



National
Qualifications
2025

X857/76/11

Physics
Paper 2 — Relationships sheet

THURSDAY, 15 MAY
10:15 AM – 12:30 PM



Relationships required for Physics Higher

$$d = \bar{v}t$$

$$s = \bar{v}t$$

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \frac{1}{2}(u + v)t$$

$$F = ma$$

$$W = mg$$

$$E_w = Fd, \text{ or } W = Fd$$

$$E_p = mgh$$

$$E_k = \frac{1}{2}mv^2$$

$$P = \frac{E}{t}$$

$$p = mv$$

$$Ft = mv - mu$$

$$F = G \frac{m_1 m_2}{r^2}$$

$$t' = \frac{t}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$$

$$l' = l \sqrt{1 - \left(\frac{v}{c}\right)^2}$$

$$f_o = f_s \left(\frac{v}{v \pm v_s} \right)$$

$$z = \frac{\lambda_{\text{observed}} - \lambda_{\text{rest}}}{\lambda_{\text{rest}}}$$

$$z = \frac{v}{c}$$

$$v = H_0 d$$

$$W = QV$$

$$E = mc^2$$

$$I = \frac{P}{A}$$

$$I = \frac{k}{d^2}$$

$$I_1 d_1^2 = I_2 d_2^2$$

$$E = hf$$

$$E_k = hf - hf_0$$

$$v = f\lambda$$

$$E_2 - E_1 = hf$$

$$d \sin \theta = m\lambda$$

$$n = \frac{\sin \theta_1}{\sin \theta_2}$$

$$\frac{\sin \theta_1}{\sin \theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$$

$$\sin \theta_c = \frac{1}{n}$$

$$V_{rms} = \frac{V_{peak}}{\sqrt{2}}$$

$$I_{rms} = \frac{I_{peak}}{\sqrt{2}}$$

$$T = \frac{1}{f}$$

$$V = IR$$

$$P = IV = I^2 R = \frac{V^2}{R}$$

$$R_T = R_1 + R_2 + \dots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$$

$$V_1 = \left(\frac{R_1}{R_1 + R_2} \right) V_S$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$E = V + Ir$$

$$C = \frac{Q}{V}$$

$$Q = It$$

$$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2} \frac{Q^2}{C}$$

$$\text{path difference} = m\lambda \quad \text{or} \quad \left(m + \frac{1}{2}\right)\lambda \quad \text{where } m = 0, 1, 2, \dots$$

$$\text{random uncertainty} = \frac{\text{max. value} - \text{min. value}}{\text{number of values}}$$

or

$$\Delta R = \frac{R_{\text{max}} - R_{\text{min}}}{n}$$

Additional relationships

Circle

$$\text{circumference} = 2\pi r$$

$$\text{area} = \pi r^2$$

Sphere

$$\text{area} = 4\pi r^2$$

$$\text{volume} = \frac{4}{3}\pi r^3$$

Trigonometry

$$\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

Electron arrangements of elements

Group 1 Group 2
(1)

1 H 1	4 Be 2,2
Hydrogen	(2)
3 Li 2,1	Lithium
11 Na 2,8,1	12 Mg 2,8,2
Sodium	Magnesium
19 K 2,8,8,1	20 Ca 2,8,8,2
Potassium	Calcium
37 Rb 2,8,18,8,1	38 Sr 2,8,18,8,2
Rubidium	Strontium
55 Cs 2,8,18,18,8,1	56 Ba 2,8,18,18,8,2
Caesium	Barium
87 Fr 2,8,18,32,18,8,1	88 Ra 2,8,18,32,18,8,2
Francium	Radium

Key

Atomic number
Symbol
Electron arrangement
Name

Transition elements

(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
21 Sc 2,8,9,2	22 Ti 2,8,10,2	23 V 2,8,11,2	24 Cr 2,8,13,1	25 Mn 2,8,13,2	26 Fe 2,8,14,2	27 Co 2,8,15,2	28 Ni 2,8,16,2	29 Cu 2,8,18,1	30 Zn 2,8,18,2
Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc
39 Y 2,8,18,9,2	40 Zr 2,8,18,10,2	41 Nb 2,8,18,12,1	42 Mo 2,8,18,13,1	43 Tc 2,8,18,13,2	44 Ru 2,8,18,15,1	45 Rh 2,8,18,16,1	46 Pd 2,8,18,18,0	47 Ag 2,8,18,18,1	48 Cd 2,8,18,18,2
Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium
57 La 2,8,18,18,9,2	72 Hf 2,8,18,32,10,2	73 Ta 2,8,18,32,11,2	74 W 2,8,18,32,12,2	75 Re 2,8,18,32,13,2	76 Os 2,8,18,32,14,2	77 Ir 2,8,18,32,15,2	78 Pt 2,8,18,32,17,1	79 Au 2,8,18,32,18,1	80 Hg 2,8,18,32,18,2
Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury
89 Ac 2,8,18,32,18,9,2	104 Rf 2,8,18,32,32,10,2	105 Db 2,8,18,32,32,11,2	106 Sg 2,8,18,32,32,12,2	107 Bh 2,8,18,32,32,13,2	108 Hs 2,8,18,32,32,14,2	109 Mt 2,8,18,32,32,15,2	110 Ds 2,8,18,32,32,17,1	111 Rg 2,8,18,32,32,18,1	112 Cn 2,8,18,32,32,18,2
Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium

2 He 2	10 Ne 2,8	18 Ar 2,8,8
Helium	Neon	Argon
(13)	(14)	(15)
5 B 2,3	6 C 2,4	7 N 2,5
Boron	Carbon	Nitrogen
13 Al 2,8,3	14 Si 2,8,4	15 P 2,8,5
Aluminium	Silicon	Phosphorus
31 Ga 2,8,18,3	32 Ge 2,8,18,4	33 As 2,8,18,5
Gallium	Germanium	Arsenic
49 In 2,8,18,18,3	50 Sn 2,8,18,18,4	51 Sb 2,8,18,18,5
Indium	Tin	Antimony
81 Tl 2,8,18,32,18,3	82 Pb 2,8,18,32,18,4	83 Bi 2,8,18,32,18,5
Thallium	Lead	Bismuth
84 Po 2,8,18,32,18,6	85 At 2,8,18,32,18,7	86 Rn 2,8,18,32,18,8
Polonium	Astatine	Xenon
(16)	(17)	(18)
8 O 2,6	9 F 2,7	10 Ne 2,8
Oxygen	Fluorine	Neon
16 S 2,8,6	17 Cl 2,8,7	18 Ar 2,8,8
Sulfur	Chlorine	Argon
(13)	(14)	(15)
5 B 2,3	6 C 2,4	7 N 2,5
Boron	Carbon	Nitrogen
13 Al 2,8,3	14 Si 2,8,4	15 P 2,8,5
Aluminium	Silicon	Phosphorus
31 Ga 2,8,18,3	32 Ge 2,8,18,4	33 As 2,8,18,5
Gallium	Germanium	Arsenic
49 In 2,8,18,18,3	50 Sn 2,8,18,18,4	51 Sb 2,8,18,18,5
Indium	Tin	Antimony
81 Tl 2,8,18,32,18,3	82 Pb 2,8,18,32,18,4	83 Bi 2,8,18,32,18,5
Thallium	Lead	Bismuth
84 Po 2,8,18,32,18,6	85 At 2,8,18,32,18,7	86 Rn 2,8,18,32,18,8
Polonium	Astatine	Xenon
(16)	(17)	(18)
8 O 2,6	9 F 2,7	10 Ne 2,8
Oxygen	Fluorine	Neon
16 S 2,8,6	17 Cl 2,8,7	18 Ar 2,8,8
Sulfur	Chlorine	Argon

Lanthanides

57 La 2,8,18,18,9,2	58 Ce 2,8,18,20,8,2	59 Pr 2,8,18,21,8,2	60 Nd 2,8,18,22,8,2	61 Pm 2,8,18,23,8,2	62 Sm 2,8,18,24,8,2	63 Eu 2,8,18,25,8,2	64 Gd 2,8,18,25,9,2	65 Tb 2,8,18,27,8,2	66 Dy 2,8,18,28,8,2	67 Ho 2,8,18,29,8,2	68 Er 2,8,18,30,8,2	69 Tm 2,8,18,31,8,2	70 Yb 2,8,18,32,8,2	71 Lu 2,8,18,32,9,2
Lanthanum	Cerium	Praseodymium	Neodymium	Promethium	Samarium	Europium	Gadolinium	Terbium	Dysprosium	Holmium	Erbium	Thulium	Ytterbium	Lutetium

Actinides

89 Ac 2,8,18,32,18,9,2	90 Th 2,8,18,32,18,10,2	91 Pa 2,8,18,32,20,9,2	92 U 2,8,18,32,21,9,2	93 Np 2,8,18,32,22,9,2	94 Pu 2,8,18,32,24,8,2	95 Am 2,8,18,32,25,9,2	96 Cm 2,8,18,32,25,9,2	97 Bk 2,8,18,32,27,8,2	98 Cf 2,8,18,32,28,8,2	99 Es 2,8,18,32,29,8,2	100 Fm 2,8,18,32,30,8,2	101 Md 2,8,18,32,31,8,2	102 No 2,8,18,32,32,8,2	103 Lr 2,8,18,32,32,9,2
Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium