CONSTANTS

Description	Value
Acceleration of gravity on Earth (g)	$9.80\ m/s^2$
Speed of light in a vacuum (c)	3.00×10^8 m/s
Planck's constant (h)	6.63×10^{-34} J•s = 4.14×10^{-15} eV•s
Electron rest mass (m_e)	9.11×10^{-31} kg
Proton rest mass (m_p)	1.67×10^{-27} kg
Elementary charge (e)	1.60×10^{-19} C
Coulomb's constant (k_e)	$8.99 \times 10^9\ N•m^2/C^2$
Boltzmann constant (k_b)	1.38×10^{-23} J/K
Gas constant (R)	8.31 J/(mol•K)
Gravitational constant (G)	$6.67 \times 10^{-11}\ N•m^2/kg^2$
Permeability of free space (μ_0)	$4\pi \times 10^{-7}$ T•m/A
Avogadro's number (N_A)	6.02×10^{23} particles/mole
Heat of fusion of water (L_f)	3.33×10^5 J/kg
Heat of vaporization of water (L_v)	2.26×10^6 J/kg
Specific heat of water (c_w)	4.19×10^3 J/(kg•°C)
Density of water (ρ_w)	$1.00 \times 10^3\ kg/m^3$

FORMULAS

Mathematics

$C = 2\pi r$

$A = \pi r^2$

$SA = 4\pi r^2$

$V = \frac{4}{3}\pi r^3$

(a, b) denotes a vector with an x-component of a and a y-component of b.

Force and Motion

$v_f = v_i + at$

$x_f = x_i + v_i t + \frac{1}{2}at^2$

$v_f^2 - v_i^2 = 2a(x_f - x_i)$

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

$\Sigma \mathbf{F} = m\mathbf{a}$

$F = -kx$

$F \le \mu N$

$F = \frac{Gm_1m_2}{r^2}$

$\theta_f = \theta_i + \omega_i t + \frac{1}{2}\alpha t^2$

$\omega_f = \omega_i + \alpha t$

$v = r\omega$

$a = r\alpha$

$\mathbf{r}_{cm} = \frac{\sum m\mathbf{r}}{\sum m}$

$I = \sum mr^2$

$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$

$\Sigma \boldsymbol{\tau} = I\boldsymbol{\alpha}$

$P = \rho gh$

$F = \rho Vg$

$A_1v_1 = A_2v_2$

$P + \frac{1}{2}\rho v^2 + \rho gy = \text{constant}$

FORMULAS (continued)

Energy, Momentum, and Heat Transfer

$W = Fd\cos\theta$

$P = \dfrac{\Delta W}{\Delta t}$

$KE = \dfrac{1}{2}mv^2$

$PE = mgh$

$PE = \dfrac{1}{2}kx^2$

$\mathbf{p} = m\mathbf{v}$

$\Delta\mathbf{p} = \mathbf{F}\Delta t$

$\Delta\ell = \alpha\ell_0\Delta T$

$Q = mc\Delta T$

$Q = mL$

$\dfrac{\Delta Q}{\Delta t} = \dfrac{kA\Delta T}{d}$

$PV = nRT$

$\dfrac{1}{2}m\overline{v^2} = \dfrac{3}{2}k_bT$

$\Delta E = Q - W$

$W = P\Delta V$

$e = \dfrac{T_h - T_c}{T_h}$

$KE = \dfrac{1}{2}I\omega^2$

$\mathbf{L} = \mathbf{r} \times \mathbf{p}$

$L = I\omega$

$T_k = 273 + T_c$

Electricity and Magnetism

$F = \dfrac{k_eq_1q_2}{r^2}$

$\mathbf{E} = \dfrac{\mathbf{F}}{q_0}$

$PE = qV$

$V = -Ed$

$V = \dfrac{k_eq}{r}$

$R = \dfrac{\rho\ell}{A}$

$V = IR$

$R = \Sigma R_i$

$\dfrac{1}{R} = \Sigma\dfrac{1}{R_i}$

$P = IV$

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

$C = \Sigma C_i$

$\dfrac{1}{C} = \Sigma\dfrac{1}{C_i}$

$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$

$\mathbf{F} = I\boldsymbol{\ell} \times \mathbf{B}$

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

$B = \dfrac{\mu_0 NI}{\ell}$

$\varepsilon_{ave} = -\dfrac{\Delta\varphi}{\Delta t}$

$\varphi = B_\perp A$

FORMULAS (continued)

Waves, Sound, and Light	Modern Physics
$T = \frac{2\pi}{\omega}$	$E = hf$
$a = -\omega^2 x$	$E = \gamma mc^2$
$x = A \sin \omega t$	$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$
$T = 2\pi\sqrt{\frac{m}{k}}$	$hf = \varphi + eV$
$T = 2\pi\sqrt{\frac{L}{g}}$	$\Delta x \Delta p \geq h$
$v = f\lambda$	$\Delta E \Delta t \geq h$
$v = \sqrt{\frac{T}{\mu}}$	$p = \frac{h}{\lambda}$
$v = \sqrt{\frac{\gamma RT}{M}}$	
$2L = n\lambda$, n is an integer	
$4L = n\lambda$, n is odd	
$n_1 \sin \theta_1 = n_2 \sin \theta_2$	
$n = \frac{c}{v}$	
$\frac{1}{f} = \frac{1}{s_i} + \frac{1}{s_0}$	
$M = \frac{h_i}{h_0} = -\frac{s_i}{s_0}$	
$d \sin \theta = m\lambda$	
$I = I_0 \cos^2 \theta$	

NOTES

Not all formulas necessary are listed, nor are all formulas listed used on this test.

In questions on electricity and magnetism, the term *current* refers to "conventional current" and the use of the right-hand rule is assumed.