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COMBINED SCIENCE

0653/32

Paper 3 Theory (Core)

February/March 2023

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Any blank pages are indicated.

- 1 (a) The alimentary canal of a human and a bear are similar.

Fig. 1.1 shows the alimentary canal and associated organs of a bear.

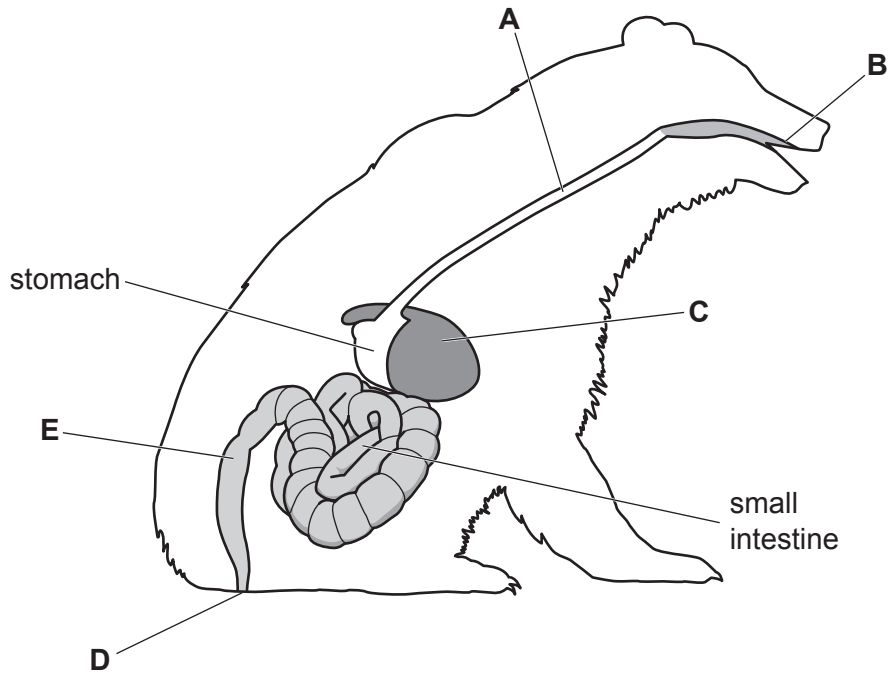


Fig. 1.1

- (i) Table 1.1 shows the names and functions of some of the parts labelled A–E in Fig. 1.1.

Complete Table 1.1 by writing your answers in the boxes.

Table 1.1

name of part	letter in Fig. 1.1	function
	B	ingestion
oesophagus		moves food to the stomach
anus		

[4]

- (ii) Digestion takes place in the stomach.

Complete this sentence about digestion.

Digestion breaks down large food molecules using chemical and processes.

[1]

(b) Chemical digestion uses enzymes to break down large food molecules.

Fig. 1.2 shows the effect of temperature on the activity of two different enzymes, **J** and **K**.

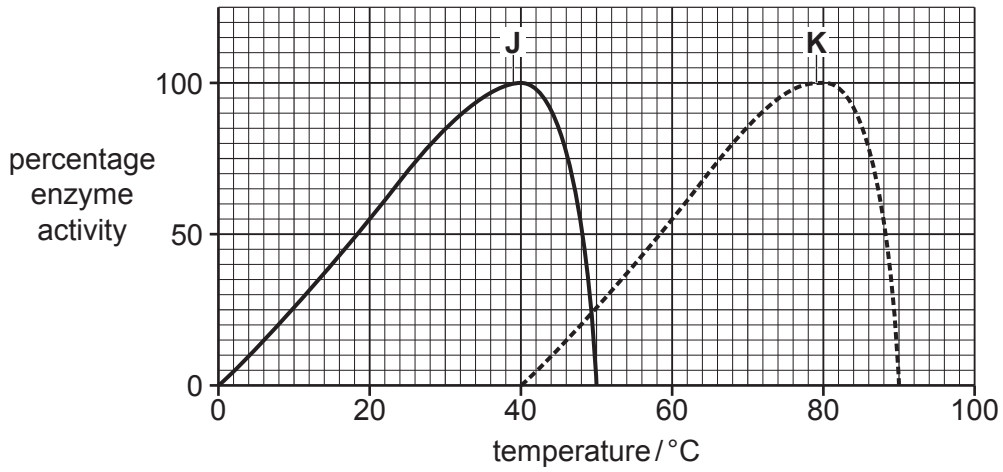


Fig. 1.2

(i) Identify the temperature in Fig. 1.2 when **both** enzymes have the same percentage activity value.

temperature = °C. [1]

(ii) Describe the effect of temperature on the activity of enzyme **K** in Fig. 1.2.

