## Nature of Science: 15 questions, 12%

| | | |
|---|---|---|
| **Vector** | magnitude **NO** direction Ex= speed, distance | |
| **Scalar** | magnitude & Direction. Ex= acceleration, displacement | |
| **Significant Figures** | all digits after the first *non-zero* are significant | |
| | ex: 0.00410 3 sig figs, 23840100 6 sig figs | |
| | leading zeros don't count | |
| | adding round to # with the fewest decimals | |
| **Accuracy** | ex:how close results are to the true value | |
| **Precision** | how close results are to one another | |
| **Systematic Error** | consistent error | |
| **Acceleration** | v/t | $1/2gt^2$ |
| **Weight** | W=mg=mass X gravity | |
| **Work** | W=Force x distance | |

## Matter and Energy: 19 questions, 15%

| | | | |
|---|---|---|---|
| **Bohr model** | electrons move in fixed orbitals (shells) and not anywhere in between and that each orbit (shell) has a fixed energy | | |
| **Particles** | *alpha*= 2p,2n bound | *beta*=high energy, high speed electrons | *gamma*=shortest wavelength electromagnetic waves |
| **Fission** | breaks | releases energy ex. atom smashing | |
| **Fusion** | combines | releases energy ex. sun | |
| **Energy transfer** | *radiation*= emitted | *conduction*= touch | *convection*= fluids |

## Matter and Energy: 19 questions, 15% (cont)

| | | | |
|---|---|---|---|
| **Thermodynamics** | *1st law*= conservation of energy | *2nd law*= entropy increases | *3rd law*= A perfect crystal at zero Kelvin has zero entropy |
| **Ideal Gas Law** | Boyle's law PV=nRT | pressure and volume of a gas have an inverse relationship | |
| **Kinetic energy** | energy of motion | $=1/2mv^2$ | |
| **Potential energy** | stored energy | =mgh | |
| PE=KE | $mgh=1/2mv^2$ | mgh=1/2mv+ mg(2R) | |
| ME= KE + PE | velocity b4 impact: square root (2gh) | | |

## Waves: 21 questions, 17%

| | |
|---|---|
| **Transverse waves** | motion in which all points on a wave oscillate along paths at right angles to the direction of the wave's advance. Ex Water ripples |
| **Longitudinal waves** | vibration of medium is parallel to the direction the wave travels and displacement of the medium is in the same direction of the wave propagation. Ex: sound |
| **Mechanical waves** | an oscillation of matter, and transfers energy through a material medium. ex: sound, water |
| **Electromagnetic** | formed when an electric field couples with a magnetic field. ex. light, gamma |
| **Compression waves** | the particle motion is in the same direction in which the wave is propagating i.e. longitudinal |

## Waves: 21 questions, 17% (cont)

| | |
|---|---|
| **Doppler effect:** | the change in the frequency of a wave in relation to an observer who is moving relative to the source of the wave |
| | moving away= longer towards=shorter |
| **Sound** | *Sonic boom*= shock waves created when an object travels through the air faster than the speed of sound |
| | *sound barrier* sudden increase in aerodynamic drag that happens when an object approaches the speed of sound |
| | *Pitch*=frequency *Loudness*=intensity |

## Waves pt 2: 21 questions, 17% (copy)

| | |
|---|---|
| **Snell's law:** | relationship between angles of incidence & refraction |
| | *refraction*= the bending of light or sound as it passes through something like a wall (sound) or a window (light). |
| | *reflection*= the throwing back without absorbing it. |
| | n1sin01 = n2sin02 change in direction |
| **Optics** | *real image*= occurs where rays converge *virtual image*= rays only appear to diverge |
| | *Polarization*= division into two sharply distinct opposites |
| **Lenses** | *converging*= both sides of the lens curve outward it will bend light from distant objects inwards toward a single point, called the focal point |

## Waves pt 2: 21 questions, 17% (copy) (cont)

| |
|---|
| *convex*=refract and converge |
| further from lens the bigger the object appears |
| *diverging*=both sides of the lens curve inward and light from distant objects will bend outwards. |
| *concave*=refract and diverge, always smaller |
| + behind lens - in front of lens |
| more lenses, - the focal length |

