STAAR PHYSICS REFERENCE MATERIALS

FORCE AND MOTION

Average velocity $= \dfrac{\text{displacement}}{\text{change in time}}$	$v_{avg} = \dfrac{\Delta d}{\Delta t}$
Acceleration $= \dfrac{\text{final velocity} - \text{initial velocity}}{\text{change in time}}$	$a = \dfrac{v_f - v_i}{\Delta t}$
Acceleration $= \dfrac{(\text{final velocity})^2 - (\text{initial velocity})^2}{2(\text{displacement})}$	$a = \dfrac{v_f^2 - v_i^2}{2\Delta d}$
Displacement $= \left(\begin{smallmatrix}\text{initial}\\\text{velocity}\end{smallmatrix}\right)\left(\begin{smallmatrix}\text{change}\\\text{in time}\end{smallmatrix}\right) + \frac{1}{2}(\text{acceleration})\left(\begin{smallmatrix}\text{change}\\\text{in time}\end{smallmatrix}\right)^2$	$\Delta d = v_i\Delta t + \frac{1}{2}a\Delta t^2$
Centripetal acceleration $= \dfrac{(\text{tangential velocity})^2}{\text{radius}}$	$a_c = \dfrac{v_t^2}{r}$
Net force $= (\text{mass})(\text{acceleration})$	$F_{net} = ma$
Work $= (\text{force})(\text{distance})$	$W = Fd$
Torque $= (\text{force})(\text{lever arm})$	$\tau = Fr$
Power $= \dfrac{\text{work}}{\text{time}}$	$P = \dfrac{W}{t}$
Pythagorean theorem	$a^2 + b^2 = c^2$

GRAVITATIONAL, ELECTRICAL, AND MAGNETIC FORCES

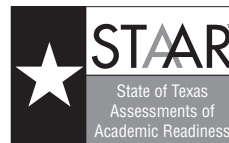|	
Force of gravitational attraction between 2 objects $= \left(\begin{smallmatrix}\text{universal}\\\text{gravitation}\\\text{constant}\end{smallmatrix}\right)\left(\dfrac{\left(\begin{smallmatrix}\text{mass of}\\\text{1st object}\end{smallmatrix}\right)\left(\begin{smallmatrix}\text{mass of}\\\text{2nd object}\end{smallmatrix}\right)}{\left(\begin{smallmatrix}\text{distance between}\\\text{centers of objects}\end{smallmatrix}\right)^2}\right)$	$F_g = G\left(\dfrac{m_1 m_2}{d^2}\right)$
Force between 2 charged particles $= \left(\begin{smallmatrix}\text{Coulomb's}\\\text{constant}\end{smallmatrix}\right)\left(\dfrac{\left(\begin{smallmatrix}\text{charge of}\\\text{1st particle}\end{smallmatrix}\right)\left(\begin{smallmatrix}\text{charge of}\\\text{2nd particle}\end{smallmatrix}\right)}{(\text{distance between particles})^2}\right)$	$F_{electric} = k_C\left(\dfrac{q_1 q_2}{d^2}\right)$
Electrical power $= (\text{voltage})(\text{current})$	$P = VI$
Current $= \dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
Equivalent resistance for resistors in series	$R = R_1 + R_2 + R_3 + \cdots$
Equivalent resistance for resistors in parallel	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3} + \cdots$

