



PHYSICS

YEAR 11

FORMULAE AND DATA

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Linear motion and force

Mean velocity	$v_{av} = \frac{s}{t} = \frac{v + u}{2}$
Equations of motion	$a = \frac{v - u}{t}$; $s = ut + \frac{1}{2}at^2$; $v^2 = u^2 + 2as$; $v = u + at$
Force	$F = ma$
Weight force	$F = mg$
Momentum	$p = mv$; $\Sigma p_{\text{before}} = \Sigma p_{\text{after}}$
Change in momentum (impulse)	$\Delta p = F\Delta t = mv - mu$
Kinetic energy	$E_k = \frac{1}{2}mv^2$
Gravitational potential energy	$E_p = mg\Delta h$
Work done	$W = Fs = \Delta E$
Power	$P = \frac{W}{t} = \frac{\Delta E}{t} = Fv_{av}$

Note: the variable t refers to the 'time taken' sometimes referred to as the 'change in time' or Δt .

Ionising radiation and nuclear reactions

Activity	$A = \frac{\Delta N}{t}$
Half-life	$N = N_0 \left(\frac{1}{2}\right)^n$
Absorbed radiation dose	absorbed dose = $\frac{E}{m}$
Dose equivalent	dose equivalent = absorbed dose \times quality factor
Mass-energy relationship	$\Delta E = \Delta mc^2$

Heating processes

Change of temperature	$Q = mc\Delta T$
Change of state	$Q = mL$
Efficiency	$\eta = \frac{\text{energy output}}{\text{energy input}} \times \frac{100}{1} \%$

Electrical circuits

Electric current	$I = \frac{q}{t}$
Work and energy	$V = \frac{W}{q}$
Ohm's law	$R = \frac{V}{I}$
Resistances in series	$R_T = R_1 + R_2 + \dots$
Resistances in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
Power	$P = \frac{W}{t} = VI$

Waves

Wave velocity	$v = f\lambda$
Period	$T = \frac{1}{f}$
Strings and open pipes	$\lambda = \frac{2\ell}{n}$
Closed pipes	$\lambda = \frac{4\ell}{(2n-1)}$
Intensity	$I \propto \frac{1}{r^2}$

Prefixes of the metric system

Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{12}	tera	T	10^{-3}	milli	m
10^9	giga	G	10^{-6}	micro	μ
10^6	mega	M	10^{-9}	nano	n
10^3	kilo	k	10^{-12}	pico	p

Physical constants

Speed of light in vacuum or air	c	=	$3.00 \times 10^8 \text{ m s}^{-1}$
Electron charge	e	=	$-1.60 \times 10^{-19} \text{ C}$
Electron volt.....	1 eV	=	$1.60 \times 10^{-19} \text{ J}$
Unified atomic mass unit	1 u	=	$1.66 \times 10^{-27} \text{ kg}$
Rest mass of electron.....	m_e	=	$9.11 \times 10^{-31} \text{ kg}$
Rest mass of proton	m_p	=	$1.67 \times 10^{-27} \text{ kg}$
Rest mass of neutron	m_n	=	$1.67 \times 10^{-27} \text{ kg}$
Rest mass of alpha particle	m_α	=	$6.64 \times 10^{-27} \text{ kg}$
Mass–energy equivalent.....	1 u	=	931 MeV
Tonne.....	1 t	=	$10^3 \text{ kg} = 10^6 \text{ g}$
Absolute zero.....	0 K	=	$-273 \text{ }^\circ\text{C}$

Physical data

Mean acceleration due to gravity on Earth.....	g	=	9.80 m s^{-2}
Specific heat capacity of water.....	c_w	=	$4.18 \times 10^3 \text{ J K}^{-1} \text{ kg}^{-1}$
Specific heat capacity of ice	c_i	=	$2.10 \times 10^3 \text{ J K}^{-1} \text{ kg}^{-1}$
Specific heat capacity of steam.....	c_s	=	$2.00 \times 10^3 \text{ J K}^{-1} \text{ kg}^{-1}$
Latent heat of fusion for H_2O	L_f	=	$3.34 \times 10^5 \text{ J kg}^{-1}$
Latent heat of vaporisation for H_2O	L_v	=	$2.26 \times 10^6 \text{ J kg}^{-1}$
Speed of sound in air at $25 \text{ }^\circ\text{C}$	v_s	=	346 m s^{-1}

Quality factors

Approximate quality factor for alpha radiation	QF_α	=	20
Approximate quality factor for beta radiation.....	QF_β	=	1
Approximate quality factor for gamma radiation...	QF_γ	=	1
Approximate quality factor for slow neutrons.....	QF_{sn}	=	3
Approximate quality factor for fast neutrons.....	QF_{fn}	=	10

