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2020 AUSTRALIAN SCIENCE OLYMPIAD EXAM EARTH & ENVIRONMENTAL SCIENCE

TO BE COMPLETED BY THE STUDENT. USE CAPITAL LETTERS.

Student Name:

Home Address:

..... **Post Code:**

Telephone: (.....) **Mobile:**

E-Mail: **Date of Birth:**/...../.....

Male Female Unspecified **Year 10** Year 11 Other:

Name of School: **State:**

Students must be Australian citizens at the time they are offered a place to attend the Australian Science Olympiad Summer School.

The Australian Olympiad teams in Biology, Chemistry, Earth and Environmental Sciences and Physics will be selected from students participating in the respective summer schools.

Please note - students in Year 12 in 2020 are not eligible to attend the 2021 Australian Science Olympiad Summer School.

Data is collected for the sole purpose of offering eligible students a place at summer school. Visit www.asi.edu.au to view our privacy policy.

I am an Australian public high school student and would like to be considered for the Australian Science Olympiad Summer School Scholarship.

Examiners Use Only:									

2020 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 that any diagrams you draw are clear and labelled.
- 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 page 56 of this booklet.
- Data that may be required for a question will be found on pages 3 – 10
- 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 or draw on the diagram provided.

MARKS

Multiple choice & variants plus True/False questions are each worth one (1) mark.

Short written answer questions are each worth five (5) marks.

Total marks for the paper: 74 marks

DATA & DEFINITIONS

Material supplied:

- Physical constants – page 3
- Periodic Table of the Elements –page 4
- International Chronostratigraphic Chart 2020 – page 5
- Important groups of organisms through time – page 6
- Mineralogy of Igneous Rocks chart – page 7
- Graptolites through time – page 8
- Trilobites through time – page 9
- Hardness scale – page 10
- Character disclaimer – page 10

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}	$6.37 \times 10^6 \text{ m}$
$g_{\text{planet}} = G \times M_{\text{planet}} / R_{\text{planet}}^2$		

