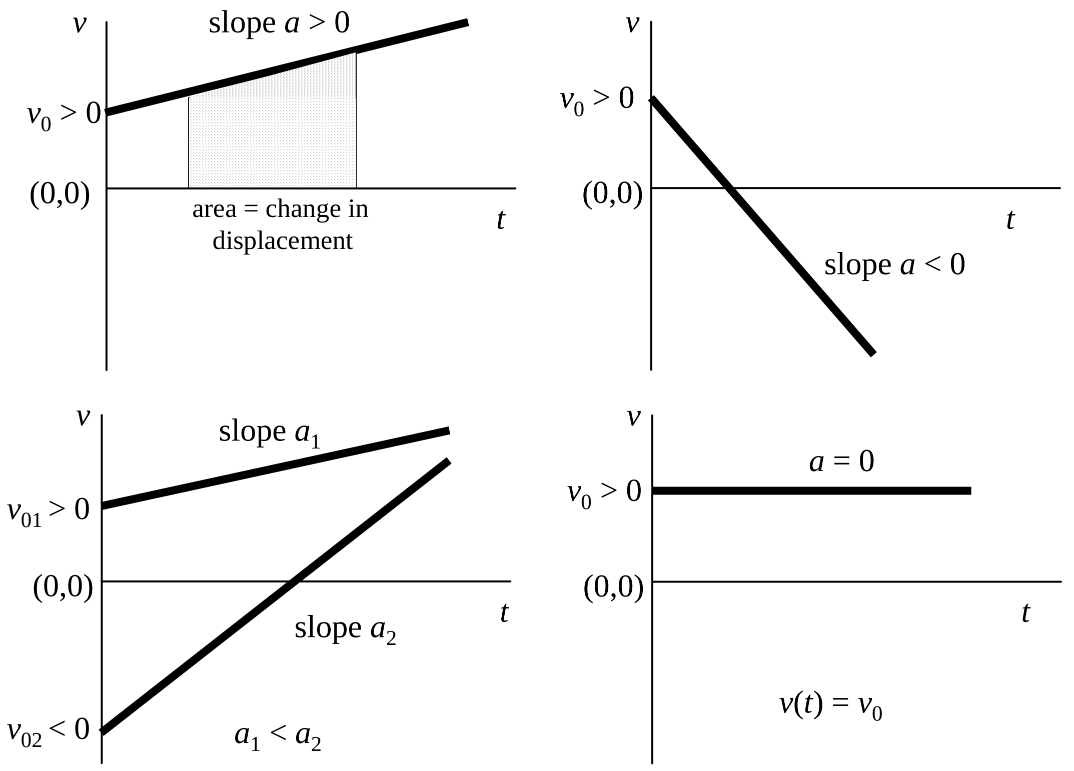
$x, y \quad x_0, y_0 \quad v_x, v_y \quad v_{0x}, v_{0y} \quad a_x = 0,\ a_y = \pm\, g = \pm\, 9.80\ \mathrm{m.s^{-2}}$



Symbol	Physical quantity	SI unit (other)	Sign (+ / -)
t	time interval measured from $t = 0$	s h	no
$x \quad y$	displacement at time t from the initial ($t = 0$) position at x_0	m km	+ -
$x_0 \quad y_0$	initial ($t = 0$) position: select frame of reference, often can choose $x_0 = 0$	m km	+ -
v	velocity of object at time t	$\mathrm{m.s^{-1}}$ $\mathrm{km.h^{-1}}$	+ -
v_0	initial velocity velocity at time t = 0 s	$\mathrm{m.s^{-1}}$ $\mathrm{km.h^{-1}}$	+ -
a	acceleration a = constant	$\mathrm{m.s^{-2}}$	+ -

Graphs

$v = v_0 + a\,t$ straight line: variables t and v, constants v_0 (intercept) a (slope)



Problem

A 5.0 kg ball is thrown vertically into the air at a speed of 20 $m.s^{-1}$. What can you easily calculate?

