

SCALARS: MEASUREMENTS/VARIABLES THAT ONLY HAVE MAGNITUDE ("BIGNESS")
 e.g. MASS, DISTANCE, SPEED, TEMPERATURE.

VECTORS: HAVE BOTH MAGNITUDE AND DIRECTION.
 e.g. DISPLACEMENT, VELOCITY, FORCE, MOMENTUM.

IF VECTORS ARE IN OPPOSITE DIRECTIONS, MUST BE +ve & -ve.
 * CAN ADD VECTORS BY PLACING THEM 'TOP-TO-TAIL'.

- VECTOR DRAWN FROM START TO FINISH IS THE RESULTANT.
 e.g. $4m/s + 3m/s = 5m/s$ (PYTHAGORAS).
 $10 \cos 30^\circ = 8.66$

- CAN FIND VECTORS FROM ANGLES e.g. 30°
 - COMPONENTS < RESULTANT
 SO RESULTANT \rightarrow COMPONENT, $\times \cos \theta / \sin \theta$.

FORCES: THRUST, LIFT, FRICTION, AIR RES., WEIGHT, ELECTROSTATIC, MAGNETIC

WORK DONE = ENERGY TRANSFERRED BY FORCE
 $E = Fd$

HOOKE'S LAW (SPRINGS): $F = ke$
 close eye in line to reduce parallax error.
 - Ind. var: weight/force = mg .
 - Dep. var: extension.
 - Controls: same spring.

WAVES TRANSFER ENERGY WITHOUT TRANSFERRING MATTER.
TRANSVERSE: OSCILLATIONS ARE PERPENDICULAR TO DIRECTION OF ENERGY TRANSFER
 e.g. LIGHT/EM, WATER WAVES, STRING.
LONGITUDINAL: OSCILLATIONS ARE PARALLEL TO DIR. OF E TRANSFER.
 e.g. SOUND, P WAVES.
 BOTH CAN BE REPRESENTED AS WAVEFORM:

WAVEFORM:
 $v = f\lambda$
 - Measure d of 10 waves $\div 10$ to get λ .
 $v = f\lambda$ to get speed.
 - Change f and repeat.
 v should be same for all.
 - Use same depth of water.

IR ABSORPTION
 Matte BLACK BEST AT ABSORBING + EMITTING IR.
 - Wrap boiling tubes in matte black, white, shiny materials.
 - Use IR lamp, same distance from each.
 - Thermometer in bung allows temp measurement.
 - Observe which has highest temp after, say, 5 mins.

REFLECTION
 LIGHT REFLECTS OFF MATERIALS AT SAME ANGLE AS INCIDENCE. ($i=r$)

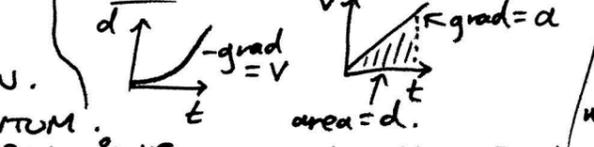
REFRACTION: WHEN LIGHT ENTERS NEW MEDIUM, IT WILL CHANGE SPEED (FASTEST IN AIR/VACUUM), AND ANGLE.
 Pracs! Change angle of incidence (i) and AND ANGLE. r refractive index (n) should be same every time.
 $n = \frac{\sin i}{\sin r}$
 Also to: speed in vacuum / speed in medium (LENSES ON SPACE MINDMAP)
 FASTER = BENDS AWAY FROM NORMAL.

EM SPECTRUM λ long! f short!
 Radio Micro Infra-Red Visible UV X-rays Gamma
 (cosms) heat \rightarrow H_2O \rightarrow higher f . (radiotherapy/medical)
 shorter λ higher E .

WAVES
 Disp. Amplitude
 eqm
 wavelength or Time period
 Frequency: NUMBER OF COMPLETE WAVES THAT PASS A POINT EVERY SECOND (Hz)
 $f = \frac{1}{T}$

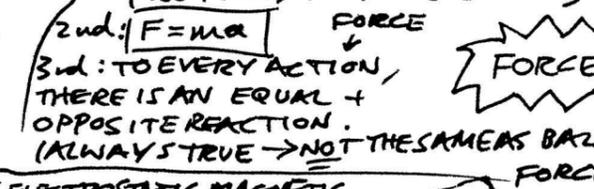
SCIENCE SHORTS
 Video
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*** DISTANCE-TIME & VEL-TIME GRAPH**



NEWTON'S LAWS OF MOTION
 1st: OBJECT'S MOTION CONSTANT IF NO EXTERNAL FORCE ACTS ('NO FORCE, NO ACCELERATION')
 2nd: $F = ma$ FORCE
 3rd: TO EVERY ACTION, THERE IS AN EQUAL + OPPOSITE REACTION. (ALWAYS TRUE \rightarrow NOT THE SAME AS BALANCED FORCES!)

FORCES & MOTION
 $F = ma$ prac!
 - Ind. var: force
 - Dep. var: acceleration
 - Controls: constant total mass, so must put masses on trolley when removed from hanger.
 Same distance between light gates. Same trolley (so same friction etc).
 * Make sure trolley is through light gates before masses hit floor!



