

2024 ASOP ANSWER BOOKLET (online)

Name: _____ School: _____ Account Number: _____

Section A: Digging Disaster (18 marks)

1. (2 marks)

a. true or false: _____

b. true or false: _____

2. (3 marks)

3. (5 marks)

4. (1 mark)

5. (2 marks)

6. (2 marks)

7. (3 marks)

Section B: Slithering Snake (31 marks)

1. (4 marks)

2. (4 marks)

3. (4 marks)

4. (4 marks)

5. (2 marks)

6. (4 marks)

7. (7 marks)

8. (2 marks)

Section C: Violin Vibrations (32 marks)

1. (1 mark)

2. (7 marks)

3. (6 marks)

4. (3 marks)

5. (2 marks)

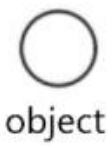
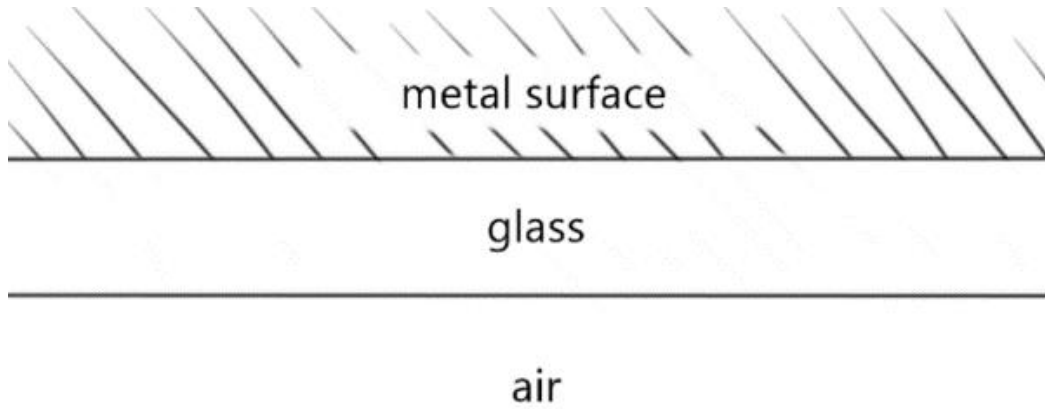
6. (3 marks)

7. (5 marks)

8. (5 marks)

Section D: Reflection Replicas (5 marks)

1. (5 marks)



Section E: Twisting Torques and Leaning Lego (24 marks)

1. (3 marks)



2. (6 marks)

a.

b.

c.

3. (4 marks)

4. (3 marks)

5. (4 marks)

6. (4 marks)

SCHOOL OF PHYSICS & ASTRONOMY

PHYSICAL CONSTANTS

Candidates are advised that they should only use the number of significant figures appropriate for the problem they are attempting to solve.

GENERAL CONSTANTS:

Charge on electron	$-e$	$= -1.60217733 \times 10^{-19} \text{ C}$
Mass of electron	m_e	$= 9.1093897 \times 10^{-31} \text{ kg}$ ($\equiv 0.510998902 \text{ Mev}/c^2$)
Mass of proton	m_p	$= 1.6726231 \times 10^{-27} \text{ kg}$ ($\equiv 938.27200 \text{ Mev}/c^2$)
Mass of neutron	m_n	$= 1.6749286 \times 10^{-27} \text{ kg}$ ($\equiv 939.56533 \text{ Mev}/c^2$)
Permeability of vacuum	μ_0	$= 4\pi \times 10^{-7} \text{ H m}^{-1}$
Permittivity of vacuum	ϵ_0	$= 8.854187817 \times 10^{-12} \text{ F m}^{-1}$
Fine structure constant	α	$= 1/137.035989$
Gravitation constant	G	$= 6.67259 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Boltzmann's constant	k_B	$= 1.3806503 \times 10^{-23} \text{ J K}^{-1}$
Atmospheric pressure	1 atm.	$= 1.01325 \times 10^5 \text{ N m}^{-2}$ (Pa)
Stefan-Boltzmann constant	σ	$= 5.6704 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$
Avogadro's number	N	$= 6.0221367 \times 10^{23}$
Velocity of light	c	$= 2.99792458 \times 10^8 \text{ m s}^{-1}$
Bohr radius	a_0	$= 5.2917721 \times 10^{-11} \text{ m}$
Bohr magneton	μ_B	$= 9.274006 \times 10^{-24} \text{ J T}^{-1}$
Planck's constant	h	$= 6.62607544 \times 10^{-34} \text{ J s}$
Planck's constant/ 2π	\hbar	$= 1.05457266 \times 10^{-34} \text{ J s}$

ASTRONOMICAL CONSTANTS

Astronomical unit:	1AU	$= 1.49597871 \times 10^{11} \text{ m}$
Parsec:	1pc	$= 3.08567758 \times 10^{16} \text{ m}$
Mass of the Earth	M_\oplus	$= 5.97 \times 10^{24} \text{ kg}$
Radius of the Earth	R_\oplus	$= 6.37814 \times 10^6 \text{ m}$
Mass of the Sun	M_\odot	$= 1.99 \times 10^{30} \text{ kg}$
Radius of the Sun	R_\odot	$= 6.96 \times 10^8 \text{ m}$
Luminosity of the Sun	L_\odot	$= 3.85 \times 10^{26} \text{ W}$
Thomson cross-section	σ_T	$= 6.652459 \times 10^{-29} \text{ m}^2$

ATOMIC AND NUCLEAR PHYSICS UNITS

	1 fm	$= 10^{-15} \text{ m}$
	1 barn	$= 10^{-28} \text{ m}^2$
Atomic mass unit	1 u.	$= 1.6605402 \times 10^{-27} \text{ kg}$
Atomic energy unit	1 a.u.	$= 27.2113834 \text{ eV}$
Ångstrom	1 Å	$= 10^{-10} \text{ m}$
Electron volt	1 eV	$= 1.6021765 \times 10^{-19} \text{ J}$
	$\hbar c$	$= 197.32696 \text{ MeV fm}$

(Updated 4 June 2010)