National Qualifications 2016

X757/77/11

Physics
Relationships Sheet

TUESDAY, 24 MAY
9:00 AM – 11:30 AM

Relationships required for Physics Advanced Higher

$$v = \frac{ds}{dt}$$

$$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$$

$$v = u + at$$

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

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

$$\omega = \frac{d\theta}{dt}$$

$$\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$$

$$\omega = \omega_o + \alpha t$$

$$\theta = \omega_o t + \frac{1}{2}\alpha t^2$$

$$\omega^2 = \omega_o{}^2 + 2\alpha\theta$$

$$s = r\theta$$

$$v = r\omega$$

$$a_t = r\alpha$$

$$a_r = \frac{v^2}{r} = r\omega^2$$

$$F = \frac{mv^2}{r} = mr\omega^2$$

$$T = Fr$$

$$T = I\alpha$$

$$L = mvr = mr^2\omega$$

$$L = I\omega$$

$$E_K = \frac{1}{2}I\omega^2$$

$$F = G\frac{Mm}{r^2}$$

$$V = -\frac{GM}{r}$$

$$v = \sqrt{\frac{2GM}{r}}$$

$$\text{apparent brightness}, b = \frac{L}{4\pi r^2}$$

$$\text{Power per unit area} = \sigma T^4$$

$$L = 4\pi r^2\sigma T^4$$

$$r_{Schwarzschild} = \frac{2GM}{c^2}$$

$$E = hf$$

$$\lambda = \frac{h}{p}$$

$$mvr = \frac{nh}{2\pi}$$

$$\Delta x\, \Delta p_x \geq \frac{h}{4\pi}$$

$$\Delta E\, \Delta t \geq \frac{h}{4\pi}$$

$$F = qvB$$

$$\omega = 2\pi f$$

$$a = \frac{d^2y}{dt^2} = -\omega^2 y$$

$y = A\cos\omega t \quad \text{or} \quad y = A\sin\omega t$

$v = \pm\omega\sqrt{(A^2 - y^2)}$

$E_K = \frac{1}{2}m\omega^2(A^2 - y^2)$

$E_P = \frac{1}{2}m\omega^2 y^2$

$y = A\sin 2\pi(ft - \frac{x}{\lambda})$

$E = kA^2$

$\phi = \frac{2\pi x}{\lambda}$

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

where $m = 0, 1, 2....$

$\Delta x = \frac{\lambda l}{2d}$

$d = \frac{\lambda}{4n}$

$\Delta x = \frac{\lambda D}{d}$

$n = \tan i_P$

$F = \frac{Q_1 Q_2}{4\pi\varepsilon_o r^2}$

$E = \frac{Q}{4\pi\varepsilon_o r^2}$

$V = \frac{Q}{4\pi\varepsilon_o r}$

$F = QE$

$V = Ed$

$F = IlB\sin\theta$

$B = \frac{\mu_o I}{2\pi r}$

$c = \frac{1}{\sqrt{\varepsilon_o \mu_o}}$

$t = RC$

$X_C = \frac{V}{I}$

$X_C = \frac{1}{2\pi fC}$

$\varepsilon = -L\frac{dI}{dt}$

$E = \frac{1}{2}LI^2$

$X_L = \frac{V}{I}$

$X_L = 2\pi fL$

$\frac{\Delta W}{W} = \sqrt{\left(\frac{\Delta X}{X}\right)^2 + \left(\frac{\Delta Y}{Y}\right)^2 + \left(\frac{\Delta Z}{Z}\right)^2}$

$\Delta W = \sqrt{\Delta X^2 + \Delta Y^2 + \Delta Z^2}$

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

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

$$v = u + at$$

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

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

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

$$W = mg$$

$$F = ma$$

$$E_W = Fd$$

$$E_P = mgh$$

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

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

$$p = mv$$

$$Ft = mv - mu$$

$$F = G\frac{Mm}{r^2}$$

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

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

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

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

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

$$v = H_0 d$$

$$E_W = QV$$

$$E = mc^2$$

$$E = hf$$

$$E_K = hf - hf_0$$

$$E_2 - E_1 = hf$$

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

$$v = f\lambda$$

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

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

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

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

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

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

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

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

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

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

$$Q = It$$

$$V = IR$$

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

$$R_T = R_1 + R_2 + ...$$

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

$$E = V + Ir$$

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

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

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

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

Additional Relationships

Circle

$circumference = 2\pi r$

$area = \pi r^2$

Sphere

$area = 4\pi r^2$

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

Trigonometry

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

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

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

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

Moment of inertia

point mass
$I = mr^2$

rod about centre
$I = \frac{1}{12}ml^2$

rod about end
$I = \frac{1}{3}ml^2$

disc about centre
$I = \frac{1}{2}mr^2$

sphere about centre
$I = \frac{2}{5}mr^2$

Table of standard derivatives

$f(x)$	$f'(x)$
$\sin ax$	$a\cos ax$
$\cos ax$	$-a\sin ax$

Table of standard integrals

$f(x)$	$\int f(x)dx$
$\sin ax$	$-\frac{1}{a}\cos ax + C$
$\cos ax$	$\frac{1}{a}\sin ax + C$

Electron Arrangements of Elements

Group 1	Group 2										Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
(1)																(18)
1 **H** 1 Hydrogen	(2)															2 **He** 2 Helium
3 **Li** 2, 1 Lithium	4 **Be** 2, 2 Beryllium										(13) 5 **B** 2, 3 Boron	(14) 6 **C** 2, 4 Carbon	(15) 7 **N** 2, 5 Nitrogen	(16) 8 **O** 2, 6 Oxygen	(17) 9 **F** 2, 7 Fluorine	10 **Ne** 2, 8 Neon
11 **Na** 2, 8, 1 Sodium	12 **Mg** 2, 8, 2 Magnesium										13 **Al** 2, 8, 3 Aluminium	14 **Si** 2, 8, 4 Silicon	15 **P** 2, 8, 5 Phosphorus	16 **S** 2, 8, 6 Sulphur	17 **Cl** 2, 8, 7 Chlorine	18 **Ar** 2, 8, 8 Argon
19 **K** 2, 8, 8, 1 Potassium	20 **Ca** 2, 8, 8, 2 Calcium	(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	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
37 **Rb** 2, 8, 18, 8, 1 Rubidium	38 **Sr** 2, 8, 18, 8, 2 Strontium	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	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
55 **Cs** 2, 8, 18, 18, 8, 1 Caesium	56 **Ba** 2, 8, 18, 18, 8, 2 Barium	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	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
87 **Fr** 2, 8, 18, 32, 18, 8, 1 Francium	88 **Ra** 2, 8, 18, 32, 18, 8, 2 Radium	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									

Key

Atomic number
Symbol
Electron arrangement
Name

Transition Elements

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

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