basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 11

TECHNICAL SCIENCES: PAPER 2

EXEMPLAR 2017

MARKS: 150

TIME: 3 hours

This question paper consists of 12 pages and two data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.

2. Start EACH question on a NEW page in the ANSWER BOOK.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

5. You may use a non-programmable calculator.

6. You are advised to use the attached DATA SHEETS.

7. Round off your final numerical answers to a minimum of TWO decimal places.

8. Give brief motivations, discussions et cetera where required.

9. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Write down the question number (1.1–1.10), choose the answer and make a cross (X) over the letter (A–D) of your choice in the ANSWER BOOK.

EXAMPLE:				
1.11	**A**	**B**	**C**	~~**D**~~

1.1 A single disturbance that travels through a medium is …

A period.

B wavelength.

C pulse.

D wave. (2)

1.2 Which ONE of the following statements about a transverse wave is CORRECT?

A The particles of the medium vibrate parallel to the direction of propagation of the pulse.

B The particles of the medium vibrate opposite the direction of propagation of the pulse.

C The particles of the medium vibrate in the same direction of propagation of the pulse.

D The particles of the medium vibrate at a right angle to the direction of propagation of the pulse. (2)

1.3 What is the S.I unit of frequency?

A Joule

B Meter per second

C Hertz

D Meter (2)

1.4 The time taken to complete one wave is known as the …

A period.

B frequency.

C wavelength.

D time interval. (2)

1.5 Which ONE of the following is within the audible range of a human being?

A Between 20 Hz and 20 000 Hz

B Between 2 Hz and 20 Hz

C Between 20 000 Hz and 200 000 Hz

D Between 0 Hz and 2 Hz (2)

1.6 A transverse wave with wavelength λ is generated in a rope by shaking one end of the rope. Then the rope is shaken at twice the rate. How will the new wavelength compare with the original wavelength?

A 2λ

B λ

C 4λ

D $\frac{1}{2}\lambda$ (2)

1.7 The amount of heat required to increase the temperature of 1 kg of a substance by 1 ^{o}C is called …

A heat capacity.

B specific heat capacity.

C a thermodynamic system.

D heat energy. (2)

1.8 Which ONE of the following combinations contains thermodynamic variables?

A Heat, energy and work

B Heat, internal energy and external energy

C Kinetic energy, temperature and pressure

D Temperature, pressure and volume (2)

1.9 An oxidising agent is a substance that undergoes …

A oxidation and loses electrons in the process.

B oxidation and gains electrons in the process.

C reduction and loses electrons in the process.

D reduction and gains electrons in the process. (2)

1.10 In which ONE of the following reactions is Cu oxidised?

A $Fe + Cu(NO_3)_2 \rightarrow Fe(NO_3)_2 + Cu$

B $2Ag + CuC\ell_2 \rightarrow 2AgC\ell + Cu$

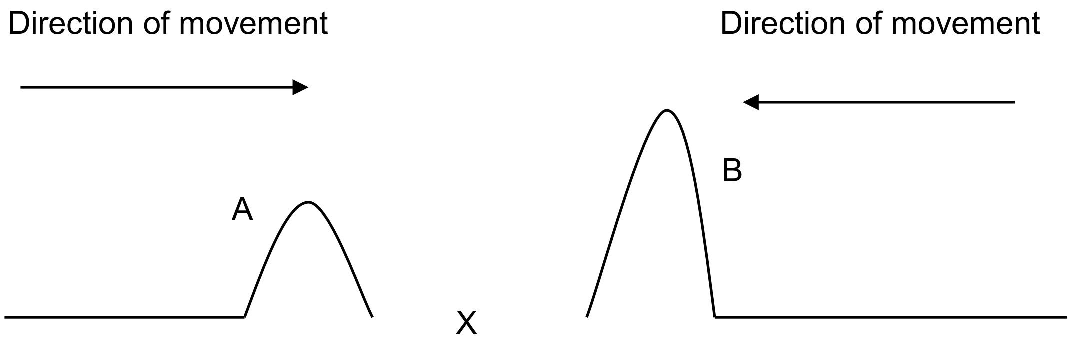
C $2Cu + O_2 \rightarrow 2CuO$

D $Cu(NO_3)_2 + 2NaC\ell \rightarrow CuC\ell_2 + 2NaNO_3$ (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 The diagram below represents two pulses, A and B, with an amplitude of 5 cm and 8 cm respectively, approaching each other.



