3.0 WHAT IS ENERGY?

- Energy: the ability to do work or effect change
  - Work = force x distance
  - Change = changes the form (liquid to vapour)

DIFFERENT FORMS OF ENERGY

- Kinetic energy (motion)
- Elastic energy (springs)
- Electrical energy (batteries)
- Thermal energy (fire)
- Radiation energy (light)
- Gravitational energy
- Chemical energy (food)
- Wind energy
- Sound energy (sound waves)
- Hydraulic energy (waterfalls)
- Nuclear energy (atomic nuclei, the sun)

3.1 LAW OF CONSERVATION OF ENERGY

- Energy can be neither created nor destroyed; it can only be transferred or transformed.
  - **Energy transfer is moving <u>one type of energy</u> from one <u>place</u> to another.**
    - You warm up in front of a heater.
  - **Energy transformation is the changing of energy from one <u>form</u> to another**
    - An iPOd changes electrical energy into sound energy.

3.2 ENERGY EFFICIENCY

- When humans create machines, some of the energy they use is wasted
  - Light bulbs waste energy as heat
  - Car engines waste energy through friction and heat
    - Only 12% of the energy from gasoline is used to run the car (p72)

$$\text{Energy efficiency} = \frac{\text{amount of used energy}}{\text{total energy available}} \times 100$$

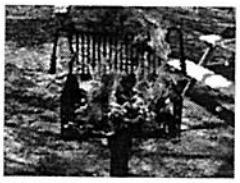
IN JOULES!

3.3 THERMAL ENERGY

- Is the energy contained in a substance.
- It results from the random movement of atoms in that substance.
- It depends on the number of atoms and their temperature
- more particles = higher temperature = more thermal energy

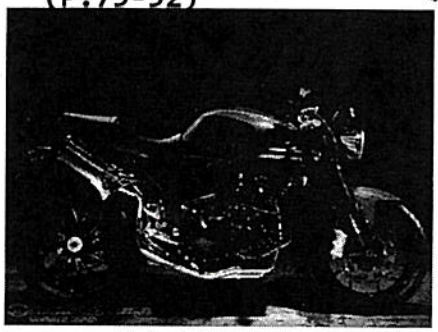
WHAT IS THE DIFFERENCE BETWEEN HEAT AND TEMPERATURE?

- <u>Heat</u> is the <u>transfer</u> of thermal energy from warmer objects to cooler objects.
- <u>Temperature</u> is a measure of the degree of movement of atoms <u>in an object</u>.



3.4 MOTION AND FORCES (P.79-92)

Write this ☺



Speed or Velocity (v)

Write this ☺

- How fast an object is travelling
- Measured in km/h or most often in science as m/s

Travel time (Δt)

Write this ☺

- The amount of time the object was moving

Acceleration (a)

Write this ☺

- The change in speed over a given time
- Measured in m/s^2

How do you calculate the speed of an object?

Write this ☺

Speed (velocity) = distance travelled (m) / travel time (s)

Same as $v = \frac{d}{\Delta t}$

What is the speed of a car that travels 10 km in 12 minutes? In km/h & m/s?

- Distance travelled (d) = 10km = **10 000m**
- Travel time (t) = 12 min = **720 sec Or 0.2 h**

v (km/h) = d (m) / t(sec) = [redacted]

v (m/s) = d (m) / t(sec) = [redacted]

3.5 Forces and Changes in Motion

- A force is a push or a pull on an object that can change its motion

Write this ☺

- On diagrams use: p80
  - Dotted line = line of action (on x, y or z axis)
  - Arrow = direction of application
  - Starting point of the arrow = Point of application
  - Length of the line = magnitude or strength

Unit of Force

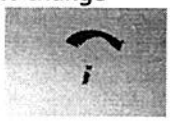
Write this ☺

- Force is measured in Newtons (N)
- 1 Newton (N) is the amount of force required to accelerate a 1 kg object at a rate of 1 m/s²

What forces can do to an object

Write this ☺

1. Can cause an object to start moving or increase the speed of an already moving object. This is called Acceleration.
2. Can cause an object to stop moving or slow down the speed of a moving object. This is called Deceleration.
3. Can cause a moving object to change direction.