Problem

A ball is thrown vertically into the air. Draw three time graphs: displacement, velocity, acceleration

PROBLEM SOLVING GUIDELINES

Think with pen and paper, not in your head

Ask yourself ***How do I approach the problem***

ISEE " I see"

Identify and Setup

- Read → interpret the problem or question → what is the marking expecting
- Identify the system (object of interest)
- Visualize the problem
- Identify the type of problem
- Data: known and unknown (?) **physical quantities** – things that you measure
  name, symbol, value, unit (SI unit), significant figures
  eg speed of car A v_A = 30.5 km.h^{-1} v_A = ? m.s^{-1}

  Use **subscripts** to identify different objects or different times
  mass: car A m_A car B m_B
  Initial velocity v_i Final velocity v_f

  Often best to use SI units: conversion of units km.h^{-1} ←→ m.s^{-1} eV ←→ J s ←→ y

- Create annotated **scientific diagrams** (need to be useful – one of the most important approaches to answering problems – always used by the "best" students); show directions for vector quantities
- What do I know: physical principles, laws, concepts, key words, equations

Execute

- Answer the question
- Linear setting out – one line after the other (you can ask for more paper to answer questions if space on exam paper insufficient)
- Qualitative answers: point form; only answer the question – just don't write what you know, avoid making incorrect physics statements; use words in a scientific context; do not re-write question
- Quantitative answers: should be mathematically correct, proper use of = sign, correct use of symbols and equations; correct units; correct significant figures
- Do algebra before substituting numbers

Evaluate

- Have I answered the question
- Check for incorrect physics statements
- Numerical answers: reasonable (sensible); units; significant figures; never use fractions in an answers – always use decimals

MATHEMATICS AN INDISPENSABLE TOOL

- Be able to interpret symbols an equations
- Equations tell a story
- Be able to change units
- Be careful with significant figures
- Be able to use scientific notation
- Be able to use your calculator using BIG and small numbers – exponential (scientific) notation – use **x10^x** and **ENG** buttons
- Be able to rearrange an equation
- Draw a scientific graph; interpret a graph; know about straight lines $y = mx + b$; find the slope m and intercept b of a straight line; know about the tangent and area under a curve

Problems

Find an expression for T from the equation

$$P = \varepsilon \sigma A\left(T^4 - T_o^{\ 4}\right)$$

A car is travelling at a speed of 165 km.h^{-1}. What is the speed of the car in m.s^{-1} ?

In the Bohr model of the hydrogen atom, the energy levels of the atom are given by

$m_e = 9.11\text{x}10^{-31}$ kg $\varepsilon_0 = 8.854\text{x}10^{-12}$ C^2.N^{-1}.m^{-2} $h = 6.626\text{x}10^{-34}$ J.s $c = 3.00\text{x}10^{8}$ m.s^{-1}

$$E_n = -\frac{m_e\, e^4}{8\varepsilon_0^{\ 2} h^2}\,\frac{1}{n^2}$$

Calculate the wavelength of the photon emitted in the transition from $n = 2$ to $n = 1$ in nanometres.

Problems

Find an expression for T from the equation

$$P = \varepsilon \sigma A\left(T^4 - T_o^{\,4}\right)$$

T = ? on left hand side of equation / Rearrange equation step by step

$$\varepsilon \sigma A\left(T^4 - T_o^{\,4}\right) = P$$

$$\left(T^4 - T_o^{\,4}\right) = \frac{P}{\varepsilon \sigma A}$$

$$T^4 = T_o^{\,4} + \frac{P}{\varepsilon \sigma A}$$

$$T = \left(T_o^{\,4} + \frac{P}{\varepsilon \sigma A}\right)^{1/4}$$

A car is travelling at a speed of 165 $km.h^{-1}$. What is the speed of the car in $m.s^{-1}$?