2.1.1 Define the term *pulse*. (2)

2.1.2 Draw a labelled diagram of the resulting pulse at point X when the two pulses meet. (2)

2.1.3 NAME and DEFINE the phenomenon that occurs at point X. (3)

2.1.4 Indicate whether the two pulses will meet in phase or out of phase. Explain your answer. (3)

2.2 Consider a scenario in which the SAME two pulses A and B meet at point X, but pulse B is moving on the OPPOSITE SIDE of the REST POSITION.

2.2.1 Define the term *amplitude*. (2)

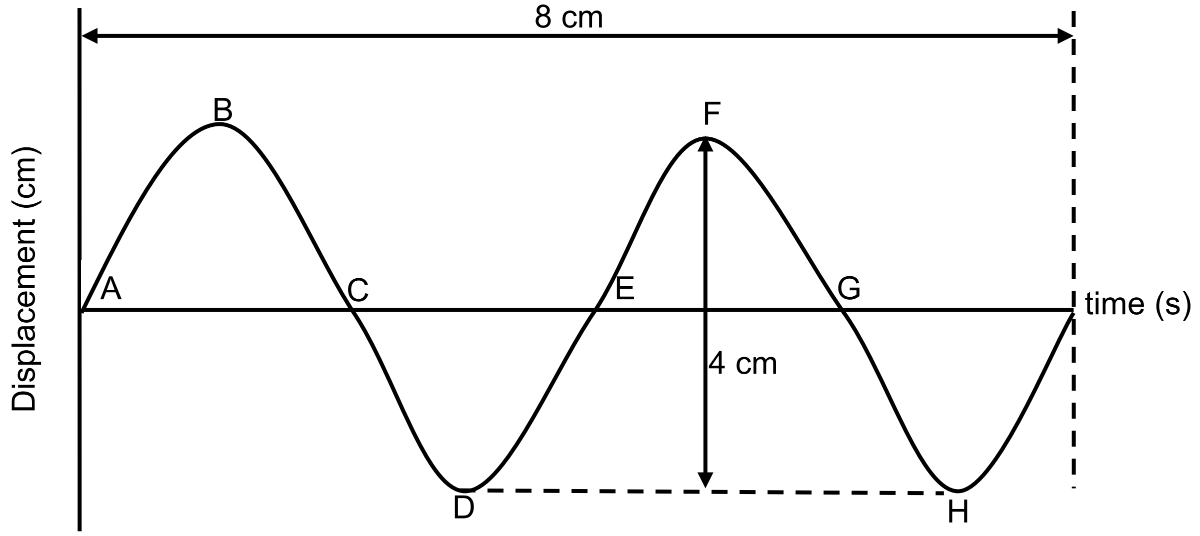
2.2.2 Write down the magnitude of the resulting AMPLITUDE of the two pulses. (2)

2.2.3 In which direction will pulse B be moving after passing point X? Write down only TO THE LEFT or TO THE RIGHT. (2)

2.2.4 Describe pulse A after passing pulse B with reference to the amplitude and direction. (4)
[20]

QUESTION 3 (Start on a new page.)

The graph below shows the displacement of particles of a wave versus time. The time taken to complete one wave is 0,2 s.



3.1 How many complete waves are represented in the diagram above? (1)

3.2 Write down any TWO points that are in phase. (2)

3.3 Write down any TWO points that are out of phase. (2)

3.4 How long will it take to complete SIX full waves? (2)

3.5 Name the following:

3.5.1 Point B and point D (2)

3.5.2 The line represented by the following points: A, C, E and G (1)

3.6 Determine the following :

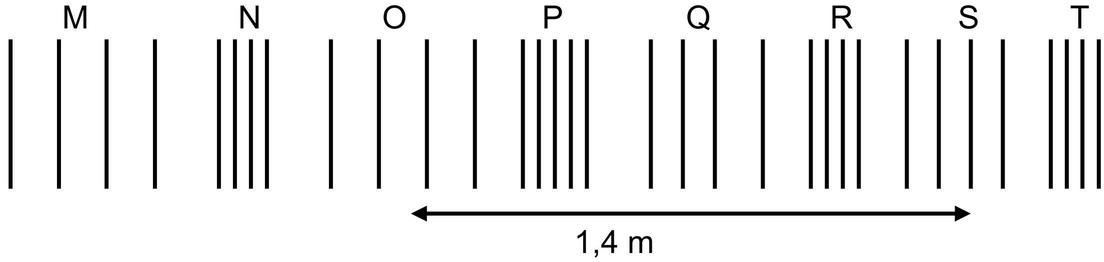
3.6.1 Amplitude (2)

3.6.2 Wavelength (2)

3.7 Calculate the speed of this wave. (5)
[19]

QUESTION 4 (Start on a new page.)