## Mechanics: 44 questions, 35%

| | |
|---|---|
| **Newton's 1st** | *law of inertia*: objects at rest remain at rest |
| **Newton's 2nd** | F=ma: the greater the mass the more force needed to accelerate |
| **Newton's 3rd** | every action has an equal and opposite reaction |
| **Kepler's 1st** | all planets move in an elliptical orbit around the sun |
| **Kepler's 2nd** | planets will move slowly far away from the sun, and faster closer to the sun |
| **Kepler's 3rd** | the square of the period of any planet is proportional to the cube of the axis of the orbit. |
| **Friction** | force that resists the sliding/rolling of a solid object over another |
| **Bernoulli's principle** | an increase in speed of a fluid simultaneously with a decrease in pressure or a decrease in the fluid's PE |
| **Uniform circular motion** | *centripetal* acceleration, net force is directed to the center |

## Mechanics: 44 questions, 35% (cont)

| | |
|---|---|
| | increasing radius decreases force |
| | $F=m(v^2/r)\cos 0$ |
| **Rotational motion** | motion of an object around an axis. *w=0/t* |
| **Harmonic motion** F = *-kx* | **Hooke's law** the force exerted by a spring is proportional to its length |
| **Collisions** | *elastic*- momentum conserved ex. pool balls move apart |
| | *inelastic*- momentum not conserved ex. 2 cars stuck together, move together |
| **Centripetal force** | increase radius, decrease the force. $F=m(v^2/r)\cos 0$ |
| **Bouyant force** F = -pgV | the upward force exerted on an object immersed in a fluid |
| **Displacement** | D=VT=velocityXtime |
| **Vectors** | add or subtract by placing tip to tail |
| **Pascal's principle** | The pressure at any point in the fluid is equal in all directions. |
| | pressure input = pressure output |
| **modulus** | *bulk*= reaction to squeezing |
| | *elastic*= ratio of stress to strain |
| | *young*= elasticity and length |
| | *shear*= elasticity and stress |
| **Pendulums** | Time=2pi(square root (length/gravity)) |
| | freq (displacement) = amplitude sin (ang freq * t) |

## Electricity & Magnetism: 26 questions, 21%

| | |
|---|---|
| **Coulomb's law** F = $k(q1q2)/r^2$ | the force of attraction/repulsion between 2 charged bodies is proportional to the product of their charges and inversely proportional to the square of the distance between them |

## Electricity & Magnetism: 26 questions, 21% (cont)

| | |
|---|---|
| **Conductors** | allows the movement of electrons and ions through. Ex. copper, gold, silver, steel, aluminium & brass |
| | have moveable charges |
| **Insulators** | don't allow electric current to pass through, electrical resistance. Ex. glass, plastic, rubber, air, & wood |
| **Ohm's law** V = IR | the relationship between voltage, current & resistance in an electrical circuit. |
| **Biot-Savart law** | describes the magnetic field generated by a constant electric current |
| **Lorentz force** | combination of electric and magnetic force on a point charge due to electromagnetic fields. *to determine the direction of the magnetic force on a positive moving charge, point right thumb in the direction of the velocity (v), index finger in the direction of the magnetic field (B), and middle finger will point in the direction of the the resulting magnetic force* |

## Electricity & Magnetism: 26 questions, 21% (cont)

| | | |
|---|---|---|
| **Ampere's law** | the sum of the length elements times the magnetic field in the direction of the length element will be equal to the permeability times the electric current. | |
| **Lenz's law** | direction of the electric current induced in a conductor by a changing magnetic field, the magnetic field created by the induced current opposes changes in the initial magnetic field | |
| **Kirchoff's laws** | sum of all currents entering a junction must equal the sum of all currents leaving the junction | |
| **Electric field** | the electric force per unit charge | |
| **Electric potential** V = k(q/r) | amount of work energy needed per unit of electric charge to move the charge from a reference point to a specific point in an electric field | |
| | the stronger the field= more potential | |
| I=V/R | V=IR | R=V/I |
| **Series** | one path | Rt=R1+ R2+R3.... |
| | It= I1 =I2 | Vt = V1 + V2 |
| **Parallel** | many paths | 1/Rt=1/R1+1/R2... |
| | It = I1 + I2 | Vt = V1 =V2 |

## Electricity & Magnetism: 26 questions, 21% (cont)

| | |
|---|---|
| | decrease resistance= decrease length, increase radius |
| | total resistance is less than individual |
| **Gauss's law** | how much of something is INSIDE a completely closed surface by measuring how much is flowing out through the sides of that surface. |
| | the electric flux Φ across any closed surface is proportional to the net electric charge q enclosed by the surface |
| **Magnetic field** | F= qvB sin 0, where q is the magnitude of the charge, B is the magnitude of the magnetic field, v is the speed, and is the angle of the velocity with respect to the field. As increases from 0° to 90°, the force increases. |

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