



2021 AUSTRALIAN SCIENCE OLYMPIAD EXAM

EARTH & ENVIRONMENTAL SCIENCE

TO BE COMPLETED BY THE STUDENT. USE CAPITAL LETTERS.

First Name: Last Name.....

Date of Birth:/...../.....

Male Female Unspecified Year 10 Year 11 Other:

Name of School:State:

Examiners Use Only:

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2021 AUSTRALIAN SCIENCE OLYMPIAD EXAM

EARTH & ENVIRONMENTAL SCIENCE

Time Allowed
Reading Time: 15 minutes
Exam Time: 120 minutes

INSTRUCTIONS

- *Attempt ALL questions of this paper.*
- Permitted materials: Non-programmable, non-graphical calculator, pens, pencils, erasers and a ruler.
- Ensure any written answers are legible.
- All numerical answers must have correct units.
- Marks will not be deducted for incorrect answers.
- Rough working must be done only on pages 69 and 70 of this booklet.
- Data that may be required for a question will be found on pages 3 – 12
- All answers should be marked on this paper. Circle the correct answer in Multiple Choice and True/False questions. Other questions require you to write in the space provided.

MARKS

Multiple choice questions are each worth one (1) mark unless otherwise indicated.

True/False questions are each worth a quarter (0.25) mark.

Other questions are worth the marks indicated on the paper.

Total marks for the paper: 60.0 marks

DATA & DEFINITIONS

Material supplied:

- Character disclaimer – page 3
- Physical constants – page 3
- Periodic Table of the Elements – page 4
- International Chronostratigraphic Chart 2021 – page 5
- Key biological groups through time – page 6
- Igneous Rock classification chart – page 7
- Graptolites through time – page 8
- Trilobites through time – page 9
- Hardness scale – page 10
- Evolution of birds and dinosaurs – page 11
- Topographic map of Mars – page 12

Characters

The names of characters, locations and events portrayed in this paper are fictitious (but fun). Enjoy!

Physical constants

Constant	Symbol	Value
Speed of light	c	299,792,458 m/s effectively 3×10^8 m/s
Universal gravitational constant	G	$6.67 \times 10^{-11} \text{ Nm}^2\text{kg}^{-2}$
Earth's gravitational acceleration	g	9.8 ms^{-2}
Earth mass	M_{\oplus}	$5.98 \times 10^{24} \text{ kg}$
Earth radius	R_{\oplus}	$6.37 \times 10^6 \text{ m}$
$g_{\text{planet}} = G \times M_{\text{planet}} / R_{\text{planet}}^2$		

Periodic Table of the Elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18												
1 H Hydrogen 1.01		3 Li Lithium 6.94	4 Be Beryllium 9.01	5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18	11 Na Sodium 22.99	12 Mg Magnesium 24.31	13 Al Aluminum 26.98	14 Si Silicon 28.09	15 P Phosphorus 30.97	16 S Sulfur 32.07	17 Cl Chlorine 35.45	18 Ar Argon 39.95												
19 K Potassium 39.10	20 Ca Calcium 40.08	21 Sc Scandium 44.96	22 Ti Titanium 47.87	23 V Vanadium 50.94	24 Cr Chromium 51.99	25 Mn Manganese 54.94	26 Fe Iron 55.85	27 Co Cobalt 58.93	28 Ni Nickel 58.69	29 Cu Copper 63.55	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.63	33 As Arsenic 74.92	34 Se Selenium 78.97	35 Br Bromine 79.90	36 Kr Krypton 84.80												
37 Rb Rubidium 84.47	38 Sr Strontium 87.62	39 Y Yttrium 88.91	40 Zr Zirconium 91.22	41 Nb Niobium 92.91	42 Mo Molybdenum 95.95	43 Tc Technetium 98.91	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.6	53 I Iodine 126.90	54 Xe Xenon 131.25												
55 Cs Cesium 132.91	56 Ba Barium 137.33	57-71 Lanthanides	72 Hf Hafnium 178.49	73 Ta Tantalum 180.95	74 W Tungsten 183.84	75 Re Rhenium 186.21	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.97	80 Hg Mercury 200.59	81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium [208.98]	85 At Astatine 209.99	86 Rn Radon 222.02												
87 Fr Francium 223.02	88 Ra Radium 226.03	89-103 Actinides	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium [unknown]	114 F1 Flerovium [289]	115 Uup Ununpentium [unknown]	116 Lv Livermorium [298]	117 Uus Ununseptium [unknown]	118 Uuo Ununoctium [unknown]												
57 La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium [144.91]	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.06	71 Lu Lutetium 174.97	89 Ac Actinium 227.03	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium 237.05	94 Pu Plutonium 244.06	95 Am Americium 243.06	96 Cm Curium 247.07	97 Bk Berkelium 247.07	98 Cf Californium 251.08	99 Es Einsteinium [254]	100 Fm Fermium 257.10	101 Md Mendelevium 258.1	102 No Nobelium 259.10	103 Lr Lawrencium [262]