Use data in your answer.

.....

.....

..... [2]

(c) All enzymes are made from one type of molecule.

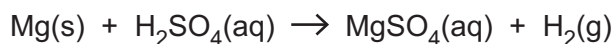
Circle this type of molecule.

fat **fibre** **protein** **vitamin** [1]

[Total: 9]

- 2 A student adds excess magnesium to dilute sulfuric acid.

The equation for the reaction is shown.



- (a) (i) State whether the change shown in the equation is a chemical change or a physical change.

Explain your answer.

change

explanation

..... [1]

- (ii) Use the equation to identify the solvent and **one** solute.

solvent

solute

[2]

- (iii) Describe the test for hydrogen gas and state the observation for a positive result.

test

.....

observation

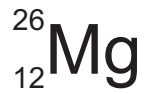
[1]

- (iv) State the separation process that is used to remove unreacted magnesium from the reaction mixture.

..... [1]

- (b) (i) Magnesium atoms can have different numbers of neutrons.

One atom of magnesium is represented as shown.



Use this information to complete Table 2.1 to show the number of protons, neutrons and electrons in this atom.

Table 2.1

number of protons	number of neutrons	number of electrons

[3]

- (ii) State how a magnesium atom differs from a magnesium ion, Mg^{2+} .

.....

..... [1]

[Total: 9]

- 3 Fig. 3.1 shows a distance–time graph for a student riding a bicycle.

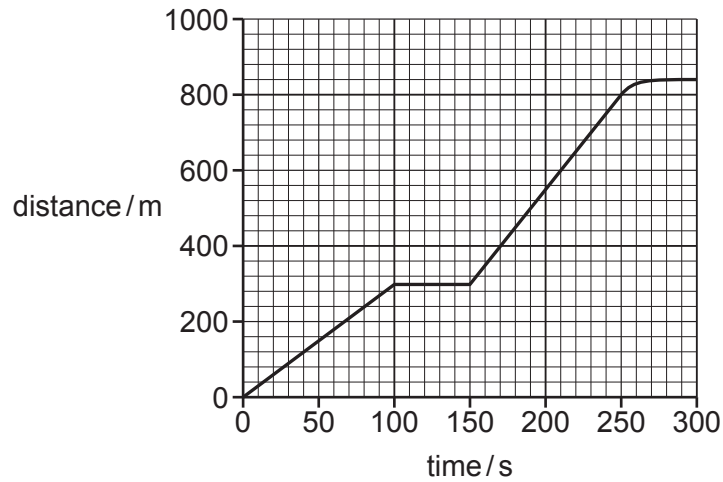


Fig. 3.1

- (a) (i) On Fig. 3.1, mark with an **X** where the student is travelling fastest. [1]
- (ii) On Fig. 3.1, mark with a **Y** where the student is gradually slowing down. [1]
- (b) (i) During the journey, the student rests for some time before moving on again.

Use Fig. 3.1 to determine for how long the student rests.

time = s [1]

- (ii) The student's journey takes 300 s.

Use Fig. 3.1 to calculate the average speed for the journey.

speed = m/s [2]

- (c) (i) Fig. 3.2 shows the student holding the bicycle off the ground with an upwards force of 97 N.

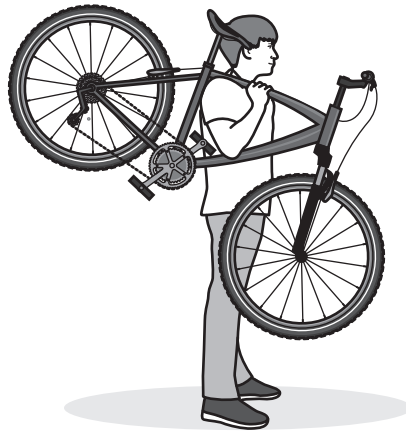


Fig. 3.2

The gravitational force on unit mass is 10 N/kg.

Calculate the mass of the bicycle.

mass = kg [2]

- (ii) The student does useful work to lift the bicycle off the ground.

Use words and phrases from the list below to state the **useful** energy transfers that take place.

