



PHYSICS

STAGE 2

FORMULAE AND DATA

2014

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This document is valid for teaching and examining until 31 December 2014.

PHYSICS STAGE 2

2

Forces and motion

 $v_{av} = \frac{s}{t} = \frac{v + u}{2}$ Mean velocity

 $a = \frac{v - u}{t}$; $s = ut + \frac{1}{2} at^2$; $v^2 = u^2 + 2as$; v = u + atEquations of motion

Force Weight force F = mg

p = mv; $\Sigma p_{\text{before}} = \Sigma p_{\text{after}}$ Momentum

Change in momentum (impulse) Ft = mv - mu $E_{\rm k} = \frac{1}{2} \ mv^2$ Kinetic energy $E_{\rm p} = mgh$ Gravitational potential energy

 $W = F_S = \Delta E$ Work done

 $P = \frac{W}{t} = \frac{\Delta E}{t} = F v_{av}$ Power

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

Nuclear physics

Activity

 $A = \frac{\Delta N}{t}$ $A = A_0 \left(\frac{1}{2}\right)^n$ Half-life

absorbed dose = $\frac{E}{m}$ Absorbed radiation dose

dose equivalent = absorbed dose × quality factor Dose equivalent

Mass-energy relationship $E = mc^2$

Heating and cooling

Change of temperature $Q = mc\Delta T$

Change of state O = mL

Absolute zero $0 \text{ K} = -273^{\circ}\text{C}$

Electricity and magnetism

 $I = \frac{q}{t}$ Electric current

Work and energy W = Vq = VIt

Ohm's law V = IR

 $R_{\rm T} = R_1 + R_2 + \dots$ Resistances in series

 $\frac{1}{R_{\rm T}} = \frac{1}{R_{\rm 1}} + \frac{1}{R_{\rm 2}} + \dots$ $P = VI = I^2 R = \frac{V^2}{R}$ Resistances in parallel

Power

Physical constants

Speed of light in vacuum or air	$= 3.00 \times 10^8 \mathrm{m \ s^{-1}}$
Electron chargee	$= -1.60 \times 10^{-19} \text{ C}$
Electron volt	$= 1.60 \times 10^{-19} \text{ J}$
Unified atomic mass unit1 u	$= 1.66 \times 10^{-27} \text{ kg}$
Rest mass of electron	$= 9.11 \times 10^{-31} \text{ kg}$
Rest mass of proton m_p	$= 1.67 \times 10^{-27} \text{ kg}$
Rest mass of neutron $m_{_{\rm n}}$	$= 1.67 \times 10^{-27} \text{ kg}$
Rest mass of alpha m_{α}	$= 6.64 \times 10^{-27} \text{ kg}$
Mass-energy equivalent1 u	= 931 MeV
Tonne1 t	$= 10^3 \text{ kg} = 10^6 \text{ g}$

Physical data

Mean acceleration due to gravity on Earth g	$= 9.80 \text{ m s}^{-2}$
Specific heat capacity of water $c_{\rm w}$	$= 4.18 \times 10^3 \text{ J K}^{-1} \text{kg}^{-1}$
Specific heat capacity of ice $c_{\rm i}$	$= 2.10 \times 10^3 \text{ J K}^{-1} \text{kg}^{-1}$
Specific heat capacity of steam $c_{\rm s}$	$= 2.00 \times 10^3 \text{ J K}^{-1} \text{kg}^{-1}$
Latent heat of fusion for ${\rm H_2O}$ $L_{\rm f}$	$= 3.34 \times 10^5 \mathrm{J kg^{-1}}$
Latent heat of vaporisation for $\mathrm{H_2O}L_{\mathrm{v}}$	$= 2.26 \times 10^6 \text{ J kg}^{-1}$

Quality factors

Approximate quality factor for alpha radiation $QF_{\alpha}=20$ Approximate quality factor for beta radiation $QF_{\beta}=1$ Approximate quality factor for gamma radiation $QF_{\gamma}=1$ Approximate quality factor for slow neutrons $QF_{\rm sn}=3$ Approximate quality factor for fast neutrons $QF_{\rm fn}=10$

