



National  
Qualifications  
2017

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X757/77/11

**Physics  
Relationships Sheet**

WEDNESDAY, 17 MAY

9:00 AM – 11:30 AM

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# Relationships required for Physics Advanced Higher

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

$$L = I\omega$$

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

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

$$v = u + at$$

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

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

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

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

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

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

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

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

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

$$\omega = \omega_o + at$$

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

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

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

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

$$E = hf$$

$$s = r\theta$$

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

$$a_t = r\alpha$$

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

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

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

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

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

$$T = Fr$$

$$F = qvB$$

$$T = I\alpha$$

$$\omega = 2\pi f$$

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

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

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

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

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

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

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

$$E = kA^2$$

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

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

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

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

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

$$n = \tan i_p$$

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

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

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

$$F = QE$$

$$V = Ed$$

$$F = IlB \sin \theta$$

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

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

$$t = RC$$

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

$$X_C = \frac{1}{2\pi f C}$$

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

$$E = \frac{1}{2} L I^2$$

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

$$X_L = 2\pi f L$$

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

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

$d = \bar{v}t$	$W = QV$	$V_{peak} = \sqrt{2}V_{rms}$
$s = \bar{v}t$	$E = mc^2$	$I_{peak} = \sqrt{2}I_{rms}$
$v = u + at$	$E = hf$	$Q = It$
$s = ut + \frac{1}{2}at^2$	$E_K = hf - hf_0$	$V = IR$
$v^2 = u^2 + 2as$	$E_2 - E_1 = hf$	$P = IV = I^2R = \frac{V^2}{R}$
$s = \frac{1}{2}(u+v)t$	$T = \frac{1}{f}$	$R_T = R_1 + R_2 + \dots$
$W = mg$	$v = f\lambda$	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$F = ma$	$d \sin \theta = m\lambda$	$E = V + Ir$
$E_w = Fd$	$n = \frac{\sin \theta_1}{\sin \theta_2}$	$V_1 = \left( \frac{R_1}{R_1 + R_2} \right) V_s$
$E_p = mgh$	$\frac{\sin \theta_1}{\sin \theta_2} = \frac{\lambda_1}{\lambda_2} = \frac{v_1}{v_2}$	$\frac{V_1}{V_2} = \frac{R_1}{R_2}$
$E_K = \frac{1}{2}mv^2$	$\sin \theta_c = \frac{1}{n}$	$C = \frac{Q}{V}$
$P = \frac{E}{t}$	$I = \frac{k}{d^2}$	$E = \frac{1}{2}QV = \frac{1}{2}CV^2 = \frac{1}{2}\frac{Q^2}{C}$
$p = mv$	$I = \frac{P}{A}$	path difference = $m\lambda$ or $\left(m + \frac{1}{2}\right)\lambda$ where $m = 0, 1, 2, \dots$
$Ft = mv - mu$	random uncertainty = $\frac{\text{max. value} - \text{min. value}}{\text{number of values}}$	
$F = G \frac{Mm}{r^2}$		
$t' = \frac{t}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}$		
$l' = l\sqrt{1 - \left(\frac{v}{c}\right)^2}$		
$f_o = f_s \left( \frac{v}{v \pm v_s} \right)$		
$z = \frac{\lambda_{observed} - \lambda_{rest}}{\lambda_{rest}}$		
$z = \frac{v}{c}$		
$v = H_0 d$		

