



National  
Qualifications  
2023

**X857/76/22**

**Physics**  
**Paper 1 — Relationships sheet**

WEDNESDAY, 17 MAY

9:00 AM – 9:45 AM

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## 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 <b>H</b> 1	4 <b>Be</b> 2,2
Hydrogen	(2)
3 <b>Li</b> 2,1	Lithium
11 <b>Na</b> 2,8,1	12 <b>Mg</b> 2,8,2
Sodium	Magnesium
19 <b>K</b> 2,8,8,1	20 <b>Ca</b> 2,8,8,2
Potassium	Calcium
37 <b>Rb</b> 2,8,18,8,1	38 <b>Sr</b> 2,8,18,8,2
Rubidium	Strontium
55 <b>Cs</b> 2,8,18,18,8,1	56 <b>Ba</b> 2,8,18,18,8,2
Caesium	Barium
87 <b>Fr</b> 2,8,18,32,18,8,1	88 <b>Ra</b> 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 <b>Sc</b> 2,8,9,2	22 <b>Ti</b> 2,8,10,2	23 <b>V</b> 2,8,11,2	24 <b>Cr</b> 2,8,13,1	25 <b>Mn</b> 2,8,13,2	26 <b>Fe</b> 2,8,14,2	27 <b>Co</b> 2,8,15,2	28 <b>Ni</b> 2,8,16,2	29 <b>Cu</b> 2,8,18,1	30 <b>Zn</b> 2,8,18,2
Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc
39 <b>Y</b> 2,8,18,9,2	40 <b>Zr</b> 2,8,18,10,2	41 <b>Nb</b> 2,8,18,12,1	42 <b>Mo</b> 2,8,18,13,1	43 <b>Tc</b> 2,8,18,13,2	44 <b>Ru</b> 2,8,18,15,1	45 <b>Rh</b> 2,8,18,16,1	46 <b>Pd</b> 2,8,18,18,0	47 <b>Ag</b> 2,8,18,18,1	48 <b>Cd</b> 2,8,18,18,2
Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium
57 <b>La</b> 2,8,18,18,9,2	72 <b>Hf</b> 2,8,18,32,10,2	73 <b>Ta</b> 2,8,18,32,11,2	74 <b>W</b> 2,8,18,32,12,2	75 <b>Re</b> 2,8,18,32,13,2	76 <b>Os</b> 2,8,18,32,14,2	77 <b>Ir</b> 2,8,18,32,15,2	78 <b>Pt</b> 2,8,18,32,17,1	79 <b>Au</b> 2,8,18,32,18,1	80 <b>Hg</b> 2,8,18,32,18,2
Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury
89 <b>Ac</b> 2,8,18,32,18,9,2	104 <b>Rf</b> 2,8,18,32,32,10,2	105 <b>Db</b> 2,8,18,32,32,11,2	106 <b>Sg</b> 2,8,18,32,32,12,2	107 <b>Bh</b> 2,8,18,32,32,13,2	108 <b>Hs</b> 2,8,18,32,32,14,2	109 <b>Mt</b> 2,8,18,32,32,15,2	110 <b>Ds</b> 2,8,18,32,32,17,1	111 <b>Rg</b> 2,8,18,32,32,18,1	112 <b>Cn</b> 2,8,18,32,32,18,2
Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium	Darmstadtium	Roentgenium	Copernicium

2 <b>He</b> 2	10 <b>Ne</b> 2,8	18 <b>Ar</b> 2,8,8
Helium	Neon	Argon
(13)	(14)	(15)
5 <b>B</b> 2,3	6 <b>C</b> 2,4	7 <b>N</b> 2,5
Boron	Carbon	Nitrogen
13 <b>Al</b> 2,8,3	14 <b>Si</b> 2,8,4	15 <b>P</b> 2,8,5
Aluminium	Silicon	Phosphorus
31 <b>Ga</b> 2,8,18,3	32 <b>Ge</b> 2,8,18,4	33 <b>As</b> 2,8,18,5
Gallium	Germanium	Arsenic
49 <b>In</b> 2,8,18,18,3	50 <b>Sn</b> 2,8,18,18,4	51 <b>Sb</b> 2,8,18,18,5
Indium	Tin	Antimony
81 <b>Tl</b> 2,8,18,32,18,3	82 <b>Pb</b> 2,8,18,32,18,4	83 <b>Bi</b> 2,8,18,32,18,5
Thallium	Lead	Bismuth
84 <b>Po</b> 2,8,18,32,18,6	85 <b>At</b> 2,8,18,32,18,7	86 <b>Rn</b> 2,8,18,32,18,8
Polonium	Astatine	Radon
(16)	(17)	(18)
8 <b>O</b> 2,6	9 <b>F</b> 2,7	10 <b>Ne</b> 2,8
Oxygen	Fluorine	Neon
16 <b>S</b> 2,8,6	17 <b>Cl</b> 2,8,7	18 <b>Ar</b> 2,8,8
Sulfur	Chlorine	Argon
34 <b>Se</b> 2,8,18,6	35 <b>Br</b> 2,8,18,7	36 <b>Kr</b> 2,8,18,8
Selenium	Bromine	Krypton
52 <b>Te</b> 2,8,18,18,6	53 <b>I</b> 2,8,18,18,7	54 <b>Xe</b> 2,8,18,18,8
Tellurium	Iodine	Xenon
84 <b>Po</b> 2,8,18,32,18,6	85 <b>At</b> 2,8,18,32,18,7	86 <b>Rn</b> 2,8,18,32,18,8
Polonium	Astatine	Radon

Lanthanides

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

Actinides

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