



National
Qualifications
2024

X857/76/11

Physics
Paper 2 — Relationships sheet

THURSDAY, 25 APRIL

10:15 AM – 12:30 PM



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Relationships required for Physics Higher

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

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

$$v = u + at$$

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

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

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

$$F = ma$$

$$W = mg$$

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

$$E_p = mgh$$

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

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

$$p = mv$$

$$Ft = mv - mu$$

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

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

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

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

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

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

$$v = H_0 d$$

$$W = QV$$

$$E = mc^2$$

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

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

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

$$E = hf$$

$$E_k = hf - hf_0$$

$$v = f\lambda$$

$$E_2 - E_1 = hf$$

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

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

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

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

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

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

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

$$V = IR$$

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

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

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

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

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

$$E = V + Ir$$

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

$$Q = It$$

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

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

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

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 (1)
Group 2 (2)

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

Key

Atomic number
Symbol
Electron arrangement
Name

Group 3 (13) Group 4 (14) Group 5 (15) Group 6 (16) Group 7 (17) Group 0 (18)

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

Transition elements

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

Lanthanides	57 La 2,8,18,18,9,2 Lanthanum	58 Ce 2,8,18,20,8,2 Cerium	59 Pr 2,8,18,21,8,2 Praseodymium	60 Nd 2,8,18,22,8,2 Neodymium	61 Pm 2,8,18,23,8,2 Promethium	62 Sm 2,8,18,24,8,2 Samarium	63 Eu 2,8,18,25,8,2 Europium	64 Gd 2,8,18,25,9,2 Gadolinium	65 Tb 2,8,18,27,8,2 Terbium	66 Dy 2,8,18,28,8,2 Dysprosium	67 Ho 2,8,18,29,8,2 Holmium	68 Er 2,8,18,30,8,2 Erbium	69 Tm 2,8,18,31,8,2 Thulium	70 Yb 2,8,18,32,8,2 Ytterbium	71 Lu 2,8,18,32,9,2 Lutetium
Actinides	89 Ac 2,8,18,32,18,9,2 Actinium	90 Th 2,8,18,32,18,10,2 Thorium	91 Pa 2,8,18,32,20,9,2 Protactinium	92 U 2,8,18,32,21,9,2 Uranium	93 Np 2,8,18,32,22,9,2 Neptunium	94 Pu 2,8,18,32,24,8,2 Plutonium	95 Am 2,8,18,32,25,8,2 Americium	96 Cm 2,8,18,32,25,9,2 Curium	97 Bk 2,8,18,32,27,8,2 Berkelium	98 Cf 2,8,18,32,28,8,2 Californium	99 Es 2,8,18,32,29,8,2 Einsteinium	100 Fm 2,8,18,32,30,8,2 Fermium	101 Md 2,8,18,32,31,8,2 Mendelevium	102 No 2,8,18,32,32,8,2 Nobelium	103 Lr 2,8,18,32,32,9,2 Lawrencium