3.6 Gravitational Force

Write this ☺

- An attraction between **all** objects, caused by their masses and distances between them.
- High mass + short distance = strong gravity.
- Small mass + larger the distance = weak gravity.

Why things fall to the ground

- When we drop an object, the force of gravity is strong because the earth has a large mass and is close by. The object gets pulled to the ground.
- Near the Earth's surface, objects accelerate to the ground at a rate of 9.8 m/s², **regardless of their masses**.

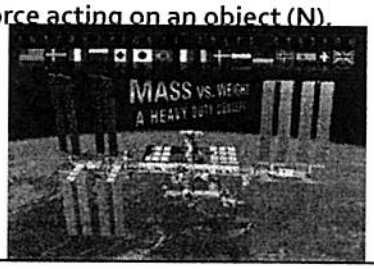
Write this ☺

EARTH'S GRAVITY = 9.8 M/S²

Mass vs. Weight

Write this ☺

- Mass is the amount of matter (1 kg)
- Weight is result of the gravitational force acting on an object (N).



Write this ☺

$F_g = mg$

m = mass (kg)

g = gravity at the earth's surface is 9.8 m/s²

F_g = downward force (N)

(See p62)

3.7 Electromagnetic Force

Write this ☺

- Attraction or repulsion between two charged objects or two magnets
- Likes repel, opposites attract

3.8 Frictional Force

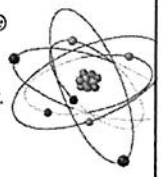
Write this ☺

- The force that prevents two objects from slipping over each other
- Air resistance is also a force of friction
- Friction depends on:
  - How smooth the surface is (the rougher the surfaces the greater the friction)
  - The pressure between the surfaces (the greater the pressure the greater the friction)

3.9 Strong & Weak Nuclear Forces

Write this ☺

- **Act within the nucleus**
- **Short range forces**
- **Holds the nucleus together**
  - Strong nuclear force
    - holds protons & neutrons together.
    - Stronger
  - Weak nuclear force
    - Hold subatomic particles together (boson, quirks, quarks, etc)
    - very weak, related to radioactivity/light



3.10 Combination of Forces

Write this ☺

- **Objects are usually subjected to several forces at once.**
- **The RESULTANT force is equal to the combination of all forces acting on an object at the same time.**
- **See p. 87 Fig. 3.21**

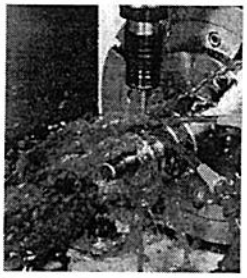
- **Equilibrium** of forces is achieved when the resultant force is zero.
  - The object will remain at rest or remain at the same velocity.
  - Ex: When you ride a bike at a constant speed, the resultant force is zero....you are in equilibrium.

Write this

PLEASE WRITE THIS ☺

Forces in Fluids

p. 92-98



3.8 What is Pressure?

- Since fluids take different shapes, the concept of a force on a fluid is better described as **PRESSURE**.
- You can't really "push" a fluid but you can exert pressure on it.
- **Pressure is the amount of force applied to a fluid per unit surface area**
  - Bike tire has 60 psi (pounds per square inch)
  - Car tire has 35 psi (pounds per square inch)

PLEASE WRITE THIS ☺

Formula to calculate pressure

$$\text{Pressure (Pa)} = \frac{\text{Force (N)}}{\text{Area (m}^2\text{)}}$$

OR

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

P is pressure measured in Pascals (Pa)
F is force exerted measured in Newtons (N)
A is surface area measured in m^2

PLEASE WRITE THIS ☺

PLEASE WRITE THIS ☺

Pressure in a liquid depends on:

- **Density**
  Higher density = increased pressure
- **Depth**
  Increased depth = increased pressure

SCUBA divers experience increased pressure the deeper they dive....you can feel it in your ears!!!