STAAR PHYSICS REFERENCE MATERIALS

ENERGY AND MOMENTUM

Kinetic energy $= \frac{1}{2}$(mass)(velocity)^2

$$KE = \frac{1}{2}mv^2$$

Gravitational potential energy $=$ (mass)$\left(\begin{array}{c}\text{acceleration}\\\text{due to gravity}\end{array}\right)$(height)

$$PE_g = mgh$$

Elastic potential energy $= \frac{1}{2}\left(\begin{array}{c}\text{spring}\\\text{constant}\end{array}\right)\left(\begin{array}{c}\text{distance stretched}\\\text{or compressed}\end{array}\right)^2$

$$PE_{elastic} = \frac{1}{2}kx^2$$

Energy $=$ (power)(time)

$$E = Pt$$

Work $=$ change in kinetic energy

$$W = \Delta KE$$

Mechanical energy $=$ kinetic energy $+$ potential energy

$$ME = KE + PE$$

Law of conservation of energy

$$KE_i + PE_i = KE_f + PE_f$$

Momentum $=$ (mass)(velocity)

$$p = mv$$

Impulse $=$ (force)(change in time) $=$ (mass)(change in velocity)

$$J = F\Delta t = m\Delta v$$

Law of conservation of momentum

$$m_1 v_{1_i} + m_2 v_{2_i} = m_1 v_{1_f} + m_2 v_{2_f}$$

Heat gained or lost $=$ (mass)$\left(\begin{array}{c}\text{specific}\\\text{heat}\end{array}\right)\left(\begin{array}{c}\text{change in}\\\text{temperature}\end{array}\right)$

$$Q = mc_p\Delta T$$

WAVES AND LIGHT

Velocity $=$ (frequency)(wavelength)

$$v = f\lambda$$

$$\frac{1}{\text{Focal length}} = \frac{1}{\text{distance to image}} + \frac{1}{\text{distance to object}}$$

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$$

Energy $=$ (mass)(speed of light)^2

$$E = mc^2$$

STAAR PHYSICS
REFERENCE MATERIALS

CONSTANTS AND CONVERSIONS

$$c = \text{speed of light} = 3.00 \times 10^8 \ \frac{m}{s}$$

$$g = \text{acceleration due to gravity} = 9.8 \ \frac{m}{s^2}$$

$$G = \text{universal gravitation constant} = 6.67 \times 10^{-11} \ \frac{N \cdot m^2}{kg^2}$$

$$k_C = \text{Coulomb's constant} = 8.99 \times 10^9 \ \frac{N \cdot m^2}{C^2}$$

$$m_E = \text{mass of Earth} = 5.97 \times 10^{24} \ kg$$

$$r_E = \text{radius of Earth} = 6.37 \times 10^6 \ m$$

$$\text{newton (N)} = \frac{kg \cdot m}{s^2}$$

$$\text{joule (J)} = N \cdot m$$

$$\text{watt (W)} = \frac{J}{s} = \frac{N \cdot m}{s}$$

$$\text{hertz (Hz)} = \frac{cycle}{s}$$

STAAR PHYSICS
REFERENCE MATERIALS

Key:

Atomic number	14
Symbol	**Si**
Atomic mass	28.086
Name	Silicon

Mass numbers in parentheses are those of the most stable or most common isotope.

