



# **PHYSICS**

## **STAGE 2**

### **FORMULAE AND DATA**

#### **2013**

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**Forces and motion**

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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)	$Ft = mv - mu$
Kinetic energy	$E_k = \frac{1}{2} mv^2$
Gravitational potential energy	$E_p = mgh$
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  $\Delta t$ .

**Nuclear physics**

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Activity	$A = \frac{\Delta N}{t}$
Half-life	$A = A_0 \left(\frac{1}{2}\right)^n$
Absorbed radiation dose	absorbed dose = $\frac{E}{m}$
Dose equivalent	dose equivalent = absorbed dose $\times$ quality factor
Mass-energy relationship	$E = mc^2$

**Heating and cooling**

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Change of temperature	$Q = mc\Delta T$
Change of state	$Q = mL$
Absolute zero	0 K = $-273^\circ\text{C}$

**Electricity and magnetism**

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Electric current	$I = \frac{q}{t}$
Work and energy	$W = Vq = VIt$
Ohm's law	$V = IR$
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	$P = VI = I^2R = \frac{V^2}{R}$

**Physical constants**

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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.....	$1 \text{ eV}$	=	$1.60 \times 10^{-19} \text{ J}$
Unified atomic mass unit .....	$1 \text{ u}$	=	$1.66 \times 10^{-27} \text{ kg}$
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.....	$m_\alpha$	=	$6.64 \times 10^{-27} \text{ kg}$
Mass–energy equivalent.....	$1 \text{ u}$	=	$931 \text{ MeV}$
Tonne.....	$1 \text{ t}$	=	$10^3 \text{ kg} = 10^6 \text{ g}$

**Physical data**

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Mean acceleration due to gravity on Earth.....	$g$	=	$9.80 \text{ m s}^{-2}$
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 $\text{H}_2\text{O}$ .....	$L_f$	=	$3.34 \times 10^5 \text{ J kg}^{-1}$
Latent heat of vaporisation for $\text{H}_2\text{O}$ .....	$L_v$	=	$2.26 \times 10^6 \text{ J kg}^{-1}$

**Quality factors**

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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.....	$QF_{\text{sn}}$	=	3
Approximate quality factor for fast neutrons .....	$QF_{\text{fn}}$	=	10

**Prefixes of the metric system**

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

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Periodic table

1

1

H

hydrogen

1.008

3

2

Li

lithium

6.941

11

12

Na

sodium

22.99

Mg

magnesium

24.31

19

20

K

potassium

39.10

Sr

strontium

87.62

37

38

Rb

rubidium

85.47

Cs

caesium

132.9

55

56

\*La

lanthanum

138.9

\*\*Ac

actinium

87

88

Fr

francium

Ra

radium

226.0

21

22

Sc

scandium

44.96

Y

yttrium

88.91

39

40

Zr

zirconium

91.22

Nb

niobium

92.91

57–71

72

\*La

lanthanum

138.9

Hf

hafnium

178.5

89–103

104

\*\*Ac

actinium

Rf

rutherfordium

23

24

V

vanadium

50.94

Cr

chromium

52.00

41

42

Nb

niobium

92.91

Mo

molybdenum

95.94

73

74

Ta

tantalum

180.9

W

tungsten

183.9

105

106

Db

dubnium

Sg

seaborgium

25

26

Mn

manganese

54.94

Fe

iron

55.85

43

44

Tc

technetium

Ru

ruthenium

101.1

75

76

Re

rhenium

186.2

Os

osmium

190.2

107

108

Bh

bohrium

Hs

hassium

27

28

Co

cobalt

58.93

Ni

nickel

58.69

45

46

Rh

rhodium

102.9

Pd

palladium

106.4

77

78

Ir

iridium

192.2

Pt

platinum

195.1

109

110

Mt

meitnerium

Ds

darmstadtium

29

30

Cu

copper

63.55

Zn

zinc

65.38

47

48

Ag

silver

107.9

Cd

cadmium

112.4

79

80

Au

gold

197.0

Hg

mercury

200.6

111

112

Rg

roentgenium

Cn

copernicium

31

32

Ga

gallium

69.72

Ge

germanium

72.59

49

50

In

indium

114.8

Sn

tin

118.7

81

82

Tl

thallium

204.4

Pb

lead

207.2

113

114

Nh

nihonium

Fl

flerovium

33

34

As

arsenic

74.92

Se

selenium

78.96

51

52

Sb

antimony

121.8

Te

tellurium

127.6

83

84

Bi

bismuth

209.0

Po

polonium

115

116

Mc

moscovium

Lv

livermorium

35

36

Br

bromine

79.90

Kr

krypton

83.80

53

54

I

iodine

126.9

Xe

xenon

131.3

85

86

At

astatine

Rn

radon

5

6

B

boron

10.81

C

carbon

12.01

13

14

Al

aluminium

26.98

Si

silicon

28.09

31

32

Ga

gallium

69.72

Ge

germanium

72.59

49

50

In

indium

114.8

Sn

tin

118.7

81

82

Tl

thallium

204.4

Pb

lead

207.2

113

114

Nh

nihonium

Fl

flerovium

7

8

N

nitrogen

14.01

O

oxygen

16.00

15

16

P

phosphorus

30.97

S

sulfur

32.06

33

34

As

arsenic

74.92

Se

selenium

78.96

51

52

Sb

antimony

121.8

Te

tellurium

127.6

83

84

Bi

bismuth

209.0

Po

polonium

9

10

F

fluorine

19.00

Ne

neon

20.18

17

18

Cl

chlorine

35.45

Ar

argon

39.95

2

3

He

helium

4.003

63

64

Lanthanide series

91

92

Actinide series

Atomic number

Symbol

Name

Standard atomic weight

Key:

71

70

69

68

67

66

65

64

63

62

61

60

59

58

Lu

Yb

Tm

Er

Ho

Dy

Tb

Gd

Eu

Sm

Pm

Nd

Pr

Ce

103

102

101

100

99

98

97

96

95

94

93

92

91

90

Lr

No

Md

Fm

Es

Cf

Bk

Cm

Am

Pu

Np

U

Pa

Th

lutetium

ytterbium

thulium

erbium

holmium

dysprosium

terbium

gadolinium

europium

samarium

promethium

neodymium

praseodymium

cerium

luteium

ylterbium

thulium

erblum

holmium

dysprosium

terblum

gadolinium

europium

samarium

plutonium

neptunium

uranium

protactinium

thorium

lawrencium

nobelium

mendelevium

fermium

einsteinium

californium

berkelium

curium

americium

plutonium

neptunium

uranium

protactinium

thorium