PLEASE WRITE THIS ☺

Pressure in a gas depends on:

- Temperature
- Volume
- Concentration (# of particles)

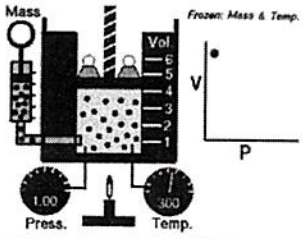
As temperature increase, pressure increases.
because the molecules are moving faster (hitting harder)

PLEASE WRITE THIS ☺

As volume decreases, pressure increases.

There are more molecules hitting the sides at any moment!

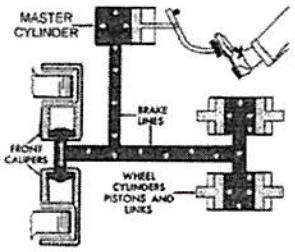
As concentration increases, pressure increases.



PLEASE WRITE THIS ☺

Pascal's Principle:

- An increase in the pressure on a fluid is transmitted uniformly in all directions
- Used in:
  - water pistols,
  - hydraulic breaks,
  - syringes.



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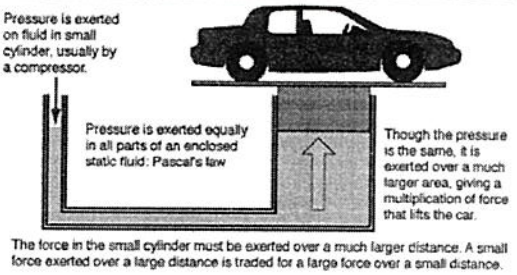
A small force applied to a small piston makes a strong force on the large piston.



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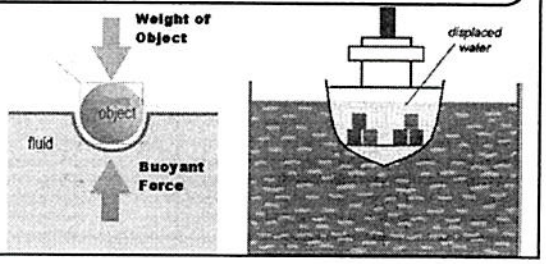
Archimedes' Principle:

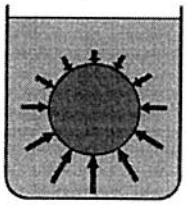
- **Archimedes' Principle: the magnitude of the buoyant force will equal the weight of the fluid displaced by the object**



- Since the pressure in a liquid increases with depth, an upward force called "buoyancy" is exerted on objects placed in liquids

PLEASE WRITE THIS ☺

- Archimedes' determined Principle explains
  - why some objects will float in water and some don't.
  - why objects feel "lighter" when underwater.

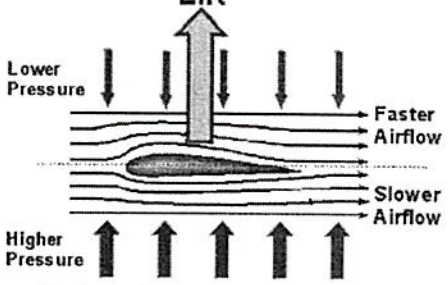


PLEASE WRITE THIS ☺

Bernoulli's Principle:

- When a fluid or gas is in motion, like the wind in the air, its pressure varies with its speed
- **Bernoulli's Principle: the higher the speed of the fluid or gas, the lower its pressure**
- This explains how a plane can fly
  - Fig. 3.38, p. 98

Bernoulli's Principle



When the force from the lift exceeds that of gravity, the plane rises into the air.