SUVAT (NEWTON'S EQNS OF MOTION)
 (DON'T NEED TO REMEMBER!) * IF OBJECT THROWN HORIZONTALLY: (PROJECTILE MOTION): USES SUVAT VERTICALLY, BUT JUST USE speed = $\frac{d}{t}$ HORIZONTALLY. (time is same for both)

GCSE PHYSICS PAPER 2 (APART FROM SPACE)
 - Write down SUVAT + fill in, e.g. $s = 10m$, $v = 0$ for dropped objects
 $a = 9.8m/s^2$ for falling - no matter what mass!
 - FIND EQN W/O UNUSED VARIABLE
 - REARRANGE IF NEEDED.
 (e.g. $2s = at^2$, $\frac{2s}{a} = t^2$, $t = \sqrt{\frac{2s}{a}}$)

WAVES
 Dipper makes waves. String using vibrator oscillator.
 $\lambda = 2 \times$ length of string.
 f is given by generator powering oscillator. use $v = f\lambda$ to get speed.
 - Controls: thickness, mass, weight.

MOMENTUM - TOTAL MOMENTUM IS ALWAYS CONSERVED, SO TOTAL MOM IN = TOTAL MOM OUT.
 momentum = mv
 RECOIL: TOTAL MOM = 0 BEFORE AFTER OF BALL, TO ADD UP TO 0.
 UNIT: kgm/s
 FORCE + MOMENTUM: $F = \frac{mv}{t}$ BIGGER FORCE = FASTER CHANGE IN MOMENTUM
 SO $m_e v_e = m_b v_b$ BIG FORCE NEEDED TO STOP OBJECT QUICKLY.

STOPPING DISTANCE = THINKING D + BRAKING D.
 Fair res. weight
 DISTRACTIONS, TIREDRIVEN, DRUGS, ALCOHOL SPEED $\times 2$, $D \times 2$
 WEATHER, ROAD/TYRE CONDITION $E_k = \frac{1}{2}mv^2$ SPEED $\times 2$, $D \times 4$

MOMENTS: (TURNING FORCE)
 MOMENT = Fd (TORQUE)
 distance from force \rightarrow pivot
 e.g. weight/force, $10N$, $d = 0.5m$, so moment = $10 \times 0.5 = 5 Nm$.
 FOR OBJECT TO BE IN EQUILIBRIUM (NOT TURNING), THE SUM (TOTAL) OF CLOCKWISE MOMENTS = SUM OF ANTICLOCKWISE MOMENTS. e.g. $20N$ weight placed at $0.25m$ other side \checkmark $20 \times 0.25 = 5 Nm$

PRESSURE
 $P = \frac{F}{A}$ area
 UNIT: N/m^2 or Pa.
 PRESSURE IS SAME EVERYWHERE IN A HYDRAULIC SYSTEM (PIPES, PISTONS) e.g. $F_1 = F_2$, so $A_1 = A_2$, $F = 100N$, $A_1 = 0.1m^2$, $A_2 = 0.05m^2$, $\frac{100}{0.1} = \frac{F}{0.05}$, $F = 50N$

MAGNETIC FIELDS
 FIELD LINES SHOW DIR OF FORCE ON AN 'IMAGINARY' N-POLE. THEY NEVER CROSS/BREAK.
 LINES CLOSER TOGETHER = STRONGER FIELD.
 - MAGNETIC FIELD STRENGTH: SYMBOL: B (FLUX DENSITY) UNIT: T (Tesla)

CURRENT IN COIL/SOLENOID MAKES ELECTROMAGNET
 BIGGER CURRENT/MORE TURNS IN COIL = STRONGER
 PUTTING IRON NAIL/CORE IN, STRONGER

GENERATOR/DYNAMO
 'REVERSE MOTOR' TURN IT \rightarrow MAKES CURRENT (INDUCED)
 * MICROPHONE 'REVERSE SPEAKER'
 DIAPHRAGM MOVES, MOVES MAGNET IN COIL, CURRENT INDUCED.

MAGNETIC FIELDS
 CAN MEASURE USING MOTOR EFFECT:
 CAN MEASURE BY PUTTING MAGNETS ON BALANCE, FORCE = mg
 WIRE WILL FEEL FORCE $F = BIL$
 field strength, current of wire, length in field

TO FIND DIRECTION OF FORCE: FLEMING'S L.H. RULE
 F \uparrow , B \rightarrow , I \rightarrow
 FREEZE! FBI TWIST WRIST, FINGERS!
 MOTOR

SPEAKER
 SPLIT-RING COMMUTATOR NEEDED TO 'FLIP' CURRENT EVERY $\frac{1}{2}$ TURN, OR IT WOULD STOP AT VERTICAL!
 FASTER: STRONGER FIELD, HIGHER V/I , MORE TURNS.

*** TRANSFORMERS**
 PRIMARY COIL N_1 TURNS, SECONDARY COIL N_2 TURNS
 LAMINATED (LAYERED) TO REDUCE ENERGY LOST
 NO CURRENT IN CORE, ONLY MAG FIELD!
 IF 100% EFF $P_1 = P_2$ SO $I_1 V_1 = I_2 V_2$. LOWER I USED TO STEP UP V OUTSIDE POWER STATION TO REDUCE ENERGY LOST AS HEAT DUE TO RESISTANCE OF CABLES. A.C. NEEDED AS SECONDARY COIL NEEDS CHANGING MAG. FIELD IN CORE IN ORDER FOR CURRENT TO BE INDUCED IN IT.

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