Periodic table of the elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<div><div>1</div><div>H</div><div>hydrogen</div><div>1.008</div></div>																	<div><div>2</div><div>He</div><div>helium</div><div>4.003</div></div>
<div><div>3</div><div>Li</div><div>lithium</div><div>6.94</div></div>	<div><div>4</div><div>Be</div><div>beryllium</div><div>9.012</div></div>																<div><div>9</div><div>F</div><div>fluorine</div><div>19.00</div></div>
<div><div>11</div><div>Na</div><div>sodium</div><div>22.99</div></div>	<div><div>12</div><div>Mg</div><div>magnesium</div><div>24.31</div></div>																<div><div>17</div><div>Cl</div><div>chlorine</div><div>35.45</div></div>
<div><div>19</div><div>K</div><div>potassium</div><div>39.10</div></div>	<div><div>20</div><div>Ca</div><div>calcium</div><div>40.08</div></div>	<div><div>21</div><div>Sc</div><div>scandium</div><div>44.96</div></div>	<div><div>22</div><div>Ti</div><div>titanium</div><div>47.87</div></div>	<div><div>23</div><div>V</div><div>vanadium</div><div>50.94</div></div>	<div><div>24</div><div>Cr</div><div>chromium</div><div>52.00</div></div>	<div><div>25</div><div>Mn</div><div>manganese</div><div>54.94</div></div>	<div><div>26</div><div>Fe</div><div>iron</div><div>55.85</div></div>	<div><div>27</div><div>Co</div><div>cobalt</div><div>58.93</div></div>	<div><div>28</div><div>Ni</div><div>nickel</div><div>58.69</div></div>	<div><div>29</div><div>Cu</div><div>copper</div><div>63.55</div></div>	<div><div>30</div><div>Zn</div><div>zinc</div><div>65.38</div></div>	<div><div>31</div><div>Ga</div><div>gallium</div><div>69.72</div></div>	<div><div>32</div><div>Ge</div><div>germanium</div><div>72.63</div></div>	<div><div>33</div><div>As</div><div>arsenic</div><div>74.92</div></div>	<div><div>34</div><div>Se</div><div>selenium</div><div>78.97</div></div>	<div><div>35</div><div>Br</div><div>bromine</div><div>79.90</div></div>	<div><div>36</div><div>Kr</div><div>krypton</div><div>83.80</div></div>
<div><div>37</div><div>Rb</div><div>rubidium</div><div>85.47</div></div>	<div><div>38</div><div>Sr</div><div>strontium</div><div>87.62</div></div>	<div><div>39</div><div>Y</div><div>yttrium</div><div>88.91</div></div>	<div><div>40</div><div>Zr</div><div>zirconium</div><div>91.22</div></div>	<div><div>41</div><div>Nb</div><div>niobium</div><div>92.91</div></div>	<div><div>42</div><div>Mo</div><div>molybdenum</div><div>95.95</div></div>	<div><div>43</div><div>Tc</div><div>technetium</div><div></div></div>	<div><div>44</div><div>Ru</div><div>ruthenium</div><div>101.1</div></div>	<div><div>45</div><div>Rh</div><div>rhodium</div><div>102.9</div></div>	<div><div>46</div><div>Pd</div><div>palladium</div><div>106.4</div></div>	<div><div>47</div><div>Ag</div><div>silver</div><div>107.9</div></div>	<div><div>48</div><div>Cd</div><div>cadmium</div><div>112.4</div></div>	<div><div>49</div><div>In</div><div>indium</div><div>114.8</div></div>	<div><div>50</div><div>Sn</div><div>tin</div><div>118.7</div></div>	<div><div>51</div><div>Sb</div><div>antimony</div><div>121.8</div></div>	<div><div>52</div><div>Te</div><div>tellurium</div><div>127.6</div></div>	<div><div>53</div><div>I</div><div>iodine</div><div>126.9</div></div>	<div><div>54</div><div>Xe</div><div>xenon</div><div>131.3</div></div>
<div><div>55</div><div>Cs</div><div>caesium</div><div>132.9</div></div>	<div><div>56</div><div>Ba</div><div>barium</div><div>137.3</div></div>	<div><div>57–71</div><div></div><div>lanthanoids</div><div></div></div>	<div><div>72</div><div>Hf</div><div>hafnium</div><div>178.5</div></div>	<div><div>73</div><div>Ta</div><div>tantalum</div><div>180.9</div></div>	<div><div>74</div><div>W</div><div>tungsten</div><div>183.8</div></div>	<div><div>75</div><div>Re</div><div>rhenium</div><div>186.2</div></div>	<div><div>76</div><div>Os</div><div>osmium</div><div>190.2</div></div>	<div><div>77</div><div>Ir</div><div>iridium</div><div>192.2</div></div>	<div><div>78</div><div>Pt</div><div>platinum</div><div>195.1</div></div>	<div><div>79</div><div>Au</div><div>gold</div><div>197.0</div></div>	<div><div>80</div><div>Hg</div><div>mercury</div><div>200.6</div></div>	<div><div>81</div><div>Tl</div><div>thallium</div><div>204.4</div></div>	<div><div>82</div><div>Pb</div><div>lead</div><div>207.2</div></div>	<div><div>83</div><div>Bi</div><div>bismuth</div><div>209.0</div></div>	<div><div>84</div><div>Po</div><div>polonium</div><div></div></div>	<div><div>85</div><div>At</div><div>astatine</div><div></div></div>	<div><div>86</div><div>Rn</div><div>radon</div><div></div></div>
<div><div>87</div><div>Fr</div><div>francium</div><div></div></div>	<div><div>88</div><div>Ra</div><div>radium</div><div></div></div>	<div><div>89–103</div><div></div><div>actinoids</div><div></div></div>	<div><div>104</div><div>Rf</div><div>rutherfordium</div><div></div></div>	<div><div>105</div><div>Db</div><div>dubnium</div><div></div></div>	<div><div>106</div><div>Sg</div><div>seaborgium</div><div></div></div>	<div><div>107</div><div>Bh</div><div>bohrium</div><div></div></div>	<div><div>108</div><div>Hs</div><div>hassium</div><div></div></div>	<div><div>109</div><div>Mt</div><div>meitnerium</div><div></div></div>	<div><div>110</div><div>Ds</div><div>darmstadtium</div><div></div></div>	<div><div>111</div><div>Rg</div><div>roentgenium</div><div></div></div>	<div><div>112</div><div>Cn</div><div>copernicium</div><div></div></div>	<div><div>113</div><div>Nh</div><div>nihonium</div><div></div></div>	<div><div>114</div><div>Fl</div><div>flerovium</div><div></div></div>	<div><div>115</div><div>Mc</div><div>moscovium</div><div></div></div>	<div><div>116</div><div>Lv</div><div>livermorium</div><div></div></div>	<div><div>117</div><div>Ts</div><div>tennessine</div><div></div></div>	<div><div>118</div><div>Og</div><div>oganeson</div><div></div></div>