Basic conversions

1 km = 10^3 m 1 h = (60)(60) s = 3.6×10^3 s

1 km. h^{-1} = (10^3) / (3.6×10^3) $m.s^{-1}$

165 $km.h^{-1}$ = (165) / (3.6) $m.s^{-1}$ = 45.8 $m.s^{-1}$

In the Bohr model of the hydrogen atom, the energy levels of the atom are given by

$m_e = 9.11\text{x}10^{-31}$ kg $\varepsilon_0 = 8.854\text{x}10^{-12}$ $C^2.N^{-1}.m^{-2}$ $h = 6.626\text{x}10^{-34}$ J.s c = 3.00x108 $m.s^{-1}$

$$E_n = -\frac{m_e\, e^4}{8\varepsilon_0^{\,2} h^2}\frac{1}{n^2}$$

Calculate E_1 and E_2 in (J and eV) and the wavelength λ of the photon emitted in the transition from n = 2 to n = 1 (n and nm)

$E_1 = -\ 2.17\text{x}10^{-18}$ J = -13.6 eV 1 eV = $1.60\text{x}10^{-19}$ J

$E_2 = -5.42\text{x}10^{-19}$ J = -3.40 eV

$h\,f = |E_1 - E_2|\ /\ h = 2.45\text{x}10^{15}$ Hz

$\lambda = 1.22\text{x}10^{-7}$ m = 122 nm $c = \lambda f$ $c = 3.00\text{x}10^{8}$ $m.s^{-1}$ 1 nm = 10^{-9} m

Problem

What is this equation all about?

$$t_v = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

t_0 = 2.56 y and v = 0.0511 c → t_v = ? y

t_0 = 2.56 y and t_v = 9.84 y → v = ?

What is this equation all about?

$$t_v = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

t_0 = 2.56 y and v = 0.0511 c → t_v = ? y

t_0 = 2.56 y and t_v = 9.84 y → v = ?

Time Dilation Effect – moving clocks are observed to run slow

t_v dilated time interval / t_0 proper time interval / v speed of frame of reference / c speed of light

t_0 = 2.56 y v = 0.511 c t_v = ? y → t_v = 2.98 y > 2.56 y = t_0

Different observers observe different time intervals

Rearranging the equation → $v/c = \sqrt{1-\left(\frac{t_0}{t_v}\right)^2}$

t_v = 9.84 y t_0 = 2.56 y v = ? c

v = 0.966 c

GRAPHS

http://www.physics.usyd.edu.au/teach_res/hsp/u0/t0_889.pdf

Mathematical conclusions can only be made from straight lines

Linear relationship ←→ straight line

Proportional relationship → straight line passing through origin (0,0)

Equation of a straight line $y = m\,x + b$

x and y are variables m (slope) and b (intercept) are constant

$x = 0 \rightarrow y = b$ slope $m = \dfrac{\Delta y}{\Delta x} = \dfrac{rise}{run}$

Problem – sketch straight line graphs for

- $b = 0$ $m > 0$, $b > 0$ $m > 0$, $b > 0$ $m = 0$, $b < 0$ $m < 0$
- $v = u + at$ $u > 0, a < 0$
- $h\,f = eV_s + W_{\min}$ f (x-axis) and V_s (y-axis) are the variable h, e and W_{min} are constants
  From the graph how do you find h, e, W_{min} and f_c

Problem

Photoelectric Effect $h\,f = eV_s + W_{min}$ e = 1.60x10^{-19} C

An experiment was performed using a photocell. The surface was illuminated by light of different frequencies *f* and the stopping voltages V_s were measured.