Each word or phrase may be used once, more than once, or not at all.

- | | | |
|--------------------------------|--------------------------|-----------------------------|
| chemical potential | elastic potential | electrical potential |
| gravitational potential | kinetic | sound |
| | | thermal |

Energy is transferred:

from energy in the student

to energy of the moving bicycle

and then to energy in the stationary lifted bicycle. [3]

- (iii) Explain why the total energy transferred by the student is more than the useful work done on the bicycle.

.....

 [1]

- 4 (a) The boxes on the left name some parts of the male reproductive system in humans.

The boxes on the right state the functions of some of these parts.

Draw **one** straight line from each part to its function.

part	function
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 20px;">prostate gland</div> <div style="border: 1px solid black; padding: 5px; width: fit-content;">scrotum</div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 20px;">carries urine and semen out of the body</div> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-bottom: 20px;">sac that holds testes outside the body</div> <div style="border: 1px solid black; padding: 5px; width: fit-content;">secretes fluid for sperm to swim in</div>

[2]

- (b) Fertilisation takes place in the female reproductive system in humans.

- (i) The fertilised ovum divides to form a ball of cells.

State the name of this ball of cells.

..... [1]

- (ii) The ball of cells develops into a fetus inside the uterus.

State the name of the ring of muscle at the opening of the uterus.

..... [1]

(c) A scientist measures the growth of a human fetus.

Table 4.1 shows the measurements.

Table 4.1

age of fetus /weeks	length of fetus /mm	mass of fetus /g
8	15	1
16	116	100
24	300	600
32	424	1702
40	512	3404

(i) Use Table 4.1 to calculate the increase in length of the fetus between **week 16** and **week 24**.

length = mm [1]

(ii) Identify when the **mass** of the fetus doubles.

Place one tick (✓) in the correct box.

week 8 to week 16	
week 16 to week 24	
week 24 to week 32	
week 32 to week 40	

[1]

(iii) Define the term growth.

.....
 [1]

(d) The developing fetus absorbs oxygen from the mother’s blood for aerobic respiration.

Complete the word equation for aerobic respiration.

..... + oxygen → + [2]

[Total: 9]

5 Copper is a transition element.

(a) State **two** properties of transition elements that are **not** properties of Group I metals.

- 1
- 2 [2]

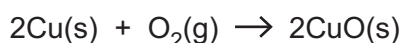
(b) Copper is extracted from copper oxide by heating with carbon.

Identify the greenhouse gas formed in this process.

..... [1]

(c) Copper is slowly oxidised by oxygen when it is left in air.

The reaction equation is shown.



(i) State the meaning of the term oxidised.

.....

..... [1]

(ii) Suggest **one** change that increases the rate of this reaction.

..... [1]

(d) (i) State the percentage of oxygen in clean air.

..... % [1]

(ii) Suggest the percentage of argon in clean air.

..... % [1]

(iii) State why argon does **not** react with copper.

.....

..... [1]

[Total: 8]

- 6 Fig. 6.1 shows a house in the Himalayas. The roof of the house is covered in snow. As the Sun shines on the roof, the snow begins to melt. Drops of water fall from the roof.

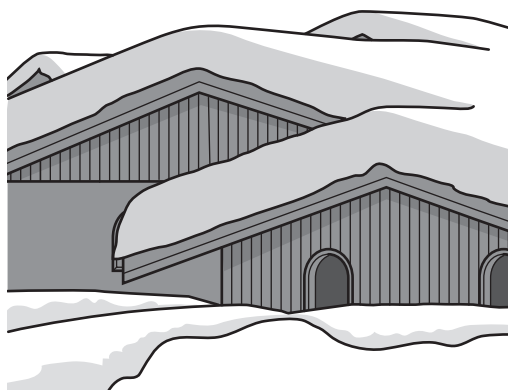


Fig. 6.1

- (a) State the temperature at which the snow melts.

temperature = °C [1]

- (b) Electromagnetic radiation from the Sun transfers thermal energy which warms the snow.

Fig. 6.2 shows part of the electromagnetic spectrum.

