

**Paper Reference(s) 1AS0/02**  
**Pearson Edexcel Level 1/Level 2 GCSE (9–1)**

**Astronomy**  
**PAPER 2: Telescopic Astronomy**

**Wednesday 21 June 2023 – Afternoon**

**Formulae and Data Booklet**

**DO NOT RETURN THIS BOOKLET WITH THE  
QUESTION PAPER.**

## FORMULAE

<b>Equation of Time = Apparent Solar Time (AST) – Mean Solar Time (MST)</b>	
<b>Kepler's 3rd law:</b>	$\frac{T^2}{r^3} = \text{a constant}$
<b>Magnification of telescope:</b>	$\text{magnification} = \frac{f_o}{f_e}$
<b>Distance modulus formula:</b>	$M = m + 5 - 5 \log d$
<b>Redshift formula:</b>	$\frac{\lambda - \lambda_0}{\lambda_0} = \frac{v}{c}$
<b>Hubble's law:</b>	$v = H_0 d$

## DATA

<b>Mass of Earth</b>	<b><math>6.0 \times 10^{24} \text{ kg}</math></b>
<b>Mean diameter of Earth</b>	<b>13 000 km</b>
<b>Mean diameter of Moon</b>	<b>3500 km</b>
<b>Mean diameter of Sun</b>	<b><math>1.4 \times 10^6 \text{ km}</math></b>
<b>One Astronomical Unit (AU)</b>	<b><math>1.5 \times 10^8 \text{ km}</math></b>
<b>Mean Earth to Moon distance</b>	<b>380 000 km</b>
<b>One light year (l.y.)</b>	<b><math>9.5 \times 10^{12} \text{ km}</math></b>
<b>One parsec (pc)</b>	<b><math>3.1 \times 10^{13} \text{ km} = 3.26 \text{ l.y.}</math></b>
<b>Sidereal day of Earth</b>	<b>23 h 56 min</b>
<b>Synodic day of Earth</b>	<b>24 h 00 min</b>
<b>Temperature of solar photosphere</b>	<b>5800 K</b>
<b>Hubble Constant</b>	<b>68 km/s/Mpc</b>
<b>Speed of light in vacuum</b>	<b><math>3.0 \times 10^8 \text{ m/s}</math></b>

Name	Type of body	Mean distance from Sun / AU	Sidereal period / Earth year	Mean temperature / °C	Diameter / 1000 km	Mass / Earth mass	Ring system	Moons
Mercury	planet	0.38	0.24	170	4.9	0.055	no	none
Venus	planet	0.72	0.62	470	12.1	0.82	no	none
Earth	planet	1.0	1.0	15	12.8	1.00	no	1: the Moon
Mars	planet	1.5	1.9	−50	6.9	0.11	no	2 small moons: Deimos and Phobos
Ceres	dwarf planet	2.8	4.6	−105	0.95	$1.5 \times 10^{-4}$	no	none
Jupiter	planet	5.2	11.9	−150	143	318	yes	4 major moons: Ganymede, Callisto, Europa, Io >60 others

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Name	Type of body	Mean distance from Sun / AU	Sidereal period / Earth year	Mean temperature / °C	Diameter / 1000 km	Mass / Earth mass	Ring system	Moons
Saturn	planet	9.5	29.5	−180	121	95	yes	5 major moons: including Titan, Iapetus >55 others
Uranus	planet	19.1	84.0	−210	51	15	yes	5 major moons: including Titania, Oberon >20 others
Neptune	planet	30.0	165	−220	50	17	yes	1 major moon: Triton >12 others
Pluto	dwarf planet	39.5	248	−230	2.4	$2.2 \times 10^{-3}$	no	1 major moon: Charon >4 other moons
Haumea	dwarf planet	43.1	283	−241	1.4	$6.7 \times 10^{-4}$	no	2
Eris	dwarf planet	67.8	557	−230	2.3	$2.8 \times 10^{-3}$	no	at least 1