Prefixes of the metric system

Factor	Prefix	Symbol	Factor	Prefix	Symbol
1012	tera	Т	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	р

Periodic table

18	2 Helium 4.003	S O	neon 20.18	18 A	argon 39.95	36	<u>ک</u>	krypton 83.80	54	Xe	xenon 131.3	98	Ru	radon			
17		o LL	fluorine 19.00	္င	chlorine 35.45	35	ğ	bromine 79.90	53	_	iodine 126.9	85	Ą	astatine			
16		∞ O	oxygen 16.00	ဗ္ လ	sulfur 32.07	34	Se	selenium 78.96	52	<u>e</u>	tellurium 127.6	84	Ъо	polonium	116		livermorium
15		► Z	nitrogen 14.01	55 C	phosphorus 30.97	33	As	arsenic 74.92	51	Sp	antimony 121.8	83	<u></u>	bismuth 209.0			
41		ဖပ	carbon 12.01	գ . ։	silicon 28.09	32	Ge	germanium 72.59	20	Sn	tin 118.7	82	Pb	lead 207.2	114	E	flerovium
13		ۍ س	boron 10.82	13 A 8	aluminium 26.98	31	Ga	gallium 69.72	49	므	indium 114.8	81	ع 1	thallium 204.4			
12						30	Zn	zinc 65.38	48	D C	cadmium 112.4	80	Ε̈́Ε	mercury 200.6	112	S	copernicium
£						29	D C	copper 63.55	47	Ag	silver 107.9	79	Au	gold 197.0	111	Rg	roentgenium
10						28	Z	nickel 58.69	46	Pd	palladium 106.4	78	Ŧ	platinum 195.1	110	Ds	darmstadtium
တ						27	ပိ	cobalt 58.93	45	R	rhodium 102.9	77	<u>-</u>	iridium 192.2	109	Ĭ	meitnerium
∞						26	Ь	iron 55.85	44	Ru	ruthenium 101.1	9/	0s	osmium 190.2	108	Hs	hassium
7						25	Z Z	manganese 54.94	43	ဍ	technetium	75	Re	rhenium 186.2	107	Bh	bohrium
9						24	ပ်	chromium 52.00	42	Mo	molybdenum 95.94	74	>	tungsten 183.9	106	Sg	seaborgium
2						23	>	vanadium 50.94	41	Q Q	niobium 92.91	73	<u>n</u>	tantalum 180.9	105	Op	dubnium
4						22	F	titanium 47.88	40	Zr	zirconium 91.22	72	Ŧ	hafnium 178.5	104	Rf	rutherfordium
က						21	သင	scandium 44.96	39	>	yttrium 88.91	57-71	<u>ہ</u>	lanthanum 138.9	89-103	**Ac	actinium
2		[↑]	beryllium 9.012	12 M g	magnesium 24.31	20	Ca	calcium 40.08	38	S	strontium 87.62	56	Ba	barium 137.3	88	Ra	radium 226.0
_	hydrogen 1.008	ღ 🗖	lithium 6.968	= S	sodium 22.99	19	¥	potassium 39.10	37	Rb	rubidium 85.47	55	Cs	caesium 132.9	87	F	francium

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Atomic number Symbol Name Standard atomic weight

	28	59	09	61	62	63	64	65	99	29	89	69	20	71
* Lanthanide	Ce	Pr	P N	Pm	Sm	Eu	g d	T P	Dy	운	Ē	T	Υp	Ľ
	cerium 140.1	praseodymium 140.9	neodymium 144.2	۵	samarium 150.4	europium 152.0	gadolinium 157.3	terbium 158.9	dysprosium 162.5	holmium 164.9	erbium 167.3	thulium 168.9	ytterbium 173.0	lutetium 175.0
	06	91	92	93	94	92	96	97	86	66	100	101	102	103
** Actinide series	H	Ра	⊃	Q Q	Pu	Am	CB	BK	ŭ	ES	Fm	βQ	°Z	בֿ
	thorium 232.0	protactinium	uranium 238.0	neptunium	plutonium	americium	curium	berkelium	californium	einsteinium	fermium	mendelevium	nobelium	lawrencium

[Data source: The International Union of Pure and Applied Chemistry Periodic Table of the Elements (May 2013)]