

X757/77/11

Physics Relationships Sheet

WEDNESDAY, 17 MAY 9:00 AM – 11:30 AM





Relationships required for Physics Advanced Higher

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

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

$$v = u + at$$

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

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

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

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

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

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

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

$$s = r\theta$$

$$v = r\omega$$

$$a_{t} = r\alpha$$

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

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

$$T = Fr$$

$$T = I\alpha$$

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

$$L = I\omega$$

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

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

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

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

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

Power per unit area = σT^4

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

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

$$E = hf$$

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

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

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

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

$$F = qvB$$

$$\omega = 2\pi f$$

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

$$y = A\cos\omega t$$
 or $y = A\sin\omega t$

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

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

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

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

$$E = kA^2$$

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

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

where m = 0, 1, 2...

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

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

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

 $n = \tan i_P$

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

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

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

$$F = QE$$

$$V = Ed$$

 $F = IlB\sin\theta$

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

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

$$t = RC$$

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

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

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

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

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

$$X_L = 2\pi f L$$

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

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

$$d = \overline{v}t \qquad W = QV \qquad V_{poot} = \sqrt{2}V_{rms}$$

$$s = \overline{v}t \qquad E = mc^2 \qquad I_{poot} = \sqrt{2}I_{rms}$$

$$v = u + at \qquad E = hf \qquad Q = ht$$

$$s = ut + \frac{1}{2}at^2 \qquad E_K = hf - hf_0 \qquad V = IR$$

$$v^2 = u^2 + 2as \qquad E_2 - E_1 = hf \qquad P = IV = I^2R = 1$$

$$s = \frac{1}{2}(u + v)t \qquad T = \frac{1}{f} \qquad R_F = R_1 + R_2 + 1$$

$$W = mg \qquad v = f\lambda \qquad \frac{1}{R_F} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$F = ma \qquad E = V + Ir$$

$$E_W = Fd \qquad n = \frac{\sin \theta_1}{\sin \theta_2} \qquad V_1 = \left(\frac{R_1}{R_1 + R_2}\right)$$

$$E_K = \frac{1}{2}mv^2 \qquad \frac{\sin \theta_1}{\sin \theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$$

$$\sin \theta_c = \frac{1}{n} \qquad C = \frac{Q}{V}$$

$$Ft = mv - mu \qquad I = \frac{P}{A} \qquad C = \frac{Q}{V}$$

$$T = \frac{1}{V} = \frac{1}{V} + \frac{$$

$$\begin{split} W &= QV & V_{peak} = \sqrt{2}V_{rms} \\ E &= mc^2 & I_{peak} = \sqrt{2}I_{rms} \\ E &= hf & Q = It \\ E_{_{K}} &= hf - hf_0 & V = IR \\ E_{_{2}} - E_{_{1}} &= hf & P = IV = I^2R = \frac{V^2}{R} \\ T &= \frac{1}{f} & R_{_{T}} = R_1 + R_2 + \\ v &= f\lambda & \frac{1}{R_{_{T}}} = \frac{1}{R_1} + \frac{1}{R_2} + \\ h &= \frac{\sin\theta_1}{\sin\theta_2} & V_1 = \left(\frac{R_1}{R_1 + R_2}\right)V_S \\ \sin\theta_c &= \frac{1}{n} & V_1 = \left(\frac{R_1}{R_1 + R_2}\right)V_S \\ I &= \frac{k}{d^2} & C &= \frac{Q}{V} \\ I &= \frac{P}{A} & C &= \frac{Q}{V} \\ path \ difference &= m\lambda \ \ or \ \left(m + \frac{1}{2}\right)\lambda \ \ \ where \ m = 0,1,2... \\ random \ uncertainty &= \frac{\max. value - \min. value}{number \ of \ values} \end{split}$$