Periodic Table of the Elements courtesy of

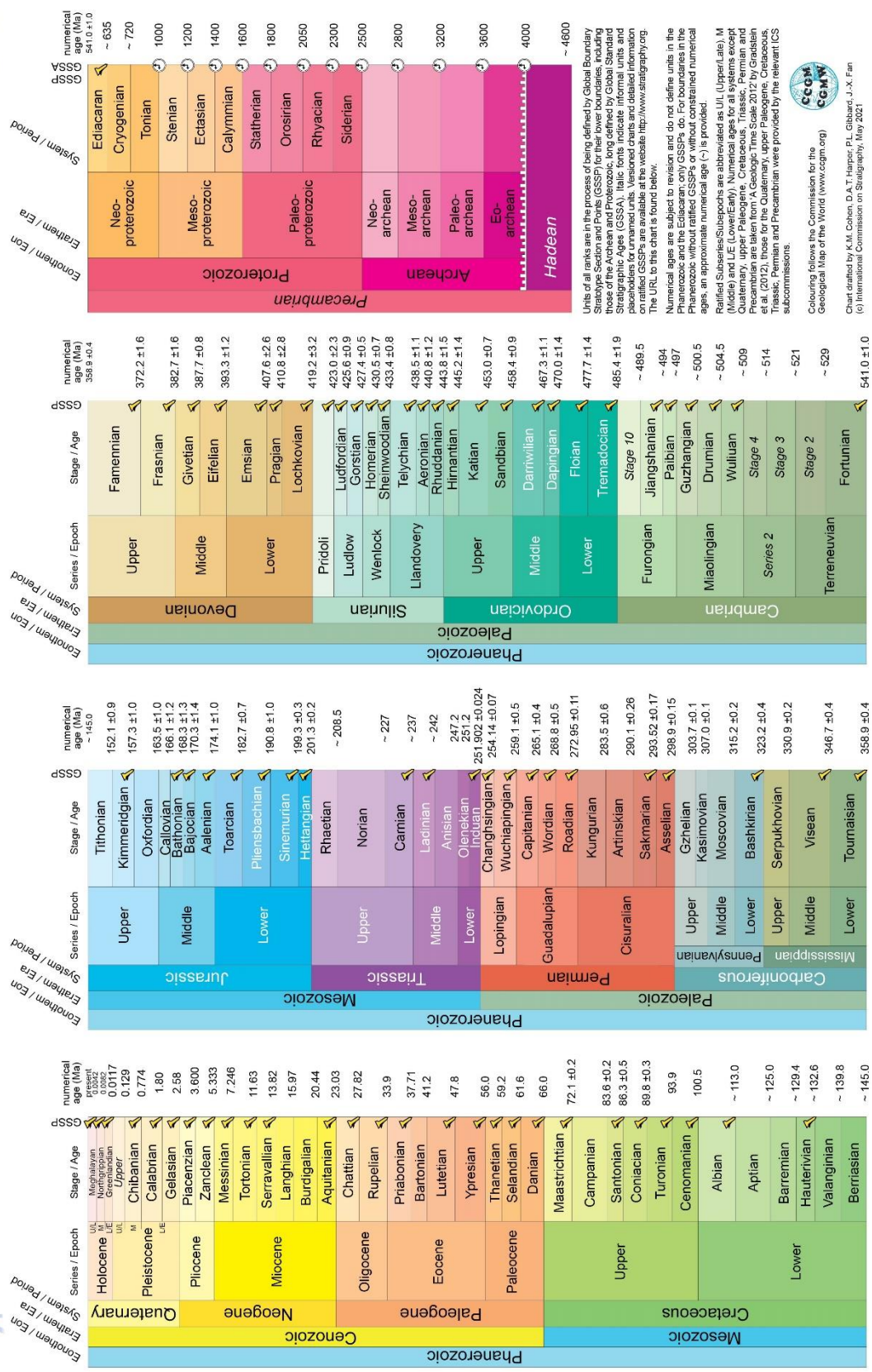
<http://sciencenotes.org/category/chemistry/periodic-table-chemistry/>



INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

v 2021/05

International Commission on Stratigraphy



Units of all ranks are in the process of being defined by Global Boundary Stratotype Section and Points (GSSP) for their lower boundaries, including those of the Archean and Proterozoic long defined by Global Standard Stratigraphic Ages (GSSA). Italic fonts indicate informal units and paleogeographic or unranked units. Versioned charts and detailed information on the GSSP are available at <http://www.stratigraphy.org>. The URL to this chart is found below.

Numerical ages are subject to revision and do not define units in the Phanerozoic without ratified GSSPs or without constrained numerical ages, an approximate numerical age (~) is provided.

Ratified Subseries/Subepochs are abbreviated as U/L (Upper/Lower), M (Middle) and LE (Lower/Early). Numerical ages for all systems except Quaternary, upper Paleogene, Cretaceous, Triassic, Permian and Precambrian are taken from 'A Geologic Time Scale 2012 by Gradstein et al. (2012), those for the Quaternary, upper Paleogene, Cretaceous, Triassic, Permian and Precambrian were provided by the relevant ICS subcommissions.

Colouring follows the Commission for the Geological Map of the World (www.cgmw.org)

Chart drafted by K.M. Cohen, D.A.T. Hancox, P.L. Gibbard, J.-X. Fan
 (c) International Commission on Stratigraphy, May 2021
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URL: <http://www.stratigraphy.org/ICSChart/ChronostratChart2021-05.pdf>

International Chronostratigraphic Chart 2021/05 courtesy of <http://www.stratigraphy.org/index.php/ics-chart-timescale>

Note: Numerical age (Ma) means the age in millions of years

Biostratigraphy of some key organisms found in the fossil record										
	Trilobites	Graptolites	Cyanobacteria (stromatolites)	Placoderm fish	Ray-finned fish	Dinosaurs	Birds	Hominids	Whales	
Holocene										
Pleistocene										
Neogene										
Paleogene										
Cretaceous										
Jurassic										
Triassic										
Permian										
Carboniferous										
Devonian										
Silurian										
Ordovician										
Cambrian										
Precambrian										

