# STAAR PHYSICS REFERENCE MATERIALS

## FORCE AND MOTION

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

## GRAVITATIONAL, ELECTRICAL, AND MAGNETIC FORCES

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

# 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)$\left(\begin{matrix}\text{acceleration}\\ \text{due to gravity}\end{matrix}\right)$(height) | $PE_g = mgh$ |
| Elastic potential energy $= \frac{1}{2}\left(\begin{matrix}\text{spring}\\ \text{constant}\end{matrix}\right)\left(\begin{matrix}\text{distance stretched}\\ \text{or compressed}\end{matrix}\right)^2$ | $PE_{\text{elastic}} = \frac{1}{2}kx^2$ |
| 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 | $m_1v_{1_i} + m_2v_{2_i} = m_1v_{1_f} + m_2v_{2_f}$ |
| Heat gained or lost = (mass)$\left(\begin{matrix}\text{specific}\\ \text{heat}\end{matrix}\right)\left(\begin{matrix}\text{change in}\\ \text{temperature}\end{matrix}\right)$ | $Q = mc_p\Delta T$ |

## 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

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

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

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

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

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

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

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

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

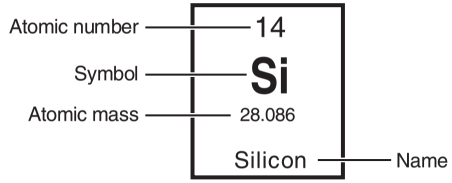
$$\text{watt (W)} = \frac{\text{J}}{\text{s}} = \frac{\text{N} \cdot \text{m}}{\text{s}}$$

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

# STAAR PHYSICS REFERENCE MATERIALS

STAAR™ State of Texas Assessments of Academic Readiness

## PERIODIC TABLE OF THE ELEMENTS




| | 1 1A | | | | | | | | | | | | 13 3A | 14 4A | 15 5A | 16 6A | 17 7A | 18 8A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 H 1.008 Hydrogen | 2 2A | | | | | | | | | | | | | | | | 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 | 3 3B | 4 4B | 5 5B | 6 6B | 7 7B | 8 | 9 8B | 10 | 11 1B | 12 2B | 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 | | | | | | | |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |

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