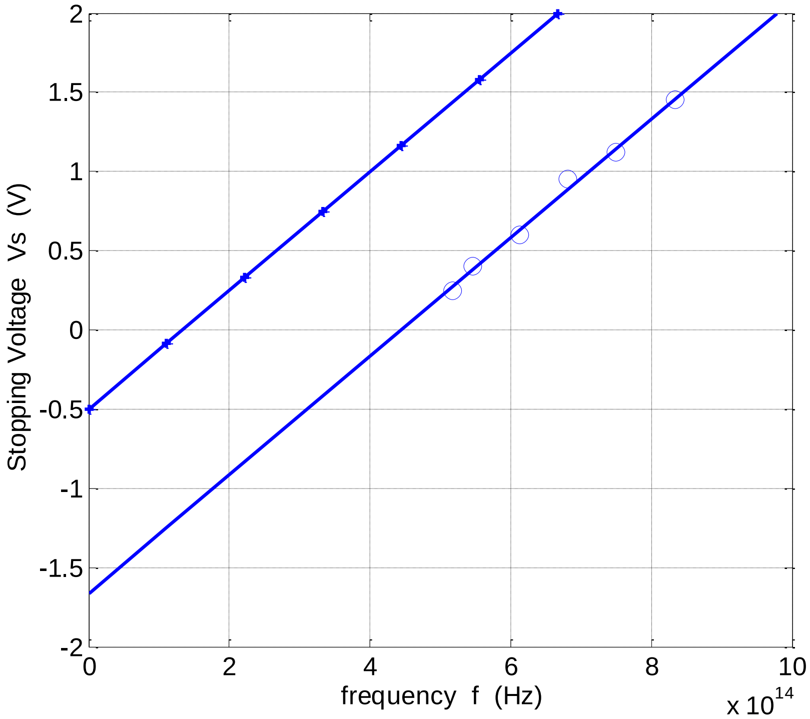
frequency *f* (x10^{14} Hz)	8.3	7.5	6.8	6.1	5.5	5.2
stopping voltage V_S (V)	1.45	1.12	0.95	0.60	0.40	0.25

Plot the stopping voltage V_s versus the frequency *f* of the light.
(y-axis V_s from -2 V to +2 V x-axis *f* from 0 to 10x10^{14} Hz)

Determine: the cut-off frequency f_c, the work function W_{min} in eV and J, and the value of Planck's constant *h*.

Another surface was used in the experiment. Its work function was 0.5 eV. Draw a line on the graph for this surface.

Stopping voltage	Voltage required to reduce photocurrent to zero – eV_s is the measurement of the maximum kinetic energy a photoelectron
Cut-off frequency	Minimum frequency for the release of electrons from the surface of the material



$$h\,f = \tfrac{1}{2}mv_{\max}{}^2 + W_{\min} = eV_{stopping} + W_{\min} \qquad V_{stopping} \equiv V_s$$

$$V_{stopping} = \frac{h}{e}f - \frac{W_{\min}}{e}$$

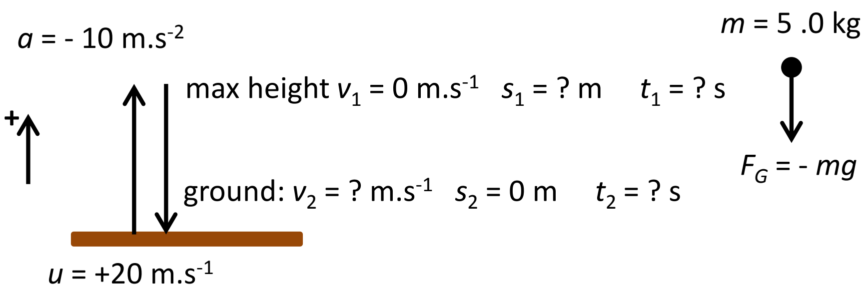
slope	slope = $h/e = 3.75\times10^{-15}$ (V.Hz^{-1})
intercept	b = -1.67 V
Work function	W = 1.7 eV = 2.7×10^{-19} J 1 eV = $1.6\text{x}10^{-19}$ J
Planck's constant	$h = 6.0\times10^{-34}$ J.s *note – answer low than accepted value*
Cut-off frequency	$f_c = 4.5\times10^{14}$ Hz

The two lines have the same slope = h / e.

Problem

A 5.0 kg ball is thrown vertically into the air at a speed of 20 m.s^{-1}. What can you easily calculate?