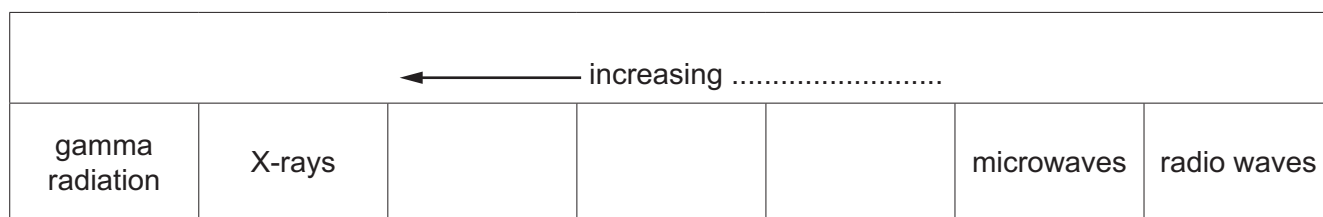


Fig. 6.2

- (i) Complete Fig. 6.2 to state the property of electromagnetic radiation that increases in the direction of the arrow. [1]
- (ii) Write in the correct space in Fig. 6.2 the name of the type of radiation that transfers thermal energy and warms the snow. [1]

- (c) There is ice on a lake near the house.

Fig. 6.3 shows a ray of light from the Sun incident on the ice.

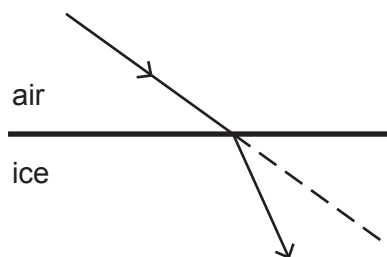


Fig. 6.3

State the term used to describe the change in direction of light as it enters the ice.

..... [1]

- (d) Fig. 6.4 shows waves on the surface of the lake when there is no ice on it.



Fig. 6.4

- (i) On Fig. 6.4, use a double-headed arrow (\leftrightarrow or \updownarrow) to show one wavelength. [1]

- (ii) A student counts 40 waves moving past her in 25 s.

Calculate the frequency of the waves. Include the unit.

frequency = unit = [3]

[Total: 8]

- 7 (a) Fig. 7.1 is a diagram of two guard cells surrounding an open stoma from a plant leaf.

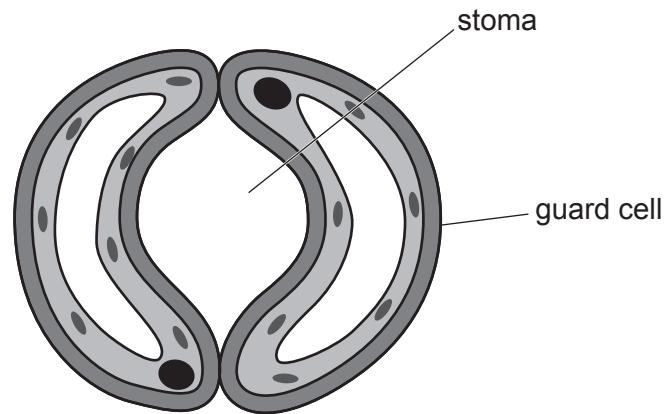


Fig. 7.1

- (i) Draw a label line and the letter **C** to identify **one** chloroplast in Fig. 7.1. [1]
- (ii) Complete these sentences about guard cells and photosynthesis.

Choose words from the list.

Each word or phrase may be used once, more than once or not at all.

carbon dioxide

epidermis

evaporation

mesophyll

nitrogen

osmosis

oxygen

palisade

transpiration

Guard cells are found in the lower of the leaf.

The stomata are pores that allow the gas needed for photosynthesis to enter.

This gas is called

Water vapour diffuses out of the stomata during the process of

[3]

(b) Fig. 7.2 shows a food chain from a forest.

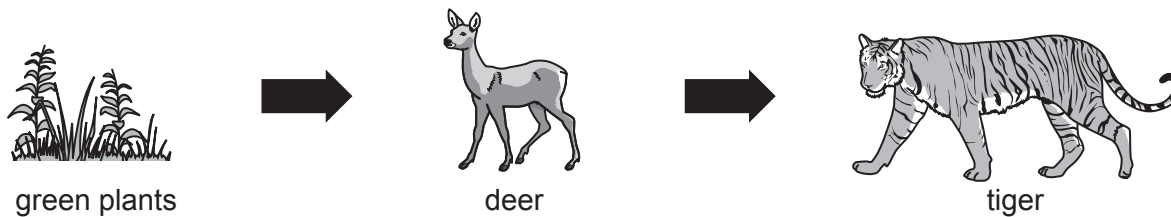


Fig. 7.2

(i) Place ticks (✓) in **all** the boxes that describe the tiger.

carnivore	
herbivore	
primary consumer	
secondary consumer	
tertiary consumer	

[2]

(ii) State the name of the type of organism that gets its energy from waste organic matter.

