GCE A LEVEL

A420U10-1A

FRIDAY, 24 MAY 2024 – MORNING

PHYSICS – A level component 1

Data Booklet

A clean copy of this booklet should be issued to candidates for their use during each A level component 1 Physics examination.

Centres are asked to issue this booklet to candidates at the start of the course to enable them to become familiar with its contents and layout.

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VALUES AND CONVERSIONS

Avogadro constant	N_A	=	$6{\cdot}02 \times 10^{23}\ \text{mol}^{-1}$
Fundamental electronic charge	e	=	$1{\cdot}60 \times 10^{-19}\ \text{C}$
Mass of an electron	m_e	=	$9{\cdot}11 \times 10^{-31}\ \text{kg}$
Molar gas constant	R	=	$8{\cdot}31\ \text{J mol}^{-1}\ \text{K}^{-1}$
Acceleration due to gravity at sea level	g	=	$9{\cdot}81\ \text{m s}^{-2}$
Gravitational field strength at sea level	g	=	$9{\cdot}81\ \text{N kg}^{-1}$
Universal constant of gravitation	G	=	$6{\cdot}67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
Planck constant	h	=	$6{\cdot}63 \times 10^{-34}\ \text{J s}$
Boltzmann constant	k	=	$1{\cdot}38 \times 10^{-23}\ \text{J K}^{-1}$
Speed of light in vacuo	c	=	$3{\cdot}00 \times 10^{8}\ \text{m s}^{-1}$
Permittivity of free space	ε_o	=	$8{\cdot}85 \times 10^{-12}\ \text{F m}^{-1}$
Permeability of free space	μ_o	=	$4\pi \times 10^{-7}\ \text{H m}^{-1}$
Stefan constant	σ	=	$5{\cdot}67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}$
Wien constant	W	=	$2{\cdot}90 \times 10^{-3}\ \text{m K}$
Hubble constant	H_0	=	$2{\cdot}20 \times 10^{-18}\ \text{s}^{-1}$

$T/\text{K} = \theta/°\text{C} + 273{\cdot}15$

1 parsec = 3.09×10^{16} m

1 u = $1{\cdot}66 \times 10^{-27}$ kg

1 eV = $1{\cdot}60 \times 10^{-19}$ J

$$\frac{1}{4\pi\varepsilon_0} \approx 9.0 \times 10^{9}\ \text{F}^{-1}\text{m}$$

$$\rho = \frac{m}{V}$$

$$v = u + at$$

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

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

$$v^2 = u^2 + 2ax$$

$$\sum F = ma$$

$$p = mv$$

$$W = Fx\cos\theta$$

$$\Delta E = mg\Delta h$$

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

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

$$Fx = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$$

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

$$\text{efficiency} = \frac{\text{useful energy transfer}}{\text{total energy input}} \times 100\%$$

$$\omega = \frac{\theta}{t}$$

$$v = \omega r$$

$$a = \omega^2 r$$

$$a = \frac{v^2}{r}$$

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$pV = nRT \text{ and } pV = NkT$$

$$p = \frac{1}{3}\rho\overline{c^2} = \frac{1}{3}\frac{N}{V}m\overline{c^2}$$

$$M \text{ / kg} = \frac{M_r}{1000}$$

$$n = \frac{\text{total mass}}{\text{molar mass}}$$

$$k = \frac{R}{N_A}$$

$$U = \frac{3}{2}nRT = \frac{3}{2}NkT$$

$$W = p\Delta V$$

$$\Delta U = Q - W$$

$$Q = mc\Delta\theta$$

$$I = \frac{\Delta Q}{\Delta t}$$

$$I = nAve$$

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

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

$$R = \frac{\rho l}{A}$$

$$V = E - Ir$$

$$\frac{V}{V_{\text{total}}}\left[\text{or } \frac{V_{\text{OUT}}}{V_{\text{IN}}}\right] = \frac{R}{R_{\text{total}}}$$

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

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

$$F = m\omega^2 r$$

$$a = -\omega^2 x$$

$$x = A\cos(\omega t + \varepsilon)$$

$$T = \frac{2\pi}{\omega}$$

$$v = -A\omega\sin(\omega t + \varepsilon)$$

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$\varepsilon = \frac{\Delta l}{l}$$

$$E = \frac{\sigma}{\varepsilon}$$

$$W = \frac{1}{2}Fx$$

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Q_1 Q_2}{r^2}$$

$$F = G\frac{M_1 M_2}{r^2}$$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

