



National
Qualifications
2016

X757/77/11

Physics Relationships Sheet

TUESDAY, 24 MAY

9:00 AM – 11:30 AM



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Relationships required for Physics Advanced Higher

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

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

$$v = u + at$$

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

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

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

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

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

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

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

$$s = r\theta$$

$$v = r\omega$$

$$a_t = r\alpha$$

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

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

$$T = Fr$$

$$T = I\alpha$$

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

$$L = I\omega$$

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

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

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

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

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

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

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

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

$$E = hf$$

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

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

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

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

$$F = qvB$$

$$\omega = 2\pi f$$

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

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

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

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

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

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

$$E = kA^2$$

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

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

$$\text{where } m = 0, 1, 2, \dots$$

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

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

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

$$n = \tan i_p$$

$$F = \frac{Q_1 Q_2}{4\pi \epsilon_0 r^2}$$

$$E = \frac{Q}{4\pi \epsilon_0 r^2}$$

$$V = \frac{Q}{4\pi \epsilon_0 r}$$

$$F = QE$$

$$V = Ed$$

$$F = IlB \sin \theta$$

$$B = \frac{\mu_0 I}{2\pi r}$$

$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

$$t = RC$$

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

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

$$\mathcal{E} = -L \frac{dI}{dt}$$

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

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

$$X_L = 2\pi fL$$

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

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

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

$$E_W = QV$$

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

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

$$E = mc^2$$

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

$$v = u + at$$

$$E = hf$$

$$Q = It$$

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

$$E_K = hf - hf_0$$

$$V = IR$$

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

$$E_2 - E_1 = hf$$

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

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

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

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

$$W = mg$$

$$v = f\lambda$$

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

$$F = ma$$

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

$$E = V + Ir$$

$$E_W = Fd$$

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

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

$$E_P = mgh$$

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

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

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

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

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

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

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

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

$$p = mv$$

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

$$Ft = mv - mu$$

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

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

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

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

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

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

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

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

$$v = H_0 d$$

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

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

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

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

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

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	2	3	4	5	6	7	0	Group
Group	1	2	3	4	5	6	7	0	Group

Key

(18)

Group	1	2	3	4	5	6	7	0	Group
Group	1	2	3	4	5	6	7	0	Group
1	1	2	3	4	5	6	7	0	18
Hydrogen	H	He							Helium
1	1	2	3	4	5	6	7	0	10
3	Li	Be	B	C	N	O	F	Ne	Neon
2, 1		2, 2	2, 3	2, 4	2, 5	2, 6	2, 7	2, 8	
Lithium		Beryllium	Boron	Carbon	Nitrogen	Oxygen	Fluorine		
11	Na	Mg	13	14	15	16	17	18	18
Sodium		Magnesium	Aluminium	Silicon	Phosphorus	Sulphur	Chlorine	Argon	
2, 8, 1		2, 8, 2	2, 8, 3	2, 8, 4	2, 8, 5	2, 8, 6	2, 8, 7	2, 8, 8	
Potassium			Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton	
37	Rb	Sr	31	32	33	34	35	36	36
2, 8, 18, 8, 1		2, 8, 18, 8, 2	2, 8, 18, 3	2, 8, 18, 4	2, 8, 18, 5	2, 8, 18, 6	2, 8, 18, 7	2, 8, 18, 8	
Rubidium		Strontium	Gallium	Germanium	Arsenic	Selenium	Bromine	Krypton	
55	Cs	Ba	49	50	51	52	53	54	54
2, 8, 18, 18, 8, 1		2, 8, 18, 18, 8, 2	2, 8, 18, 18, 3	2, 8, 18, 18, 4	2, 8, 18, 18, 5	2, 8, 18, 18, 6	2, 8, 18, 18, 7	2, 8, 18, 18, 8	
Caesium		Barium	Indium	Tin	Antimony	Tellurium	Iodine	Xenon	
87	Fr	Ra	81	82	83	84	85	86	86
2, 8, 18, 32, 18, 8, 1		2, 8, 18, 32, 18, 8, 2	2, 8, 18, 32, 18, 3	2, 8, 18, 32, 18, 4	2, 8, 18, 32, 18, 5	2, 8, 18, 32, 18, 6	2, 8, 18, 32, 18, 7	2, 8, 18, 32, 18, 8	
Francium		Radium	Thallium	Lead	Bismuth	Polonium	Astatine	Radon	

Transition Elements

Group	1	2	3	4	5	6	7	8	9	10	11	12
Group	1	2	3	4	5	6	7	8	9	10	11	12
21	22	23	24	25	26	27	28	29	30			
Scandium	Titanium	Vanadium	Chromium	Manganese	Iron	Cobalt	Nickel	Copper	Zinc			
2, 8, 9, 2	2, 8, 10, 2	2, 8, 11, 2	2, 8, 13, 1	2, 8, 13, 2	2, 8, 14, 2	2, 8, 15, 2	2, 8, 16, 2	2, 8, 18, 1	2, 8, 18, 2			
Yttrium	Zirconium	Niobium	Molybdenum	Technetium	Ruthenium	Rhodium	Palladium	Silver	Cadmium			
2, 8, 18, 9, 2	2, 8, 18, 10, 2	2, 8, 18, 12, 1	2, 8, 18, 13, 1	2, 8, 18, 13, 2	2, 8, 18, 15, 1	2, 8, 18, 16, 1	2, 8, 18, 18, 0	2, 8, 18, 18, 1	2, 8, 18, 18, 2			
Lanthanum	Hafnium	Tantalum	Tungsten	Rhenium	Osmium	Iridium	Platinum	Gold	Mercury			
2, 8, 18, 18, 9, 2	2, 8, 18, 32, 10, 2	2, 8, 18, 32, 11, 2	2, 8, 18, 32, 12, 2	2, 8, 18, 32, 13, 2	2, 8, 18, 32, 14, 2	2, 8, 18, 32, 15, 2	2, 8, 18, 32, 17, 1	2, 8, 18, 32, 18, 1	2, 8, 18, 32, 18, 2			
Actinium	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Meitnerium						
89	104	105	106	107	108	109						
Ac	Rf	Db	Sg	Bh	Hs	Mt						
2, 8, 18, 32, 18, 9, 2	2, 8, 18, 32, 32, 10, 2	2, 8, 18, 32, 32, 11, 2	2, 8, 18, 32, 32, 12, 2	2, 8, 18, 32, 32, 13, 2	2, 8, 18, 32, 32, 14, 2	2, 8, 18, 32, 32, 15, 2						

Lanthanides

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

Actinides

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

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