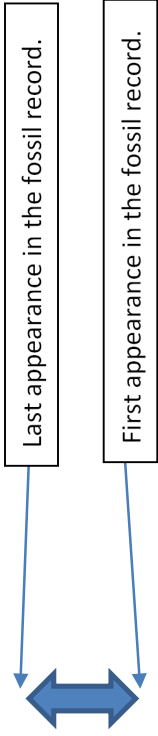
Periodic Table of the Elements

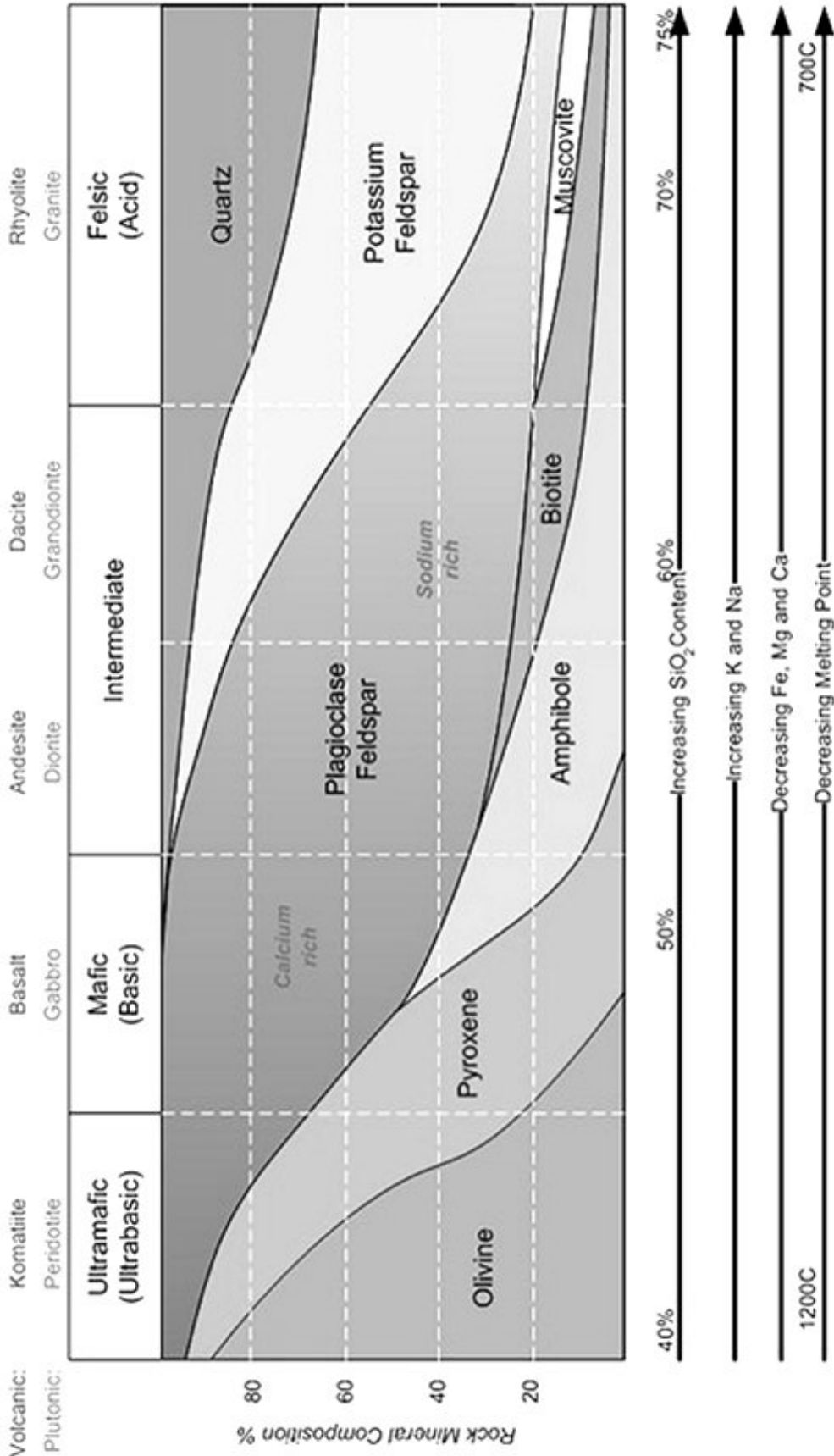
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18												
1 H Hydrogen 1.01		3 Li Lithium 6.94	4 Be Beryllium 9.01	5 B Boron 10.81	6 C Carbon 12.01	7 N Nitrogen 14.01	8 O Oxygen 16.00	9 F Fluorine 19.00	10 Ne Neon 20.18	11 Na Sodium 22.99	12 Mg Magnesium 24.31	13 Al Aluminum 26.98	14 Si Silicon 28.09	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 Fl 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]