..... [1]

(c) Deforestation has undesirable effects on the animals in a food chain.

Suggest **two** undesirable effects on the **animals**.

1

2

[2]

[Total: 9]

8 Methane, CH_4 , and ethene, C_2H_4 , are hydrocarbons.

(a) Methane is the main constituent of one fossil fuel.

(i) State the name of this fossil fuel.

..... [1]

(ii) State the type of chemical bonding in methane.

..... [1]

(iii) Complete Fig. 8.1 to show the dot-and-cross diagram of a molecule of methane.

Show only the outer shell electrons.

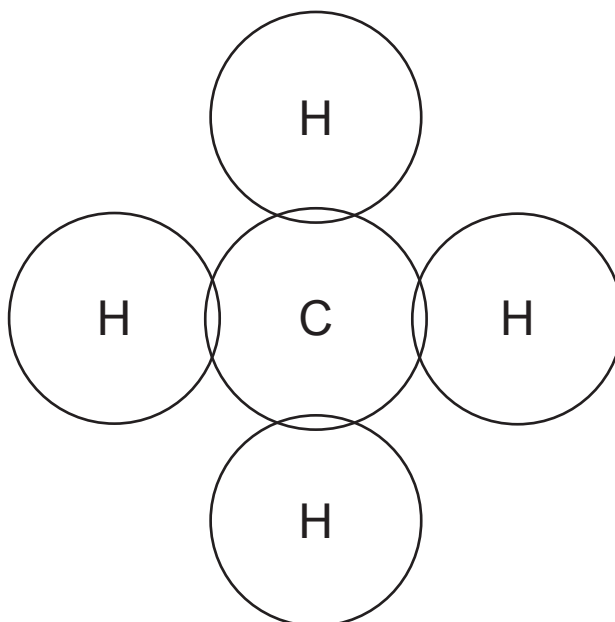


Fig. 8.1

[1]

(iv) State the **two** products of the complete combustion of methane.

1

2

[2]

(b) Ethene is an unsaturated hydrocarbon.

(i) State what is meant by the terms unsaturated and hydrocarbon.

unsaturated

.....

hydrocarbon

.....

[2]

(ii) State the process that produces ethene and other unsaturated hydrocarbon molecules from alkanes.

..... [1]

(c) Hydrocarbon **W** turns aqueous bromine colourless.

State whether hydrocarbon **W** is saturated or unsaturated.

Give a reason for your answer.

hydrocarbon **W**

reason

.....

[1]

[Total: 9]

9 Fig. 9.1 shows an electrical circuit.

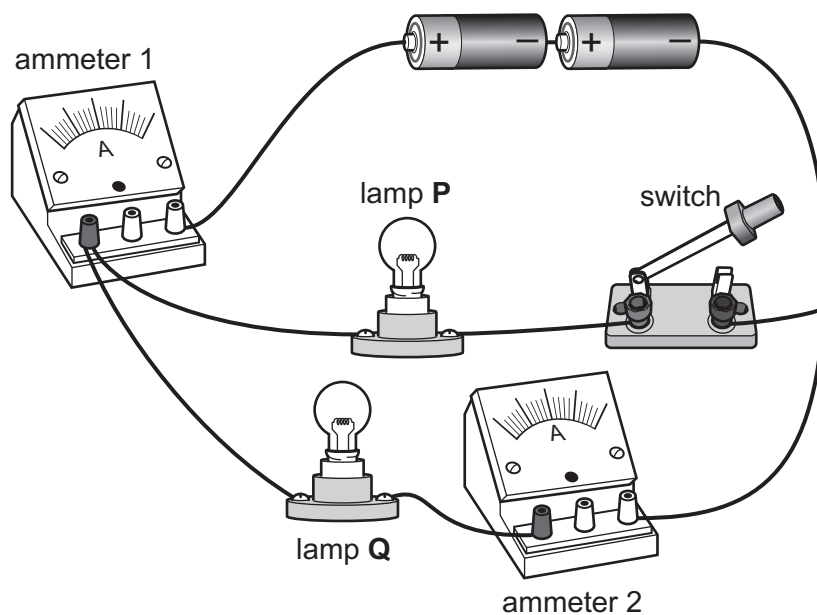


Fig. 9.1

The two lamps **P** and **Q** are identical. When the switch shown in Fig. 9.1 is closed, both lamps **P** and **Q** are equally bright.

