



National  
Qualifications  
2016

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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

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

$$L = I\omega$$

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

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

$$v = u + at$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$E = hf$$

$$s = r\theta$$

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

$$v = r\omega$$

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

$$a_t = r\alpha$$

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

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

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

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

$$T = Fr$$

$$F = qvB$$

$$T = I\alpha$$

$$\omega = 2\pi f$$

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

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

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

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

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

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

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

$$E = kA^2$$

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

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

where  $m = 0, 1, 2, \dots$

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

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

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

$$n = \tan i_p$$

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

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

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

$$F = QE$$

$$V = Ed$$

$$F = IlB \sin \theta$$

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

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

$$t = RC$$

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

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

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

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

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

$$X_L = 2\pi f L$$

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

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

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

$$E_w = QV$$

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

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

$$E = mc^2$$

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

$$v = u + at$$

$$E = hf$$

$$Q = It$$

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

$$E_K = hf - hf_0$$

$$V = IR$$

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

$$E_2 - E_1 = hf$$

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

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

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

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

$$W = mg$$

$$v = f\lambda$$

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

$$F = ma$$

$$ds \sin \theta = m \lambda$$

$$E = V + Ir$$

$$E_w = Fd$$

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

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

$$E_P = mgh$$

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

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

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

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

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

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

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

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

$$p = mv$$

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

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

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

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

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

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

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

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

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

$$v = H_0 d$$

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

(1)

(18)

Key	Atomic number Symbol	Electron arrangement	Name

## Transition Elements

	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Sc	21	22	23	24	25	26	27	28	29	30
Scandium	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	2,8,17,1	Zn
Ti	28	29	30	31	32	33	34	35	36	Kr
Titanium	Chromium	Manganese	Iron	Nickel	Copper	Zinc	Arsenic	Selenium	Br	Neon
V	28	29	30	31	32	33	34	35	36	Krypton
Cr	28	29	30	31	32	33	34	35	36	
Mn	28	29	30	31	32	33	34	35	36	
Fe	28	29	30	31	32	33	34	35	36	
Co	28	29	30	31	32	33	34	35	36	
Ni	28	29	30	31	32	33	34	35	36	
Cu	28	29	30	31	32	33	34	35	36	
Zn	28	29	30	31	32	33	34	35	36	
Al	28,3	28,4	28,5	28,6	28,7	28,8	28,9	28,10	28,11	Ar
Si	28,3	28,4	28,5	28,6	28,7	28,8	28,9	28,10	28,11	Argon
Boron	Carbon	Nitrogen	Oxygen	F	Neon	Fluorine	Neon	Neon	Neon	
Aluminum	Gallium	Germanium	Silicon	Phosphorus	Sulphur	Chlorine	Chlorine	Chlorine	Chlorine	
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