

1994 Introductory Physics Examination



Instructions

1. **Do Not Open** the examination until you are instructed to do so by your teacher.
2. **Do Not Write** anything in the examination booklet or on the formula sheet. You will be supplied with scratch paper and an answer sheet.
3. The examination is divided into seven sections as shown below. During a given time period, you should work only on questions in the section assigned by your teacher. If you finish before time is called, you should check your answers for that section only. You may use a calculator, non-programmable or cleared of data and programs, and the physics formulas and constants provided with these instructions.
4. When you are instructed to stop working, put down your pencil, close the examination booklet, and wait for further instruction.

Part I - Multiple Choice

SECTION A: Mechanics	24 questions	25 minutes	page 3
SECTION B: Waves, Optics, and Sound	16 questions	20 minutes	page 9
SECTION C: Heat and Kinetic Theory	8 questions	10 minutes	page 12
SECTION D: Electricity and Magnetism	20 questions	25 minutes	page 14
SECTION E: Modern Physics	12 questions	15 minutes	page 18

Each multiple choice question or incomplete statement has a single best answer. When you have made your choice for the best answer, completely blacken the corresponding space on the answer sheet. Use a number 2 pencil and make a heavy black mark that completely fills space to record your answer. Mark only one answer for each question. If you wish to change your answer, completely erase the previous mark. Your score on Part I of this examination is equal to the number of correct answers. There is no penalty for wrong answers; therefore, you should answer every question in the section.

Part II - Free Response

SECTION F: Mechanics	2 of 3 questions	25 minutes	page 21
SECTION G: Electricity & Magnetism	2 of 3 questions	25 minutes	page 23

Each free response question is worth 10 points. Select two of the three problems to work. You can receive partial credit for your answers to these questions, so be sure to show all your work on the answer sheet.

This examination was prepared by members of a test-development committee consisting of physics instructors representing the American Association of Physics Teachers (AAPT).

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**Values of Some Physical Constants**

acceleration due to gravity	g	$= 10 \text{ m/s}^2$
gravitational constant	G	$= 6.7 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$
specific heat of water	c_w	$= 1.0 \text{ kcal/kg}\cdot\text{K} = 4.2 \times 10^3 \text{ J/kg}\cdot\text{K}$
atomic mass unit	1 u	$= 1.7 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$
electron volt	1 eV	$= 1.6 \times 10^{-19} \text{ J}$
mass of electron	m_e	$= 9.1 \times 10^{-31} \text{ kg}$
mass of proton	m_p	$= 1.7 \times 10^{-27} \text{ kg}$
elementary electronic charge	e	$= 1.6 \times 10^{-19} \text{ C}$
Coulomb's constant	k	$= 9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$
permittivity constant	ϵ_0	$= 8.9 \times 10^{-12} \text{ C}^2/\text{N}\cdot\text{m}^2$
permeability constant	μ_0	$= 4\pi \times 10^{-7} \text{ T}\cdot\text{m/A}$
speed of sound in air (20°C)	v_s	$= 340 \text{ m/s}$
speed of light in vacuum	c	$= 3.0 \times 10^8 \text{ m/s}$
Planck's Constant	h	$= 6.6 \times 10^{-34} \text{ J}\cdot\text{s} = 4.14 \times 10^{-15} \text{ eV}\cdot\text{s}$



Physics Formulas

$$\Delta x = v_0 t + \frac{1}{2} a t^2$$

$$v^2 = v_0^2 + 2a\Delta x$$

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

$$F = G \frac{m_1 m_2}{r^2}$$

$$KE = K = \frac{1}{2} m v^2$$

$$P = \frac{W}{\Delta t} = F v \cos \theta = F_{\parallel} v$$

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

$$n\lambda = d \frac{x}{L} = d \sin \theta_n$$

$$Q = mc\Delta T$$

$$pV = nRT$$

$$E = \frac{F}{q}$$

$$V = Ed$$

$$P = VI$$

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

$$E = mc^2$$

$$v = v_0 + at$$

$$v_{0x} = v_0 \cos \theta$$

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

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

$$PE = U = mgh$$

$$\tau = RF \sin \theta = RF_{\perp}$$

$$v = f\lambda$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$Q = mL$$

$$W = p\Delta V$$

$$V = \frac{W}{q}$$

$$Q = CV$$

$$F = qvB \sin \theta = qvB_{\perp}$$

$$B = \mu_0 nI$$

$$E = hf$$

$$\Delta x = \bar{v}t$$

$$v_{0y} = v_0 \sin \theta$$

$$W = mg$$

$$W = F s \cos \theta = F_{\parallel} s$$

$$PE = U = \frac{1}{2} kx^2$$

$$\sum \tau = I\alpha$$

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

$$m = -\frac{d_i}{d_o}$$

$$Q = W + \Delta U$$

$$F = k \frac{q_1 q_2}{r^2}$$

$$V = k \frac{q}{r}$$

$$V = RI$$

$$F = ILB \sin \theta = ILB_{\perp}$$

$$\text{cmf} = Blv$$

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