Apply: How to approach the problem: Identify Setup Execute Evaluate



Problem Type motion with constant acceleration

$$v = u + a t \qquad s = u t + \tfrac{1}{2} a t^2 \qquad v^2 = u^2 + 2 a s$$

At maximum height

$$v_1^{\,2} = u^2 + 2a\,s_1 \quad s_1 = \frac{v_1^{\,2} - u^2}{2a} = \frac{0 - 20^2}{(2)(-10)}\ \mathrm{m} = +20\ \mathrm{m}$$

$$v_1 = u + a\,t_1 \quad t_1 = \frac{v_1 - u}{a} = \frac{0 - 20}{-10}\ \mathrm{s} = 2.0\ \mathrm{s}$$

Just before impact

v_2 = - u = - 20 m.s^{-1} t_2 = (2 t_1) = 4.0 s

or $v_2^{\,2} = u^2 + 2a\,s_2 = u^2 \quad v = -u = -20\ m.s^{-1}$

$$v_2 = u + a\,t_2 = -v_2 + a\,t_2 \quad t_2 = \frac{2v_2}{a} = \frac{(2)(-20)}{-10}\ \mathrm{s} = 4.0\ \mathrm{s}$$

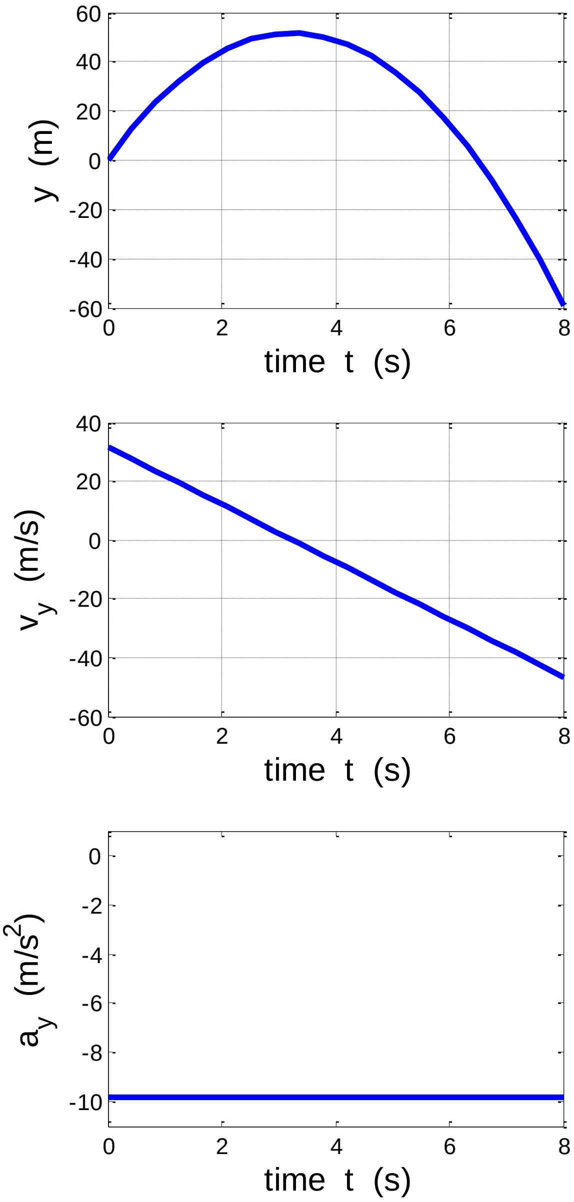
Force on ball during flight

F_G = m g = m a = (5)(-10) N = - 500 N

Problem

A ball is thrown vertically into the air. Draw three time graphs: displacement, velocity, acceleration

Apply: How to approach the problem: Identify Setup Execute Evaluate



Displacement curve → parabola $s = u\,t + \tfrac{1}{2}a\,t^2$ slope of tangent $v = \dfrac{ds}{dt}$

Velocity curve → straight line $v = u + a\,t$ slope is constant and negative $a = \dfrac{dv}{dt}$

Acceleration curve → constant – independent of time

Problem

Two balls with the same mass are dropped from rest and from the same height onto the ground. One ball bounces off the floor to nearly its original height, while the other ball does not bounce at all. Which ball exerts the greatest force on the ground during the impact?