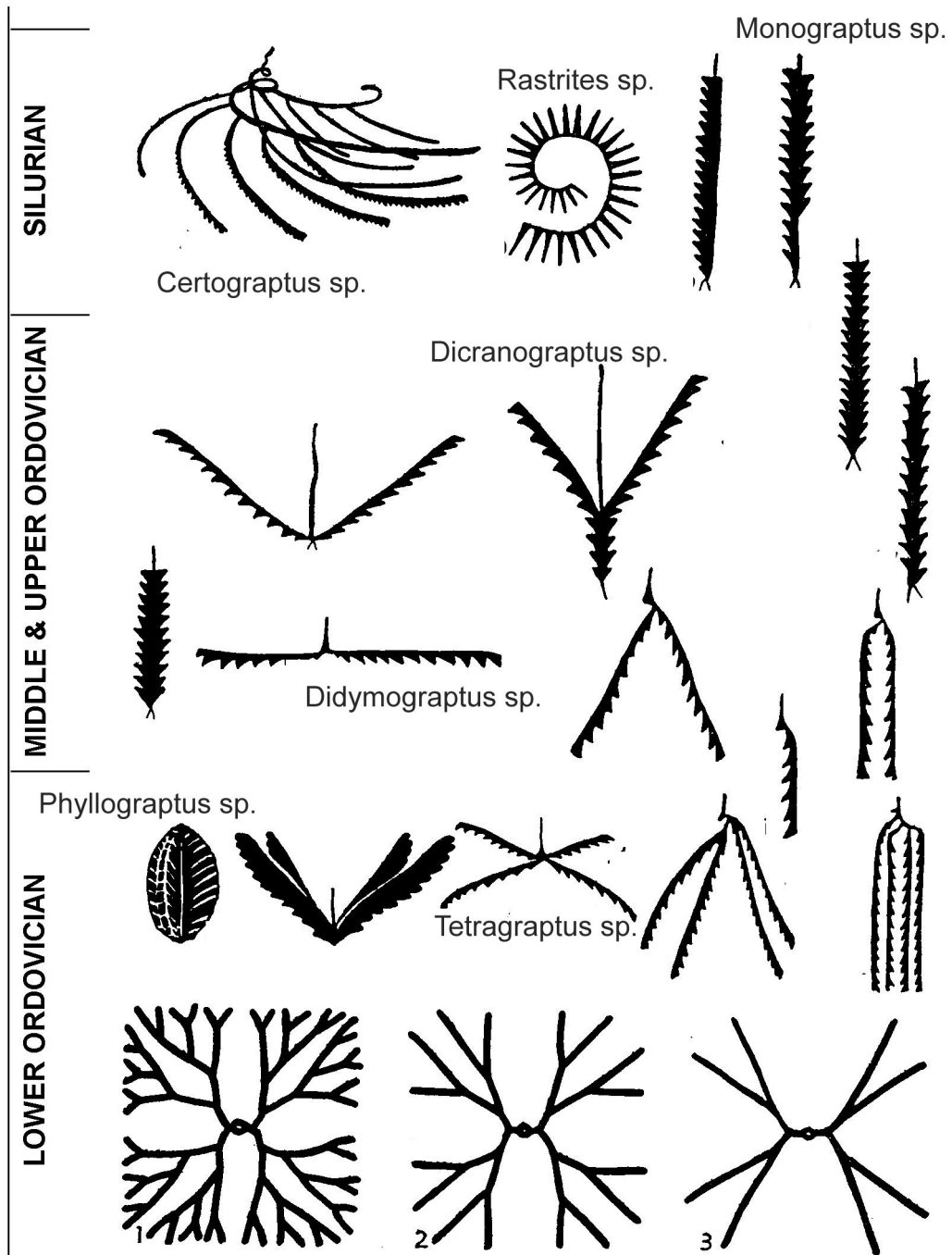
Periodic Table of the Elements courtesy of

