



# *Physics 30*

## *Learner Assessment*

*Data Sheets of*

*Constants*

*Equations*

*Periodic Table of the Elements*

Government  
of Alberta ■

Alberta ■

Freedom To Create. Spirit To Achieve.

# PHYSICS DATA SHEET

## Constants

|                                             |                                                                                                         |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Acceleration Due to Gravity Near Earth..... | $ \vec{a}_g  = 9.81 \text{ m/s}^2$                                                                      |
| Gravitational Constant .....                | $G = 6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$                                         |
| Radius of Earth .....                       | $r_e = 6.37 \times 10^6 \text{ m}$                                                                      |
| Mass of Earth .....                         | $M_e = 5.97 \times 10^{24} \text{ kg}$                                                                  |
| Elementary Charge .....                     | $e = 1.60 \times 10^{-19} \text{ C}$                                                                    |
| Coulomb's Law Constant ..                   | $k = 8.99 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$                                              |
| Electron Volt .....                         | $1 \text{ eV} = 1.60 \times 10^{-19} \text{ J}$                                                         |
| Index of Refraction of Air.                 | $n = 1.00$                                                                                              |
| Speed of Light in Vacuum.                   | $c = 3.00 \times 10^8 \text{ m/s}$                                                                      |
| Planck's Constant .....                     | $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$<br>$h = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s}$ |
| Atomic Mass Unit .....                      | $u = 1.66 \times 10^{-27} \text{ kg}$                                                                   |

## Physics Principles

- 0 Uniform motion ( $\vec{F}_{\text{net}} = 0$ )
- 1 Accelerated motion ( $\vec{F}_{\text{net}} \neq 0$ )
- 2 Uniform circular motion ( $\vec{F}_{\text{net}}$  is radially inward)
- 3 Work-energy theorem
- 4 Conservation of momentum
- 5 Conservation of energy
- 6 Conservation of mass-energy
- 7 Conservation of charge
- 8 Conservation of nucleons
- 9 Wave-particle duality

## Prefixes Used with SI Units

| Prefix      | Symbol      | Exponential Value |
|-------------|-------------|-------------------|
| atto .....  | a .....     | $10^{-18}$        |
| femto ..... | f .....     | $10^{-15}$        |
| pico .....  | p .....     | $10^{-12}$        |
| nano .....  | n .....     | $10^{-9}$         |
| micro ..... | $\mu$ ..... | $10^{-6}$         |
| milli ..... | m .....     | $10^{-3}$         |
| centi ..... | c .....     | $10^{-2}$         |
| deci .....  | d .....     | $10^{-1}$         |
| deka .....  | da .....    | $10^1$            |
| hecto ..... | h .....     | $10^2$            |
| kilo .....  | k .....     | $10^3$            |
| mega .....  | M .....     | $10^6$            |
| giga .....  | G .....     | $10^9$            |
| tera .....  | T .....     | $10^{12}$         |

## Particles

|                     | Charge | Mass                              |
|---------------------|--------|-----------------------------------|
| Alpha Particle..... | $+2e$  | $6.65 \times 10^{-27} \text{ kg}$ |
| Electron .....      | $-1e$  | $9.11 \times 10^{-31} \text{ kg}$ |
| Proton .....        | $+1e$  | $1.67 \times 10^{-27} \text{ kg}$ |
| Neutron.....        | 0      | $1.67 \times 10^{-27} \text{ kg}$ |

## First-Generation Fermions

|                                          | Charge          | Mass                         |
|------------------------------------------|-----------------|------------------------------|
| Electron .....                           | $-1e$           | $0.511 \text{ MeV}/c^2$      |
| Positron .....                           | $+1e$           | $0.511 \text{ MeV}/c^2$      |
| Electron neutrino, $\nu$ .....           | 0               | $< 50 \text{ eV}/c^2$        |
| Electron antineutrino, $\bar{\nu}$ ..... | 0               | $< 50 \text{ eV}/c^2$        |
| Up quark, u.....                         | $+\frac{2}{3}e$ | $\sim 5 \text{ MeV}/c^{2*}$  |
| Anti-up antiquark, $\bar{u}$ .....       | $-\frac{2}{3}e$ | $\sim 5 \text{ MeV}/c^{2*}$  |
| Down quark, d.....                       | $-\frac{1}{3}e$ | $\sim 10 \text{ MeV}/c^{2*}$ |
| Anti-down antiquark, $\bar{d}$ .....     | $+\frac{1}{3}e$ | $\sim 10 \text{ MeV}/c^{2*}$ |

\*Current models seem to suggest a significantly lower mass of these quarks than those in this table.