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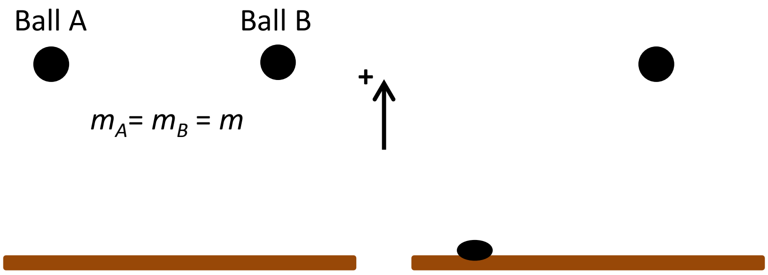

velocities of ball just before impact $u_A = -u$ $u_B = -u$

velocities of balls just after impact $v_A = 0$ $v_B = +u$

Impulse = change in momentum $F\ \Delta t = mv - mu$

Ball A $F_A\ \Delta t_A = mv_A - m(-u) = 0 + mu = mu$

Ball B $F_B\ \Delta t_B = mv_B - m(-u) = mu + mu = 2m\ u$

Impulse exerted on ball B by the ground is twice the impact exerted on ball A

Ball A sticks to the ground → $\Delta t_A > \Delta t_B$ → $F_B > F_A$

The force on the bouncing ball is greater because this ball has the greater change in its momentum

Explain how a person can walk on a corn flour mixture?

Problem

Predict Observe Explain (POE)

Compare the time it takes for a magnet to fall through a glass tube and copper tube of the same length.

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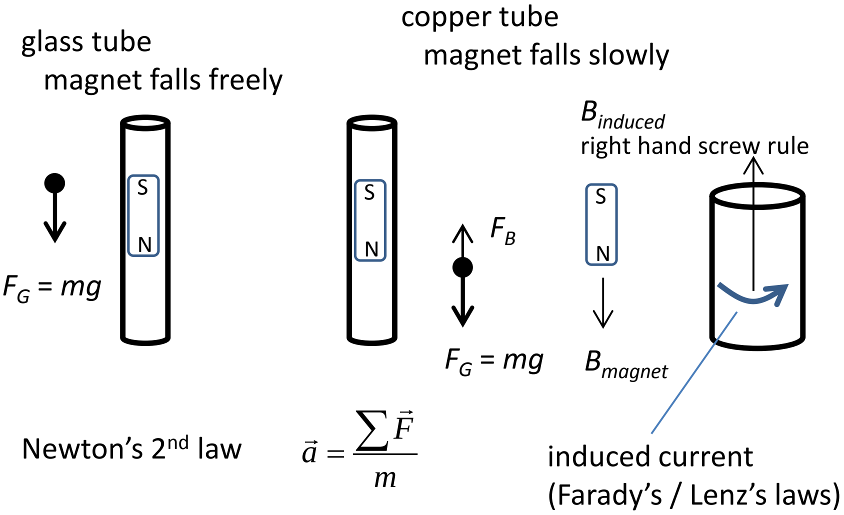
Apply: How to approach the problem: Identify Setup Execute Evaluate

Faraday's law of electromagnetic induction: an emf is induced in a conductor when the conductor is in relative motion with a magnet – a changing magnetic flux produces an emf in a conductor

$$emf = -\frac{d\phi_B}{dt} \qquad \text{magnetic flux} \quad \phi_B = B\,A\cos\phi$$

If there is a complete circuit, the induced emf will produce an induced current through the conductor.

Lenz's law → the direction of the induced current will produce a magnetic field to oppose the change in magnetic flux due to the relative motion.



Newton's 2nd law $\vec{a} = \dfrac{\sum \vec{F}}{m}$

$a_{glass} > a_{copper}$

Induced current produces a magnetic field to oppose the motion of the falling magnet (same magnetic poles repel)

Problem

Two light globes when connected separately to a 10 V battery results in one globe being very bright whereas the other globe is very dim. One globe is rated 100 W, 10 V and the other 20 W, 10 V – which globe is bright and which is dim? Comment on the brightness of each globe when both are connected to the battery in (1) series and (2) parallel.