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

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													

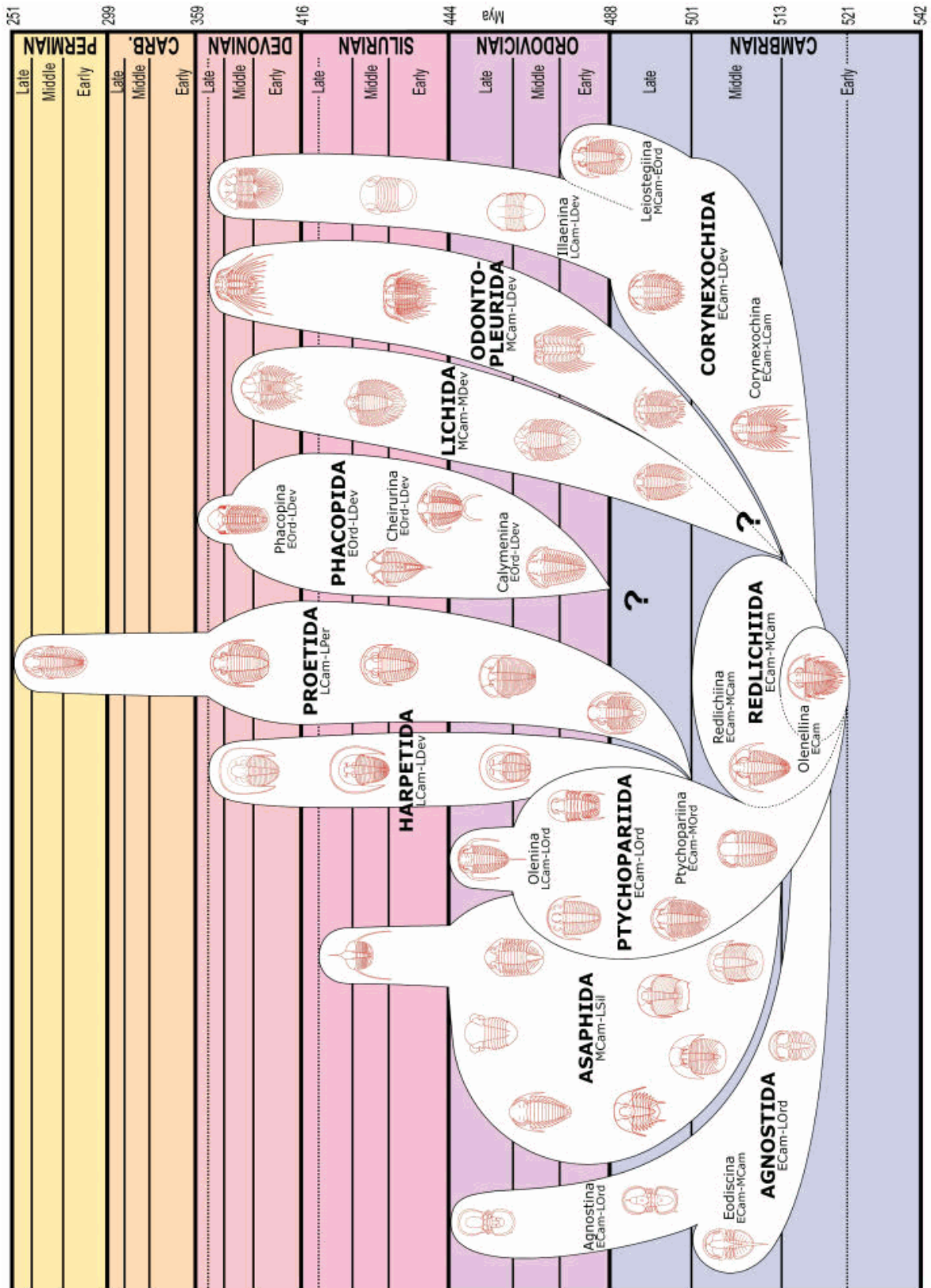






Graptolite shapes through time
 Modified from Moore, Lalicker & Fischer (1952), Figure 22-7

Graptolites through time



Trilobites through time

Hardness scale

Hardness	Example Minerals/materials
1	Talc
2	Gypsum
2.5	Fingernail, pure gold, silver, aluminium
3	Calcite, copper coin
4	Fluorite
4.5	Platinum, iron
5	Apatite, Pyroxene group (5 to 6)
6	Orthoclase feldspar, titanium, <u>spectrolite</u> , Pyroxene group (5 to 6)
6.5	Plagioclase feldspar, steel file, iron pyrite, glass, vitreous pure silica
7	Quartz, amethyst, <u>citrine</u> , agate, olivine, tridymite (high temp quartz)
7.5	Garnet, <u>coesite</u> (high pressure quartz)
8	Hardened steel, topaz, beryl, emerald, aquamarine
9	Corundum, ruby, sapphire
9.5	Carborundum
10	Diamond

Characters

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