$$g = \frac{GM}{r^2}$$

$$V_E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$$

$$\mathbf{PE} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1 Q_2}{r}$$

$$C = \frac{\varepsilon_0 A}{d}$$

$$E = \frac{V}{d}$$

$$U = \frac{1}{2}QV$$

$$Q = Q_0\left(1 - e^{-\frac{t}{RC}}\right)$$

$$Q = Q_0 e^{-\frac{t}{RC}}$$

$$F = kx$$

$$\sigma = \frac{F}{A}$$

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

$$n_1 v_1 = n_2 v_2$$

$$n_1\sin\theta_1 = n_2\sin\theta_2$$

$$n_1\sin\theta_C = n_2$$

$$E_{k\max} = hf - \phi$$

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

$$A = \lambda N$$

$$N = N_0 e^{-\lambda t}$$

$$A = A_0 e^{-\lambda t}$$

$$N = \frac{N_0}{2^x}$$

$$A = \frac{A_0}{2^x}$$

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

$$\mathbf{PE} = -\frac{GM_1M_2}{r}$$

$$W = q\Delta V_E$$

$$W = m\Delta V_g$$

$$\lambda_{\max} = \frac{W}{T}$$

$$P = A\sigma T^4$$

$$\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$$

$$v = H_0 D$$

$$\rho_c = \frac{3H_0{}^2}{8\pi G}$$

$$r_1 = \frac{M_2}{M_1 + M_2} d$$

$$T = 2\pi\sqrt{\frac{d^3}{G(M_1 + M_2)}}$$

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

$$c = f\lambda$$

$$\lambda = \frac{a\Delta y}{D}$$

$$d\sin\theta = n\lambda$$

$$\lambda = \frac{1\mathrm{n}2}{T_{\frac{1}{2}}}$$

	leptons		quarks	
particle (symbol)	electron (e^-)	electron neutrino (ν_e)	up (u)	down (d)
charge (e)	-1	0	$+\frac{2}{3}$	$-\frac{1}{3}$
lepton number	1	1	0	0

$$E = mc^2$$

$$F = BIl\sin\theta$$

$$F = Bqv\sin\theta$$

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

$$B = \mu_0 nI$$

$$\Phi = AB\cos\theta$$

$$\text{flux linkage} = N\Phi$$

MATHEMATICAL INFORMATION

SI MULTIPLIERS

Multiple	Prefix	Symbol
10^{-18}	atto	a
10^{-15}	femto	f
10^{-12}	pico	p
10^{-9}	nano	n
10^{-6}	micro	μ
10^{-3}	milli	m
10^{-2}	centi	c

Multiple	Prefix	Symbol
10^{3}	kilo	k
10^{6}	mega	M
10^{9}	giga	G
10^{12}	tera	T
10^{15}	peta	P
10^{18}	exa	E
10^{21}	zetta	Z

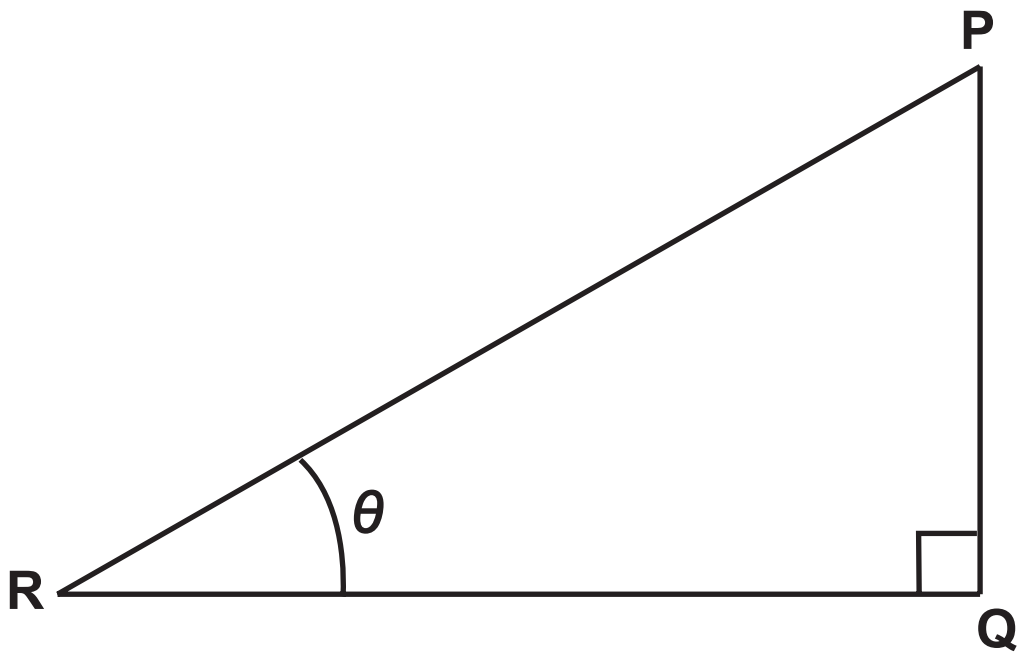
AREAS AND VOLUMES

Area of a circle = $\pi r^2 = \frac{\pi d^2}{4}$

Area of a triangle = $\frac{1}{2}$ base × height

SOLID	SURFACE AREA	VOLUME
rectangular block	$2(lh + hb + lb)$	lbh
cylinder	$2\pi r(r + h)$	$\pi r^2 h$
sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$

TRIGONOMETRY



$$\sin\theta = \frac{PQ}{PR}, \qquad \cos\theta = \frac{QR}{PR}, \qquad \tan\theta = \frac{PQ}{QR}, \qquad \frac{\sin\theta}{\cos\theta} = \tan\theta$$

$$PR^2 = PQ^2 + QR^2$$

LOGARITHMS

[Unless otherwise specified 'log' can be $\log_e$ (i.e. ln) or $\log_{10}$.]

$$\log(ab) = \log a + \log b$$

$$\log\left(\frac{a}{b}\right) = \log a - \log b$$

$$\log x^n = n \log x$$

$$\log_e e^{kx} = \ln e^{kx} = kx$$

$$\log_e 2 = \ln 2 = 0{\cdot}693$$