(a) State the type of circuit arrangement of the two lamps in this circuit.

..... [1]

(b) When the switch shown in Fig. 9.1 is open, lamp **P** does **not** light up.

State whether lamp **Q** lights up or not.

Ammeter 1 shows a current of 0.6A.

State the reading on ammeter 2. A
[1]

(c) A variable resistor is used to control the current in a circuit.

On Fig. 9.1, mark with an **R** a point where the variable resistor is included in the circuit to control the current through both lamps **P** and **Q**. [1]

(d) The resistance of a different lamp is $8.0\ \Omega$.

A voltage of 3.0V is applied across the lamp.

Calculate the current in this lamp.

current =A [2]

(e) Fig. 9.2 shows part of the circuit diagram for the circuit shown in Fig. 9.1.

On Fig. 9.2, use standard symbols to complete the circuit diagram.

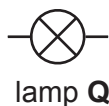
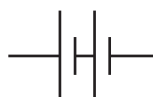


Fig. 9.2

[3]

[Total: 8]

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The Periodic Table of Elements

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11 Na sodium 23	12 Mg magnesium 24																	1 H hydrogen 1	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84	37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	58 Hf hafnium 178	59 Ta tantalum 181	60 W tungsten 184	61 Re rhenium 186	62 Os osmium 190	63 Ir iridium 192	64 Pt platinum 195	65 Au gold 197	66 Hg mercury 201	67 Tl thallium 204	68 Pb lead 207	69 Bi bismuth 209	70 Po polonium —	71 At astatine —	72 Rn radon —	73 Fr francium —	74 Ra radium —	75–103 actinoids	76 Rf rutherfordium —	77 Db dubnium —	78 Sg seaborgium —	79 Bh bohrium —	80 Hs hassium —	81 Mt meitnerium —	82 Ds darmstadtium —	83 Rg roentgenium —	84 Cn copernicium —	85 Fl flerovium —	86 Lv livermorium —	87 Uu ununseptium —	88 Uub ununbium —	89 Uut ununtrium —	90 Uuq ununquadium —	91 Uuq ununquadium —	92 Uub ununbium —	93 Uut ununtrium —	94 Uuq ununquadium —	95 Uub ununbium —	96 Uut ununtrium —	97 Uuq ununquadium —	98 Uub ununbium —	99 Uut ununtrium —	100 Uuq ununquadium —	101 Uub ununbium —	102 Uut ununtrium —	103 Uuq ununquadium —	104 Uub ununbium —	105 Uut ununtrium —	106 Uuq ununquadium —	107 Uub ununbium —	108 Uut ununtrium —	109 Uuq ununquadium —	110 Uub ununbium —	111 Uut ununtrium —	112 Uuq ununquadium —	113 Uub ununbium —	114 Uut ununtrium —	115 Uuq ununquadium —	116 Uub ununbium —	117 Uut ununtrium —	118 Uuq ununquadium —	119 Uub ununbium —	120 Uut ununtrium —	121 Uuq ununquadium —	122 Uub ununbium —	123 Uut ununtrium —	124 Uuq ununquadium —	125 Uub ununbium —	126 Uut ununtrium —	127 Uuq ununquadium —	128 Uub ununbium —	129 Uut ununtrium —	130 Uuq ununquadium —	131 Uub ununbium —	132 Uut ununtrium —	133 Uuq ununquadium —	134 Uub ununbium —	135 Uut ununtrium —	136 Uuq ununquadium —	137 Uub ununbium —	138 Uut ununtrium —	139 Uuq ununquadium —	140 Uub ununbium —	141 Uut ununtrium —	142 Uuq ununquadium —	143 Uub ununbium —	144 Uut ununtrium —	145 Uuq ununquadium —	146 Uub ununbium —	147 Uut ununtrium —	148 Uuq ununquadium —	149 Uub ununbium —	150 Uut ununtrium —	151 Uuq