

Numerical Answers to Examination Questions

1st Year Examinations, Summer 2005

Mechanics and Relativity

Q1:

- (ii) $t_h = (u/g) \sin \alpha$
- (iii) $v_e = (2gR_E)^{1/2}$
- (iv) 2.49 km s^{-1}
- (vi) $3.5 \text{ cycles s}^{-1}; 800\text{W}$

Q3:

- (ii) $U(r) = -\varepsilon$
- (iv) $3\varepsilon/4$
- (v) $(72\varepsilon/a^2\mu)^{1/2}$
- (vi) $\mu = 20 m_H$
- (vii) $1.1 \times 10^{-12} \text{ s}$

Q4:

- (iii) $0.76 \text{ m s}^{-1}; \text{successful}$
- (iv) $\text{Angles add up to approximately } 90^\circ$

Q5:

- (iii) $r_E / r_V = v_{tV} / v_{tE}$
- (vi) 27.2 km s^{-1}
- (vii) $30.0 \text{ km s}^{-1}; 2.8 \text{ km s}^{-1}; \text{opposite to Earth's orbital motion}$

Q6:

- (iii) $\beta = 0.001$
- (iv) $2 \times 10^8 \text{ light years}$

Electricity and Magnetism

Q1:

- (i) 6.23 N
- (iii) 1.42 V m^{-1} ; 17.0 J
- (iv) $E = -2Qhx / (4\pi\epsilon_0 (x^2 - h^2/4)^2)$

Q2:

- (i) (a) $R_0 = R_1 R_2 / (R_1 + R_2)$; (b) $R_0 = 4\Omega$
- (ii) Low pass filter with $\omega_{3\text{dB}} = 1/RC$ and DC gain of 10
- (iii) 1.7Ω ; $588 \mu\text{s}$

Q4:

- (ii) $\epsilon_0 E_0$; E_0/ϵ_r ; $\epsilon_0 E_0(1/\epsilon_r - 1)$; $\epsilon_0 E_0$
- (v) $5.4 \times 10^{-13} \text{ F}$

Q5:

- (i) $2 \times 10^6 \text{ V m}^{-1}$; $-4 \times 10^{12} \text{ V}^2 \text{ m}^{-2}$
- (ii) At rest at $\theta = 90^\circ$

Structure of Matter. Vibrations & Waves and Quantum Physics

Q1:

- (iii) 0.293 m^3
- (iv) $2.4 \times 10^{-5} \text{ m}; 7.2 \times 10^{-7} \text{ m}^3$

Q2:

- (i) 76.2 m s^{-1}
- (ii) $381.5 \text{ N m}^{-1}; 87.3 \text{ N m}^{-1}$
- (iii) 7.00 s

Q3:

- (ii) $4.31 \times 10^{-6} \text{ eV}$
- (iii) $1.97 \times 10^{-12} \text{ m}$

Q5

- (iii) $2.5 \times 10^{-10} \text{ m}$

Q6

- (i) 2 rad s^{-1}
- (v) $12.8 \text{ W}; 0.8 \text{ m}; 0.279 \text{ Hz to } 0.358 \text{ Hz}$

Q7:

- (i) (c) 0.369 m
- (ii) (b) $2005.4 \text{ Hz};$ (c) $71.57^\circ;$ 30 m; (d) $7.01 \times 10^{-8} \text{ W m}^{-2}$

Q8

- (v) $1.59 \times 10^{13} \text{ s}; 0.01 \text{ s}$

Q9:

- (ii) $a/2$
- (iv) $(7^{1/2}) \hbar/a$

Please note that the numerical solutions for **Mathematics** and **Mathematical Analysis** are not available.

Prepared April 2007