Key:

Atomic number

Symbol

Name

Standard atomic weight

<div><div>57</div><div>La</div><div>lanthanum</div><div>138.9</div></div>	<div><div>58</div><div>Ce</div><div>cerium</div><div>140.1</div></div>	<div><div>59</div><div>Pr</div><div>praseodymium</div><div>140.9</div></div>	<div><div>60</div><div>Nd</div><div>neodymium</div><div>144.2</div></div>	<div><div>61</div><div>Pm</div><div>promethium</div><div></div></div>	<div><div>62</div><div>Sm</div><div>samarium</div><div>150.4</div></div>	<div><div>63</div><div>Eu</div><div>europtium</div><div>152.0</div></div>	<div><div>64</div><div>Gd</div><div>gadolinium</div><div>157.3</div></div>	<div><div>65</div><div>Tb</div><div>terbium</div><div>158.9</div></div>	<div><div>66</div><div>Dy</div><div>dysprosium</div><div>162.5</div></div>	<div><div>67</div><div>Ho</div><div>holmium</div><div>164.9</div></div>	<div><div>68</div><div>Er</div><div>erbium</div><div>167.3</div></div>	<div><div>69</div><div>Tm</div><div>thulium</div><div>168.9</div></div>	<div><div>70</div><div>Yb</div><div>ytterbium</div><div>173.0</div></div>	<div><div>71</div><div>Lu</div><div>lutetium</div><div>175.0</div></div>
<div><div>89</div><div>Ac</div><div>actinium</div><div>232.0</div></div>	<div><div>90</div><div>Th</div><div>thorium</div><div>232.0</div></div>	<div><div>91</div><div>Pa</div><div>protactinium</div><div>231.0</div></div>	<div><div>92</div><div>U</div><div>uranium</div><div>238.0</div></div>	<div><div>93</div><div>Np</div><div>neptunium</div><div></div></div>	<div><div>94</div><div>Pu</div><div>plutonium</div><div></div></div>	<div><div>95</div><div>Am</div><div>americium</div><div></div></div>	<div><div>96</div><div>Cm</div><div>curium</div><div></div></div>	<div><div>97</div><div>Bk</div><div>berkelium</div><div></div></div>	<div><div>98</div><div>Cf</div><div>californium</div><div></div></div>	<div><div>99</div><div>Es</div><div>einsteinium</div><div></div></div>	<div><div>100</div><div>Fm</div><div>fermium</div><div></div></div>	<div><div>101</div><div>Md</div><div>mendelevium</div><div></div></div>	<div><div>102</div><div>No</div><div>nobelium</div><div></div></div>	<div><div>103</div><div>Lr</div><div>lawrencium</div><div></div></div>

[Data source: The International Union of Pure and Applied Chemistry (2018). IUPAC periodic table of the elements Retrieved from <https://iupac.org/what-we-do/periodic-table-of-elements/>]