4.1 The diagram below shows the pattern obtained for a sound wave.



4.1.1 Is sound a longitudinal or transverse wave? (1)

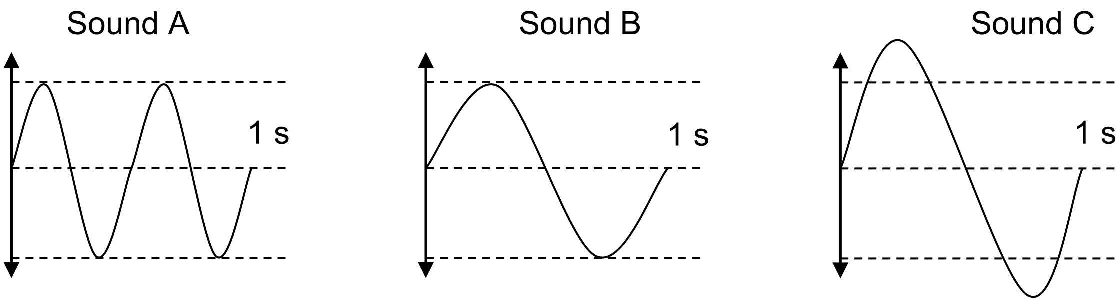
4.1.2 Draw the corresponding position versus time graph of the wave shown above. Indicate ALL the corresponding points M to T on the graph. (4)

4.2 A stationery bat emits a squeak (sound). It takes 0,019 s for the echo to return to the bat. (Take the speed of sound in the air as 340 $m{\cdot}s^{-1}$.)

4.2.1 Define an *echo*. (2)

4.2.2 Calculate how far the bat is from the object that reflected the sound waves. (4)

4.3 Anything that generates a disturbance in the air creates a pulse that travels away from the place where it is created. If this pulse enters your ear, it may cause your eardrum to vibrate, which is how one hears. Consider the three diagrams below that illustrate different sound waves on an oscilloscope.



4.3.1 Define *pitch*. (2)

4.3.2 Which ONE (A, B or C) is the loudest sound? Explain. (3)

4.3.3 Which ONE (A, B or C) has the highest pitch? Explain. (3)

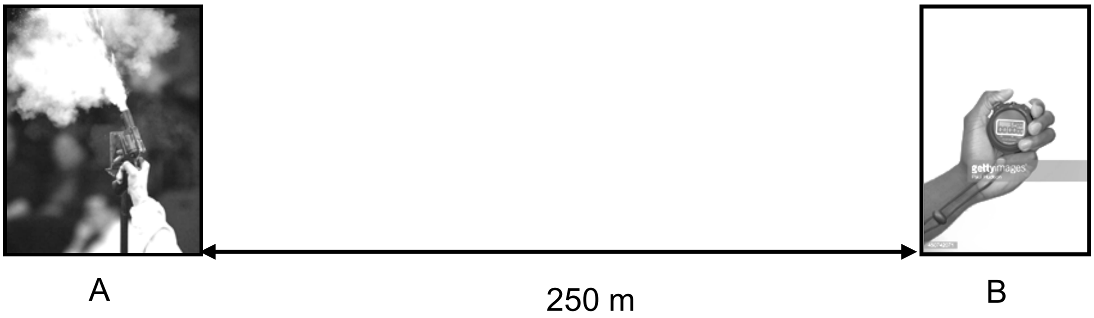
4.4 Write down the following:

4.4.1 THREE uses of ultrasound (3)

4.4.2 TWO uses of infrasound (2)
[24]

QUESTION 5 (Start on a new page.)

The picture below shows learners conducting an experiment to determine the speed of sound in air. Learner A fired the shot with the starter's pistol. Learner B started the stopwatch the instant he saw the smoke and stopped the stopwatch the instant he heard the sound of the shot. The experiment was repeated three times by the same learners. The average time recorded was 0,75 s.



5.1 Write down TWO safety precautions for this experiment. (2)

5.2 Why should the same learner have the same role when repeating the experiment? (1)

5.3 Use the information above to calculate the speed of sound in air. (3)

5.4 If the distance between the learners is doubled, will this affect the answer in QUESTION 5.3 above? Write only YES or NO. Explain your answer. (3)
[9]

QUESTION 6 (Start on a new page.)

6.1 Thermodynamics deals with processes that involve heat, work and energy.

6.1.1 Define a *working substance*. (2)

6.1.2 Give TWO examples of working substances. (2)

6.2 State a law of conservation of heat. (2)

6.3 450 kJ of heat energy is supplied to certain machine. 275 kJ of this energy is converted mechanical work. Calculate the change in internal energy of this machine. (3)
[9]

QUESTION 7 (Start on a new page.)