# Additional Relationships

## Circle

$$\text{circumference} = 2\pi r$$

$$\text{area} = \pi r^2$$

## Sphere

$$\text{area} = 4\pi r^2$$

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

## Table of standard derivatives

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

## Trigonometry

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

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

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

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

## Table of standard integrals

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

## 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

$$I = \frac{2}{5}mr^2$$

## Electron Arrangements of Elements

		Group 1		Group 2				Group 3		Group 4		Group 5		Group 6		Group 7		Group 0				
		(1)		(2)				(13)		(14)		(15)		(16)		(17)		(18)				
1	H	1	Hydrogen	3	Li	4	Be	5	B	6	C	7	N	8	O	9	F	2	He			
1	Lithium	2,1	Beryllium	2,8,1	Magnesium	2,8,2		2,3	Boron	2,4	Carbon	2,5	Nitrogen	2,6	Oxygen	2,7	Fluorine	2	Helium			
11	Na	12	Mg	19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe			
2,8,1	Potassium	2,8,8,2	Calcium	2,8,9,2	Scandium	2,8,10,2	Titanium	2,8,11,2	Vanadium	2,8,13,1	Chromium	2,8,13,2	Manganese	2,8,14,2	Iron	2,8,15,2	Cobalt	2,8,16,2	Nickel	2,8,18,1		
37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Ru	44	Rh	45	Pd	46	Ag	48	Cd	
2,8,18,8,1	Rubidium	2,8,18,8,2	Strontium	2,8,18,9,2	Yttrium	2,8,18,10,2	Zirconium	2,8,18,12,1	Niobium	2,8,18,13,1	Molybdenum	2,8,18,13,2	Tantalum	2,8,18,15,1	Ruthenium	2,8,18,16,1	Rhodium	2,8,18,0	Silver	2,8,18,2	Cadmium	
55	Cs	56	Ba	57	La	58	Hf	59	Ta	60	W	61	Re	62	Os	63	Ir	64	Pt	65	Au	
2,8,18,18,8,1	Caesium	2,8,18,18,8,2	Barium	2,8,18,18,9,2	Lanthanum	2,8,18,10,2	Hafnium	2,8,18,32,32,11,2	Tantalum	2,8,18,32,32,12,2	Tungsten	2,8,18,32,32,13,2	Rhenium	2,8,18,32,32,14,2	Ruthenium	2,8,18,32,32,15,2	Osmium	2,8,18,32,32,16,1	Iridium	2,8,18,1	Platinum	2,8,18,2
87	Fr	88	Ra	89	Ac	90	Rf	91	Db	92	Sg	93	Bh	94	Hs	95	Mt	96	Ds	97	Rg	
2,8,18,32,18,8,1	Francium	2,8,18,32,18,8,2	Radium	2,8,18,32,18,9,2	Actinium	2,8,18,32,18,9,2	Rutherfordium	2,8,18,32,21,11,2	Dubnium	2,8,18,32,22,12,2	Seaborgium	2,8,18,32,22,13,2	Bohrium	2,8,18,32,22,14,2	Hassium	2,8,18,32,22,15,2	Meitnerium	2,8,18,32,22,16,1	Darmstadtium	2,8,18,32,22,17,1	Roentgenium	2,8,18,32,22,18,1
<b>Transition Elements</b>																						
<b>Lanthanides</b>																						
57	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	
2,8,18,18,9,2	Lanthanum	2,8,18,18,9,2	Cerium	2,8,18,21,8,2	Praseodymium	2,8,18,22,8,2	Neodymium	2,8,18,23,8,2	Promethium	2,8,18,24,8,2	Samarium	2,8,18,25,8,2	Europium	2,8,18,25,9,2	Gadolinium	2,8,18,27,8,2	Terbium	2,8,18,28,8,2	Dysprosium	2,8,18,29,8,2	Holmium	2,8,18,30,8,2
89	Ac	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	
2,8,18,32,18,9,2	Actinium	2,8,18,32,18,10,2	Thorium	2,8,18,32,20,9,2	Protactinium	2,8,18,32,21,9,2	Uranium	2,8,18,32,22,9,2	Neptunium	2,8,18,32,24,8,2	Plutonium	2,8,18,32,25,8,2	Americium	2,8,18,32,25,9,2	Curium	2,8,18,32,27,8,2	Berkelium	2,8,18,32,28,8,2	Californium	2,8,18,32,29,8,2	Einsteinium	2,8,18,32,30,8,2
<b>Actinides</b>																						
<b>Key</b>																						
<b>Atomic number</b>																						
<b>Symbol</b>																						
<b>Electron arrangement</b>																						
<b>Name</b>																						

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