ununquadium —	152 Uub ununbium —	153 Uut ununtrium —	154 Uuq ununquadium —	155 Uub ununbium —	156 Uut ununtrium —	157 Uuq ununquadium —	158 Uub ununbium —	159 Uut ununtrium —	160 Uuq ununquadium —	161 Uub ununbium —	162 Uut ununtrium —	163 Uuq ununquadium —	164 Uub ununbium —	165 Uut ununtrium —	166 Uuq ununquadium —	167 Uub ununbium —	168 Uut ununtrium —	169 Uuq ununquadium —	170 Uub ununbium —	171 Uut ununtrium —	172 Uuq ununquadium —	173 Uub ununbium —	174 Uut ununtrium —	175 Uuq ununquadium —	176 Uub ununbium —	177 Uut ununtrium —	178 Uuq ununquadium —	179 Uub ununbium —	180 Uut ununtrium —	181 Uuq ununquadium —	182 Uub ununbium —	183 Uut ununtrium —	184 Uuq ununquadium —	185 Uub ununbium —	186 Uut ununtrium —	187 Uuq ununquadium —	188 Uub ununbium —	189 Uut ununtrium —	190 Uuq ununquadium —	191 Uub ununbium —	192 Uut ununtrium —	193 Uuq ununquadium —	194 Uub ununbium —	195 Uut ununtrium —	196 Uuq ununquadium —	197 Uub ununbium —	198 Uut ununtrium —	199 Uuq ununquadium —	200 Uub ununbium —	201 Uut ununtrium —	202 Uuq ununquadium —	203 Uub ununbium —	204 Uut ununtrium —	205 Uuq ununquadium —	206 Uub ununbium —	207 Uut ununtrium —	208 Uuq ununquadium —	209 Uub ununbium —	210 Uut ununtrium —	211 Uuq ununquadium —	212 Uub ununbium —	213 Uut ununtrium —	214 Uuq ununquadium —	215 Uub ununbium —	216 Uut ununtrium —	217 Uuq ununquadium —	218 Uub ununbium —	219 Uut ununtrium —	220 Uuq ununquadium —	221 Uub ununbium —	222 Uut ununtrium —	223 Uuq ununquadium —	224 Uub ununbium —	225 Uut ununtrium —	226 Uuq ununquadium —	227 Uub ununbium —	228 Uut ununtrium —	229 Uuq ununquadium —	230 Uub ununbium —	231 Uut ununtrium —	232 Uuq ununquadium —	233 Uub ununbium —	234 Uut ununtrium —	235 Uuq ununquadium —	236 Uub ununbium —	237 Uut ununtrium —	238 Uuq ununquadium —	239 Uub ununbium —	240 Uut ununtrium —	241 Uuq ununquadium —	242 Uub ununbium —	243 Uut ununtrium —	244 Uuq ununquadium —	245 Uub ununbium —	246 Uut ununtrium —	247 Uuq ununquadium —	248 Uub ununbium —	249 Uut ununtrium —	250 Uuq ununquadium —	251 Uub ununbium —	252 Uut ununtrium —	253 Uuq ununquadium —	254 Uub ununbium —	255 Uut ununtrium —	256 Uuq ununquadium —	257 Uub ununbium —	258 Uut ununtrium —	259 Uuq ununquadium —	260 Uub ununbium —	261 Uut ununtrium —	262 Uuq ununquadium —	263 Uub ununbium —	264 Uut ununtrium —	265 Uuq ununquadium —	266 Uub ununbium —	267 Uut ununtrium —	268 Uuq ununquadium —	269 Uub ununbium —	270 Uut ununtrium —	271 Uuq ununquadium —	272 Uub ununbium —	273 Uut ununtrium —	274 Uuq ununquadium —	275 Uub ununbium —	276 Uut ununtrium —	277 Uuq ununquadium —	278 Uub ununbium —	279 Uut ununtrium —	280 Uuq ununquadium —	281 Uub ununbium —	282 Uut ununtrium —	283 Uuq ununquadium —	284 Uub ununbium —	285 Uut ununtrium —	286 Uuq ununquadium —	287 Uub ununbium —	288 Uut ununtrium —	289 Uuq ununquadium —	290 Uub ununbium —	291 Uut ununtrium —	292 Uuq ununquadium —	293 Uub ununbium —	294 Uut ununtrium —	295 Uuq ununquadium —	296 Uub ununbium —	297 Uut ununtrium —	298 Uuq ununquadium —	299 Uub ununbium —	300 Uut ununtrium —	301 Uuq ununquadium —	302 Uub ununbium —	303 Uut ununtrium —	304 Uuq ununquadium —	305 Uub ununbium —	306 Uut ununtrium —	307 Uuq ununquadium —	308 Uub ununbium —	309 Uut ununtrium —	310 Uuq ununquadium —	311 Uub ununbium —	312 Uut ununtrium —	313 Uuq ununquadium —	314 Uub ununbium —	315 Uut ununtrium —	316 Uuq ununquadium —	317 Uub ununbium —	318 Uut ununtrium —	319 Uuq ununquadium —	320 Uub ununbium —	321 Uut ununtrium —	322 Uuq ununquadium —	323 Uub ununbium —	324 Uut ununtrium —	325 Uuq ununquadium —	326 Uub ununbium —	327 Uut ununtrium —	328 Uuq ununquadium —	329 Uub ununbium —	330 Uut ununtrium —	331 Uuq ununquadium —	332 Uub ununbium —	333 Uut ununtrium —	334 Uuq ununquadium —	335 Uub ununbium —	336 Uut ununtrium —	337 Uuq ununquadium —	338 Uub ununbium —	339 Uut ununtrium —	340 Uuq ununquadium —	341 Uub ununbium —	342 Uut ununtrium —	343 Uuq ununquadium —	344 Uub ununbium —	345 Uut ununtrium —	346 Uuq ununquadium —	347 Uub ununbium —	348 Uut ununtrium —	349 Uuq ununquadium —	350 Uub ununbium —	351 Uut ununtrium —	352 Uuq ununquadium —	353 Uub ununbium —	354 Uut ununtrium —	355 Uuq ununquadium —	356 Uub ununbium —	357 Uut ununtrium —	358 Uuq ununquadium —	359 Uub ununbium —	360 Uut ununtrium —	361 Uuq ununquadium —	362 Uub ununbium —	363 Uut ununtrium —	364 Uuq ununquadium —	365 Uub ununbium —	366 Uut ununtrium —	367 Uuq ununquadium —	368 Uub ununbium —	369 Uut ununtrium —	370 Uuq ununquadium —	371 Uub ununbium —	372 Uut ununtrium —	373 Uuq ununquadium —	374 Uub ununbium —	375 Uut ununtrium —	376 Uuq ununquadium —	377 Uub ununbium —	378 Uut ununtrium —	379 Uuq ununquadium —	380 Uub ununbium —	381 Uut ununtrium —	382 Uuq ununquadium —	383 Uub ununbium —	384 Uut ununtrium —	385 Uuq ununquadium —	386 Uub ununbium —	387 Uut ununtrium —	388 Uuq ununquadium —	389 Uub ununbium —	390 Uut ununtrium —	391 Uuq ununquadium —	392 Uub ununbium —	393 Uut ununtrium —	394 Uuq ununquadium —	395 Uub ununbium —	396 Uut ununtrium —	397 Uuq ununquadium —	398 Uub ununbium —	399 Uut ununtrium —	400 Uuq ununquadium —	401 Uub ununbium —	402 Uut ununtrium —	403 Uuq ununquadium —	404 Uub ununbium —	405 Uut ununtrium —	406 Uuq ununquadium —	407 Uub ununbium —	408 Uut ununtrium —	409 Uuq ununquadium —	410 Uub ununbium —	411 Uut ununtrium —	412 Uuq ununquadium —	413 Uub ununbium —	414 Uut ununtrium —	415 Uuq ununquadium —	416 Uub ununbium —	417 Uut ununtrium —	418 Uuq ununquadium —	419 Uub ununbium —	420 Uut ununtrium —	421 Uuq ununquadium —	422 Uub ununbium —	423 Uut ununtrium —	424 Uuq ununquadium —	425 Uub ununbium —	426 Uut ununtrium —	427 Uuq ununquadium —	428 Uub ununbium —	429 Uut ununtrium —	430 Uuq ununquadium —	431 Uub ununbium —	432 Uut ununtrium —	433 Uuq ununquadium —	434 Uub ununbium —	435 Uut ununtrium —	436 Uuq ununquadium —	437 Uub ununbium —	438 Uut ununtrium —	439 Uuq ununquadium —	440 Uub ununbium —	441 Uut ununtrium —	442 Uuq ununquadium —	443 Uub ununbium —	444 Uut ununtrium —	445 Uuq ununquadium —	446 Uub ununbium —	447 Uut ununtrium —	448 Uuq ununquadium —	449 Uub ununbium —	450 Uut ununtrium —	451 Uuq ununquadium —	452 Uub ununbium —	453 Uut ununtrium —