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

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

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

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

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

Moment of inertia

point mass

 $I = mr^2$

rod about centre

 $I = \frac{1}{12} m l^2$

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

		87 Fr 2,8,18,32, 18,8,1 Francium	55 Cs 2,8,18,18, 8,1 Caesium	37 Rb 2,8,18,8,1 Rubidium	19 K 2,8,8,1 Potassium	11 Na 2,8,1 Sodium	3 Li 2,1	Group 1 (1) 1 Hydrogen
	Lan	88 Ra 2,8,18,32, 18,8,2 Radium	56 Ba 2,8,18,18, 8,2 Barium	38 Sr 2,8,18,8,2 Strontium	20 Ca 2,8,8,2 Calcium	12 Mg 2,8,2 Magnesium	4 Be 2,2	Group 2
Actinides	Lanthanides	89 Ac 2,8,18,32, 18,9,2 Actinium	57 La 2,8,18,18, 9,2 Lanthanum	39 Y 2,8,18,9,2 Yttrium	21 Sc 2,8,9,2 Scandium	(3)		
Ac 2,8,18,32, 18,9,2 Actinium	57 La 2,8,18, 18,9,2 Lanthanum	104 Rf 2,8,18,32, 32,10,2 Rutherfordium	72 Hf 2,8,18,32, 10,2 Hafnium	40 Zr 2,8,18, 10,2 Zirconium	22 Ti 2,8,10,2 Titanium	(4)		Key
Th 2,8,18,32, 18,10,2 Thorium	58 Ce 2,8,18, 20,8,2 Cerium	105 Db 2,8,18,32, 32,11,2 Dubnium	73 Ta 2,8,18, 32,11,2 Tantalum	41 Nb 2,8,18, 12,1 Niobium	23 V 2,8,11,2 Vanadium	(5)	בופכנות	Ato
Pa 2,8,18,32, 20,9,2 Protactinium	,21,	106 Sg 2,8,18,32, 32,12,2 Seaborgium	74 W 2,8,18,32, 12,2 Tungsten	42 Mo 2,8,18,13, 1 Molybdenum	24 Cr 2,8,13,1 Chromium	(6)	Name	Atomic number Symbol
9,2 U 2,8,18,32, 21,9,2 Uranium	60 Nd 2,8,18,22, 8,2 Neodymium	107 Bh 2,8,18,32, 32,13,2 Bohrium	75 Re 2,8,18,32, 13,2 Rhenium	43 Tc 2,8,18,13, 2 Technetium	25 Mn 2,8,13,2 Manganese	Transition Elements		oe i
Np 2,8,18,32, 22,9,2 Neptunium	61 Pm 2,8,18,23, 8,2 Promethium	108 Hs 2,8,18,32, 32,14,2 Hassium	76 Os 2,8,18,32, 14,2 Osmium	44 Ru 2,8,18,15, 1 Ruthenium	26 Fe 2,8,14,2 Iron	Element		
94 Pu 2,8,18,32, 24,8,2 Plutonium	62 Sm 2,8,18,24, 8,2 Samarium	109 Mt 2,8,18,32, 32,15,2 Meitnerium	77 Ir 2,8,18,32, 15,2 Iridium	45 Rh 2,8,18,16, 1 Rhodium	27 Co 2,8,15,2 Cobalt	s (9)		
Am 2,8,18,32, 25,8,2 Americium	63 Eu 2,8,18,25, 8,2 Europium	110 Ds 2,8,18,32, 32,17,1 Darmstadtium	78 Pt 2,8,18,32, 17,1 Platinum	46 Pd 2,8,18, 18,0 Palladium	28 Ni 2,8,16,2 Nickel	(10)		
2,8,18,32, 25,9,2 Curium	64 Gd 2,8,18,25, 9,2 Gadolinium	110 111 112 Ds Rg Cn 2,8,18,32, 2,8,18,32, 2,8,18,32, 32,17,1 32,18,1 32,18,2 Darmstadtium Roentgenium Copernicium	79 Au 2,8,18, 32,18,1 Gold	47 Ag 2,8,18, 18,1 Silver	29 Cu 2,8,18,1 Copper	(11)		
9/ BK 2,8,18,32, 27,8,2 Berkelium	65 Tb 2,8,18,27, 8,2 Terbium	112 Cn 2,8,18,32, 32,18,2 Copernicium	80 Hg 2,8,18, 32,18,2 Mercury	48 Cd 2,8,18, 18,2 Cadmium	30 Zn 2,8,18,2 Zinc	(12)		
Cf 2,8,18,32, 28,8,2 Californium	66 Dy 2,8,18,28, 8,2 Dysprosium		81 T (2,8,18, 32,18,3 Thallium	49 In 2,8,18, 18,3 Indium	31 Ga 2,8,18,3 Gallium	13 Al 2,8,3 Aluminium	2,3	Group 3 (13)
Es 2,8,18,32, 29,8,2 Einsteinium	67 Ho 2,8,18,29, 8,2 Holmium		82 Pb 2,8,18, 32,18,4 Lead	50 Sn 2,8,18, 18,4 Tin	32 Ge 3 2,8,18,4 Germanium	14 Si 2,8,4 m Silicon	2,4	3 Group 4
700 Fm 2,8,18,32, 30,8,2 Fermium	30,		83 Bi 2,8,18, 4 32,18,5 6 Bismuth	51 Sb 2,8,18, 18,5 Antimony	33 AS 4 2,8,18,5 4 2,8renic	15 P 2,8,5 Phosphorus		4 Group 5 (15)
707 Md 2,8,18,32, 31,8,2 Mendelevium	m 31,		84 Po 2,8,18, 32,18,6	52 Te 2,8,18, 18,6 y Tellurium	34 Se 5 2,8,18,6 Selenium	16 S 2,8,6 us Sulfur		5 Group 6 (16)
No 2,8,18,32, 32,8,2 Nobelium	32,		85 At 2,8,18, 32,18,7 n Astatine	53 	35 Br 6 2,8,18,7 n Bromine	17 Cl 2,8,7 Chlorine		6 Group 7
2,8,18,32, 32,9,2 Lawrencium	71 Lu 2,8,18,32, 9,2 Lutetium		86 Rn 2,8,18, 7 32,18,8 e Radon	54 Xe , 2,8,18, 18,8 Xenon	36 Kr 7 2,8,18,8 e Krypton	18 Ar 2,8,8		7 Group 0 (18) 2 He 2 Helium

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