## EQUATIONS

### Kinematics

$$\begin{aligned}\vec{v}_{\text{ave}} &= \frac{\Delta \vec{d}}{\Delta t} & \vec{d} &= \vec{v}_f t - \frac{1}{2} \vec{a} t^2 \\ \vec{a}_{\text{ave}} &= \frac{\Delta \vec{v}}{\Delta t} & \vec{d} &= \left( \frac{\vec{v}_f + \vec{v}_i}{2} \right) t \\ \vec{d} &= \vec{v}_i t + \frac{1}{2} \vec{a} t^2 & v_f^2 &= v_i^2 + 2ad \\ |\vec{v}_c| &= \frac{2\pi r}{T} & |\vec{a}_c| &= \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}\end{aligned}$$

### Dynamics

$$\begin{aligned}\vec{F}_{\text{net}} \\ \vec{a} &= \frac{\vec{F}_{\text{net}}}{m} & |\vec{F}_g| &= \frac{Gm_1 m_2}{r^2} \\ |\vec{F}_f| &= \mu |\vec{F}_N| & |\vec{g}| &= \frac{Gm}{r^2} \\ \vec{F}_s &= -k\vec{x} & \vec{F}_g \\ \vec{g} &= \frac{\vec{F}_g}{m}\end{aligned}$$

### Momentum and Energy

$$\begin{aligned}\vec{p} &= m\vec{v} & E_k &= \frac{1}{2}mv^2 \\ \vec{F}\Delta t &= m\Delta\vec{v} & E_p &= mgh \\ W &= |\vec{F}| |\vec{d}| \cos\theta & E_p &= \frac{1}{2}kx^2 \\ W &= \Delta E \\ P &= \frac{W}{t}\end{aligned}$$

### Waves

$$\begin{aligned}T &= 2\pi\sqrt{\frac{m}{k}} & m &= \frac{h_i}{h_o} = \frac{-d_i}{d_o} \\ T &= 2\pi\sqrt{\frac{L}{g}} & \frac{1}{f} &= \frac{1}{d_o} + \frac{1}{d_i} \\ T &= \frac{1}{f} & \frac{\sin\theta_1}{\sin\theta_2} &= \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} \\ v &= f\lambda & \lambda &= \frac{d \sin\theta}{n} \\ f &= \left( \frac{v}{v \pm v_s} \right) f_s & \lambda &= \frac{xd}{nl}\end{aligned}$$

### Electricity and Magnetism

$$\begin{aligned}|\vec{F}_e| &= \frac{kq_1 q_2}{r^2} & \Delta V &= \frac{\Delta E}{q} \\ |\vec{E}| &= \frac{kq}{r^2} & I &= \frac{q}{t} \\ \vec{E} &= \frac{\vec{F}_e}{q} & |\vec{F}_m| &= \mu_{\perp} |\vec{B}| \\ |\vec{E}| &= \frac{\Delta V}{\Delta d} & |\vec{F}_m| &= qv_{\perp} |\vec{B}|\end{aligned}$$

### Atomic Physics

$$\begin{aligned}W &= hf_0 & E &= hf = \frac{hc}{\lambda} \\ E_{k_{\text{max}}} &= qeV_{\text{stop}} & N &= N_0 \left( \frac{1}{2} \right)^n\end{aligned}$$

### Quantum Mechanics and Nuclear Physics

$$\begin{aligned}\Delta E &= \Delta mc^2 & E &= pc \\ p &= \frac{h}{\lambda} & \Delta\lambda &= \frac{h}{mc}(1 - \cos\theta)\end{aligned}$$

### Trigonometry and Geometry

$$\begin{aligned}\sin\theta &= \frac{\text{opposite}}{\text{hypotenuse}} & \textbf{Line} \\ m &= \frac{\Delta y}{\Delta x} & y &= mx + b \\ \cos\theta &= \frac{\text{adjacent}}{\text{hypotenuse}} & \textbf{Area} \\ \tan\theta &= \frac{\text{opposite}}{\text{adjacent}} & \text{Rectangle} &= lw \\ c^2 &= a^2 + b^2 & \text{Triangle} &= \frac{1}{2}ab \\ \frac{a}{\sin A} &= \frac{b}{\sin B} = \frac{c}{\sin C} & \text{Circle} &= \pi r^2 \\ c^2 &= a^2 + b^2 - 2ab \cos C & \textbf{Circumference} \\ & & \text{Circle} &= 2\pi r\end{aligned}$$

### Graphing Calculator Window Format

$$\begin{aligned}x: & [x_{\text{min}}, x_{\text{max}}, x_{\text{sc}}] \\ y: & [y_{\text{min}}, y_{\text{max}}, y_{\text{sc}}]\end{aligned}$$

