Instructions and Constants Sheet

OAC 2025 Team

September 2025

Round 1 Instructions

1. The duration of the exam is **75 minutes** and it consists of **45 questions** (all MCQs).
2. The exam will be available during the following **6-hour window**:
   - **IST (Indian Standard Time):** 18:00 – 00:00, 21 Sept 2025
   - **UTC (Coordinated Universal Time):** 12:30 – 18:30, 21 Sept 2025
   - **US Eastern Time (EDT):** 08:30 – 14:30, 21 Sept 2025
   - **US Pacific Time (PDT):** 05:30 – 11:30, 21 Sept 2025

   You may begin at any time within this window, but once started, you will only have 75 minutes.
3. The exam format is **open book** – you may use any **offline resources** (books, notes, calculators, etc.).
4. The use of the **internet, AI tools, or communication with others** is strictly prohibited.
5. This is an **individual contest** – collaboration or answer-sharing will result in disqualification.
6. Keep all **scrap work** safely with you, as the organizers may request it at the end of the exam. The organizers also reserve the right to **disqualify** any participant if suspicious activity is detected.
7. The **marking scheme** is:
   - Correct answer: **+5**
   - Wrong answer: **0**
   - Unattempted: **+1**
   - Maximum score: **225**
8. The **Top 15-20 participants** will qualify for Round 2, to be held on 4 October 2025. The results of the first round will be declared by **30 September 2025**
9. By starting the exam, you agree to follow all the rules in good faith.

Good luck! Aim for the stars.

Physical Constants

c	2.997925	$\times 10^{8}$	$\mathrm{m\,s^{-1}}$	Speed of light in vacuum
G	6.67430	$\times 10^{-11}$	$\mathrm{m^{3}\,kg^{-1}\,s^{-2}}$	Gravitational constant
h	6.626070	$\times 10^{-34}$	$\mathrm{J\,s}$	Planck constant
e	1.602177	$\times 10^{-19}$	C	Elementary charge
$\hbar$	1.052572	$\times 10^{-34}$	$\mathrm{J\,s}$	Reduced Planck constant
k	1.380649	$\times 10^{-23}$	$\mathrm{J\,K^{-1}}$	Boltzmann constant
μ_0	1.256637	$\times 10^{-6}$	$\mathrm{N\,A^{-2}}$	Vacuum permeability
ε_0	8.854188	$\times 10^{-12}$	$\mathrm{F\,m^{-1}}$	Vacuum permittivity
σ	5.670374	$\times 10^{-8}$	$\mathrm{W\,m^{-2}\,K^{-4}}$	Stefan-Boltzmann constant
m_e	9.109384	$\times 10^{-31}$	kg	Electron mass
	0.510999		$\mathrm{MeV\,c^{-2}}$	
m_p	1.672622	$\times 10^{-27}$	kg	Proton mass
	938.2721		$\mathrm{MeV\,c^{-2}}$	
m_n	1.674927	$\times 10^{-27}$	kg	Neutron mass
	939.5654		$\mathrm{MeV\,c^{-2}}$	
N_A	6.022141	$\times 10^{23}$	$\mathrm{mol^{-1}}$	Avogadro constant
R	8.314463		$\mathrm{J\,mol^{-1}\,K^{-1}}$	Gas constant
a_0	5.291772	$\times 10^{-11}$	m	Bohr radius
R_∞	1.097373	$\times 10^{7}$	$\mathrm{m^{-1}}$	Rydberg constant
b_λ	2.897772	$\times 10^{-3}$	$\mathrm{m\,K}$	Wien's displacement constant
b_ν	5.878926	$\times 10^{10}$	$\mathrm{Hz\,K}$	
a	7.565767	$\times 10^{-16}$	$\mathrm{J\,m^{-3}\,K^{-4}}$	Radiation constant
α	7.297353	$\times 10^{-3}$		Fine structure constant
σ_e	6.652459	$\times 10^{-29}$	$\mathrm{m^{2}}$	Thomson cross section
μ_B	9.274010	$\times 10^{-27}$	$\mathrm{J\,T^{-1}}$	Bohr magneton
r_e	2.817940	$\times 10^{-15}$	m	Classical electron radius
g	9.80665		$\mathrm{m\,s^{-2}}$	Standard gravity on Earth
atm	1.01325	$\times 10^{5}$	Pa	Standard atmosphere

Astronomical Constants

AU	1.495979	$\times 10^{11}$	m	Astronomical Unit
ly	9.460730	$\times 10^{15}$	m	Light year
pc	3.085678	$\times 10^{16}$	m	Parsec
yr	365.2563		days	Sidereal year
$M_\odot$	1.988416	$\times 10^{30}$	kg	Solar mass
$R_\odot$	6.957	$\times 10^{8}$	m	Solar radius
$L_\odot$	3.828	$\times 10^{26}$	W	Solar luminosity
$T_{\odot,\,\mathrm{eff}}$	5772		K	Solar effective temperature
$M_{\odot,\,\mathrm{V}}$	4.83			Solar magnitude
$M_{\odot,\,\mathrm{bol}}$	4.75			
$m_{\odot,\,\mathrm{V}}$	-26.832			
$\alpha_\odot$	$32'$			Size of solar disc
$\mu_\odot$	$4\pi^2$		$\mathrm{AU}^3\,\mathrm{yr}^{-2}$	Solar gravitational parameter
$M_\oplus$	5.9722	$\times 10^{24}$	kg	Earth mass
$R_\oplus$	6.3781	$\times 10^{6}$	m	Earth radius
$e_\oplus$	0.016709			Earth eccentricity
$\omega_\oplus$	114.2078°			Earth argument of periapsis
M_{moon}	7.346	$\times 10^{22}$	kg	Moon mass
R_{moon}	1.7374	$\times 10^{6}$	m	Moon radius
$d_{\mathrm{E\text{-}M}}$	3.84399	$\times 10^{8}$	m	Earth–Moon distance
$m_{\mathrm{moon,\,V}}$	12.74			magnitude of full moon
α_{moon}	$31'$			Size of lunar disc
M_J	1.8982	$\times 10^{27}$	kg	Jupiter mass
R_J	6.9911	$\times 10^{7}$	m	Jupiter radius
a_J	5.2038		AU	Semi-major axis of Jupiter
a_V	0.723332		AU	Semi-major axis of Venus
a_M	1.523681		AU	Semi-major axis of Mars
H_0	70.1		$\mathrm{km\,s^{-1}\,Mpc^{-1}}$	Hubble constant
κ	20.49552		arcsec	Abberation constant
ε	$23^\circ\,26'\,21.4''$			Obliquity of the ecliptic
ζ	$-34'$			Refraction at horizon
Jy	1	$\times 10^{-26}$	$\mathrm{W\,m^{-2}\,Hz^{-1}}$	Jansky
$d_{\mathrm{MW\text{-}And}}$	0.7		Mpc	Milky Way-Andromeda distance
A	15		$\mathrm{km\,s^{-1}\,kpc^{-1}}$	Oort constants
B	20		$\mathrm{km\,s^{-1}\,kpc^{-1}}$	