Periodic Table

Group →	1 / 1A	2 / 2A	3 / 3B	4 / 4B	5 / 5B	6 / 6B	7 / 7B	8 / 8B	9 / 8B	10 / 8B	11 / 1B	12 / 2B	13 / 3A	14 / 4A	15 / 5A	16 / 6A	17 / 7A	18 / 8A
1	1 **H** 1.008 Hydrogen																	2 **He** 4.003 Helium
2	3 **Li** 6.941 Lithium	4 **Be** 9.012 Beryllium											5 **B** 10.812 Boron	6 **C** 12.011 Carbon	7 **N** 14.007 Nitrogen	8 **O** 15.999 Oxygen	9 **F** 18.998 Fluorine	10 **Ne** 20.180 Neon
3	11 **Na** 22.990 Sodium	12 **Mg** 24.305 Magnesium											13 **Al** 26.982 Aluminum	14 **Si** 28.086 Silicon	15 **P** 30.974 Phosphorus	16 **S** 32.066 Sulfur	17 **Cl** 35.453 Chlorine	18 **Ar** 39.948 Argon
4	19 **K** 39.098 Potassium	20 **Ca** 40.078 Calcium	21 **Sc** 44.956 Scandium	22 **Ti** 47.867 Titanium	23 **V** 50.942 Vanadium	24 **Cr** 51.996 Chromium	25 **Mn** 54.938 Manganese	26 **Fe** 55.845 Iron	27 **Co** 58.933 Cobalt	28 **Ni** 58.693 Nickel	29 **Cu** 63.546 Copper	30 **Zn** 65.38 Zinc	31 **Ga** 69.723 Gallium	32 **Ge** 72.64 Germanium	33 **As** 74.922 Arsenic	34 **Se** 78.96 Selenium	35 **Br** 79.904 Bromine	36 **Kr** 83.798 Krypton
5	37 **Rb** 85.468 Rubidium	38 **Sr** 87.62 Strontium	39 **Y** 88.906 Yttrium	40 **Zr** 91.224 Zirconium	41 **Nb** 92.906 Niobium	42 **Mo** 95.96 Molybdenum	43 **Tc** (98) Technetium	44 **Ru** 101.07 Ruthenium	45 **Rh** 102.906 Rhodium	46 **Pd** 106.42 Palladium	47 **Ag** 107.868 Silver	48 **Cd** 112.412 Cadmium	49 **In** 114.818 Indium	50 **Sn** 118.711 Tin	51 **Sb** 121.760 Antimony	52 **Te** 127.60 Tellurium	53 **I** 126.904 Iodine	54 **Xe** 131.294 Xenon
6	55 **Cs** 132.905 Cesium	56 **Ba** 137.328 Barium	71 **Lu** 174.967 Lutetium	72 **Hf** 178.49 Hafnium	73 **Ta** 180.948 Tantalum	74 **W** 183.84 Tungsten	75 **Re** 186.207 Rhenium	76 **Os** 190.23 Osmium	77 **Ir** 192.217 Iridium	78 **Pt** 195.085 Platinum	79 **Au** 196.967 Gold	80 **Hg** 200.59 Mercury	81 **Tl** 204.383 Thallium	82 **Pb** 207.2 Lead	83 **Bi** 208.980 Bismuth	84 **Po** (209) Polonium	85 **At** (210) Astatine	86 **Rn** (222) Radon
7	87 **Fr** (223) Francium	88 **Ra** (226) Radium	103 **Lr** (262) Lawrencium	104 **Rf** (267) Rutherfordium	105 **Db** (268) Dubnium	106 **Sg** (271) Seaborgium	107 **Bh** (272) Bohrium	108 **Hs** (270) Hassium	109 **Mt** (276) Meitnerium	110 **Ds** (281) Darmstadtium	111 **Rg** (280) Roentgenium							

Lanthanide Series

57 **La** 138.905 Lanthanum	58 **Ce** 140.116 Cerium	59 **Pr** 140.908 Praseodymium	60 **Nd** 144.242 Neodymium	61 **Pm** (145) Promethium	62 **Sm** 150.36 Samarium	63 **Eu** 151.964 Europium	64 **Gd** 157.25 Gadolinium	65 **Tb** 158.925 Terbium	66 **Dy** 162.500 Dysprosium	67 **Ho** 164.930 Holmium	68 **Er** 167.259 Erbium	69 **Tm** 168.934 Thulium	70 **Yb** 173.055 Ytterbium

Actinide Series

89 **Ac** (227) Actinium	90 **Th** 232.038 Thorium	91 **Pa** 231.036 Protactinium	92 **U** 238.029 Uranium	93 **Np** (237) Neptunium	94 **Pu** (244) Plutonium	95 **Am** (243) Americium	96 **Cm** (247) Curium	97 **Bk** (247) Berkelium	98 **Cf** (251) Californium	99 **Es** (252) Einsteinium	100 **Fm** (257) Fermium	101 **Md** (258) Mendelevium	102 **No** (259) Nobelium