# Periodic Table of the Elements

Periodic Table of the Elements

|                                 |                                |                                    |                                     |                                 |                                  |                                |                                  |                                  |                                    |                                   |                                 |                                  |                                    |                                    |                                   |                                  |                                   |                                |                            |                               |                            |                                    |                                   |                                  |                                   |                                |                                  |
|---------------------------------|--------------------------------|------------------------------------|-------------------------------------|---------------------------------|----------------------------------|--------------------------------|----------------------------------|----------------------------------|------------------------------------|-----------------------------------|---------------------------------|----------------------------------|------------------------------------|------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|--------------------------------|----------------------------|-------------------------------|----------------------------|------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|--------------------------------|----------------------------------|
| 1<br>H<br>1.01<br>hydrogen      |                                |                                    |                                     |                                 |                                  |                                |                                  |                                  |                                    |                                   |                                 |                                  |                                    |                                    |                                   |                                  | 2<br>He<br>4.00<br>helium         |                                |                            |                               |                            |                                    |                                   |                                  |                                   |                                |                                  |
| 3<br>Li<br>6.94<br>lithium      | 4<br>Be<br>9.01<br>beryllium   |                                    |                                     |                                 |                                  |                                |                                  |                                  |                                    |                                   |                                 |                                  |                                    |                                    |                                   | 5<br>B<br>10.81<br>boron         | 6<br>C<br>12.01<br>carbon         | 7<br>N<br>14.01<br>nitrogen    | 8<br>O<br>16.00<br>oxygen  | 9<br>F<br>19.00<br>fluorine   | 10<br>Ne<br>20.18<br>neon  |                                    |                                   |                                  |                                   |                                |                                  |
| 11<br>Na<br>22.99<br>sodium     | 12<br>Mg<br>24.31<br>magnesium |                                    |                                     |                                 |                                  |                                |                                  |                                  |                                    |                                   |                                 |                                  |                                    |                                    |                                   | 13<br>Al<br>26.98<br>aluminium   | 14<br>Si<br>28.09<br>silicon      | 15<br>P<br>30.97<br>phosphorus | 16<br>S<br>32.07<br>sulfur | 17<br>Cl<br>35.45<br>chlorine | 18<br>Ar<br>39.95<br>argon |                                    |                                   |                                  |                                   |                                |                                  |
| 19<br>K<br>39.10<br>potassium   | 20<br>Ca<br>40.08<br>calcium   | 21<br>Sc<br>44.96<br>scandium      | 22<br>Ti<br>47.87<br>titanium       | 23<br>V<br>50.94<br>vanadium    | 24<br>Cr<br>52.00<br>chromium    | 25<br>Mn<br>54.94<br>manganese | 26<br>Fe<br>55.85<br>iron        | 27<br>Co<br>58.93<br>cobalt      | 28<br>Ni<br>58.69<br>nickel        | 29<br>Cu<br>63.55<br>copper       | 30<br>Zn<br>65.39<br>zinc       | 31<br>Ga<br>69.72<br>gallium     | 32<br>Ge<br>72.64<br>germanium     | 33<br>As<br>74.92<br>arsenic       | 34<br>Se<br>78.96<br>selenium     | 35<br>Br<br>79.90<br>bromine     | 36<br>Kr<br>83.80<br>krypton      |                                |                            |                               |                            | 51<br>Sb<br>121.75<br>antimony     | 52<br>Te<br>127.60<br>tellurium   | 53<br>I<br>126.90<br>iodine      | 54<br>Xe<br>131.29<br>xenon       |                                |                                  |
| 37<br>Rb<br>85.47<br>rubidium   | 38<br>Sr<br>87.62<br>strontium | 39<br>Y<br>88.91<br>yttrium        | 40<br>Zr<br>91.22<br>zirconium      | 41<br>Nb<br>92.91<br>niobium    | 42<br>Mo<br>95.94<br>molybdenum  | 43<br>Tc<br>(98)<br>technetium | 44<br>Ru<br>101.07<br>ruthenium  | 45<br>Rh<br>102.91<br>rhodium    | 46<br>Pd<br>106.42<br>palladium    | 47<br>Ag<br>107.87<br>silver      | 48<br>Cd<br>112.41<br>cadmium   | 49<br>In<br>114.82<br>indium     | 50<br>Sn<br>118.71<br>tin          | 51<br>Sb<br>121.75<br>antimony     | 52<br>Te<br>127.60<br>tellurium   | 53<br>I<br>126.90<br>iodine      | 54<br>Xe<br>131.29<br>xenon       |                                |                            |                               |                            | 83<br>Bi<br>208.98<br>bismuth      | 84<br>Po<br>(209)<br>polonium     | 85<br>At<br>(210)<br>astatine    | 86<br>Rn<br>(222)<br>radon        |                                |                                  |
| 55<br>Cs<br>132.91<br>cesium    | 56<br>Ba<br>137.33<br>barium   | 57-71                              | 72<br>Hf<br>178.49<br>hafnium       | 73<br>Ta<br>180.95<br>tantalum  | 74<br>W<br>183.84<br>tungsten    | 75<br>Re<br>186.21<br>rhenium  | 76<br>Os<br>190.23<br>osmium     | 77<br>Ir<br>192.22<br>iridium    | 78<br>Pt<br>195.08<br>platinum     | 79<br>Au<br>196.97<br>gold        | 80<br>Hg<br>200.59<br>mercury   | 81<br>Tl<br>204.38<br>thallium   | 82<br>Pb<br>207.21<br>lead         | 83<br>Bi<br>208.98<br>bismuth      | 84<br>Po<br>(209)<br>polonium     | 85<br>At<br>(210)<br>astatine    | 86<br>Rn<br>(222)<br>radon        |                                |                            |                               |                            | 115<br>Uup<br>(288)<br>ununpentium | 116<br>Uuh<br>(292)<br>ununhexium | 117<br>Uus<br>(?)<br>ununseptium | 118<br>Uuo<br>(294)<br>ununoctium |                                |                                  |
| 87<br>Fr<br>(223)<br>francium   | 88<br>Ra<br>(226)<br>radium    | 89-103                             | 104<br>Rf<br>(261)<br>rutherfordium | 105<br>Db<br>(262)<br>dubnium   | 106<br>Sg<br>(266)<br>seaborgium | 107<br>Bh<br>(264)<br>bohrium  | 108<br>Hs<br>(277)<br>hassium    | 109<br>Mt<br>(268)<br>meitnerium | 110<br>Ds<br>(271)<br>darmstadtium | 111<br>Rg<br>(272)<br>roentgenium | 112<br>Uub<br>(285)<br>ununbium | 113<br>Uut<br>(284)<br>ununtrium | 114<br>Uuq<br>(289)<br>ununquadium | 115<br>Uup<br>(288)<br>ununpentium | 116<br>Uuh<br>(292)<br>ununhexium | 117<br>Uus<br>(?)<br>ununseptium | 118<br>Uuo<br>(294)<br>ununoctium |                                |                            |                               |                            | 68<br>Er<br>167.26<br>erbium       | 69<br>Tm<br>168.93<br>thulium     | 70<br>Yb<br>173.04<br>ytterbium  | 71<br>Lu<br>174.97<br>lutetium    |                                |                                  |
| 57<br>La<br>138.91<br>lanthanum | 58<br>Ce<br>140.12<br>cerium   | 59<br>Pr<br>140.91<br>praseodymium | 60<br>Nd<br>144.24<br>neodymium     | 61<br>Pm<br>(145)<br>promethium | 62<br>Sm<br>150.36<br>samarium   | 63<br>Eu<br>151.96<br>europium | 64<br>Gd<br>157.25<br>gadolinium | 65<br>Tb<br>158.93<br>terbium    | 66<br>Dy<br>162.50<br>dysprosium   | 67<br>Ho<br>164.93<br>holmium     | 68<br>Er<br>167.26<br>erbium    | 69<br>Tm<br>168.93<br>thulium    | 70<br>Yb<br>173.04<br>ytterbium    | 71<br>Lu<br>174.97<br>lutetium     | 101<br>Md<br>(258)<br>mendelevium | 102<br>No<br>(259)<br>nobelium   | 103<br>Lr<br>(262)<br>lawrencium  |                                |                            |                               |                            | 98<br>Cf<br>(251)<br>californium   | 99<br>Es<br>(252)<br>einsteinium  | 100<br>Fm<br>(257)<br>fermium    | 101<br>Md<br>(258)<br>mendelevium | 102<br>No<br>(259)<br>nobelium | 103<br>Lr<br>(262)<br>lawrencium |

Key

Atomic number → 3 Li ← Symbol

Atomic molar mass (g/mol) → 6.94

Name → lithium

Based on <sup>12</sup>C

( ) Indicates mass of the most stable isotope

Key

Atomic number → 3

Symbol → Li

Atomic molar mass (g/mol) → 6.94

Name → Lithium

Based on <sup>12</sup>C

( ) Indicates mass of the most stable isotope