7.1 Distinguish between a *closed system* and an *isolated system*. (4)

7.2 Which ONE, water or ethyl alcohol (ethanol), can be used as an excellent coolant? Explain your answer by referring to the specific heat capacities of the two substances. (3)

7.3 150 g of water at 75 °C is added to a certain unknown mass of water at 10°C. If the final temperature of the mixture is 27 °C, calculate the unknown mass of water. (4)

7.4 Learners followed the following steps in an experiment to determine the heat capacity of copper:

Step 1: They heated a 65 g piece of copper to a temperature of 100 °C by immersing it in 500 mℓ water and heating the water until it boiled at 100 °C (Figure 7.1).
Step 2: They then transferred a copper mass piece into 125 mℓ of water at 23 °C in polystyrene cups (stacked together as shown in Figure 7.2).
Step 3: They measured the temperature of the water until it stabilised (become constant) at 26,63 °C and recorded this reading as the final temperature of the water and copper mass piece.

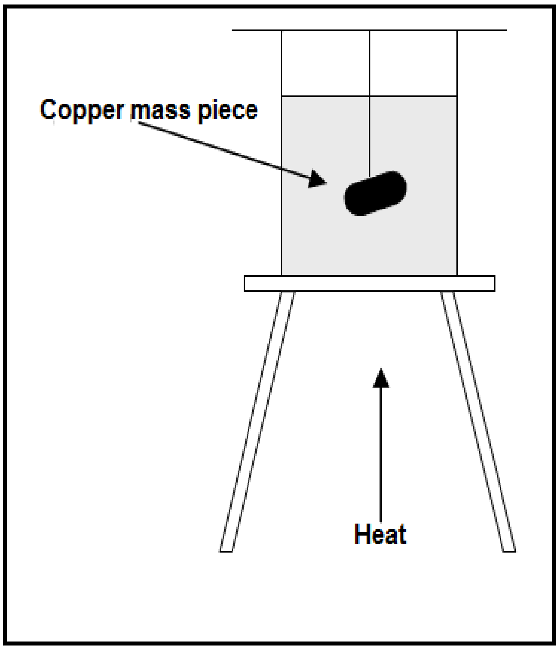


Figure 7.1

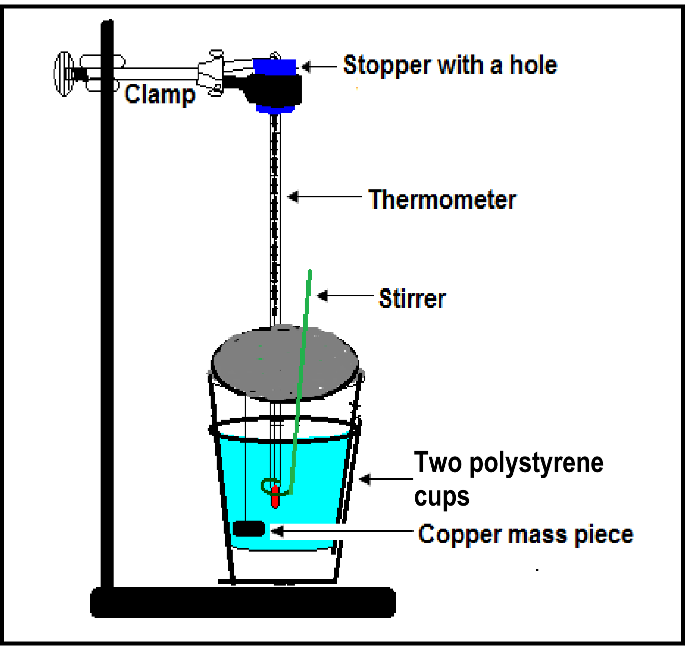


Figure 7.2

7.4.1 Write down TWO safety precautions that learners have to observe during this experiment. (2)

Assume that there was no heat loss to the surroundings, stirrer, thermometer, polystyrene cup lid and polystyrene cups. Calculate:

7.4.2 The amount of energy transferred from the copper mass piece to the water in the polystyrene cups (3)

7.4.3 The heat capacity of a copper mass piece . (3)
[19]

QUESTION 8 (Start on a new page.)

8.1 Differentiate between a *reducing agent* and an *oxidising agent*. (4)

8.2 Determine the oxidation numbers of each of the underlined elements. Write down every step to show how you arrived at the answer.

8.2.1 $\underline{Mn}O_2$ (2)

8.2.2 $K_2\underline{Cr}_2O_7$ (2)

8.2.3 $\underline{N}H_4^+$ (2)

Consider the following balanced chemical reaction:

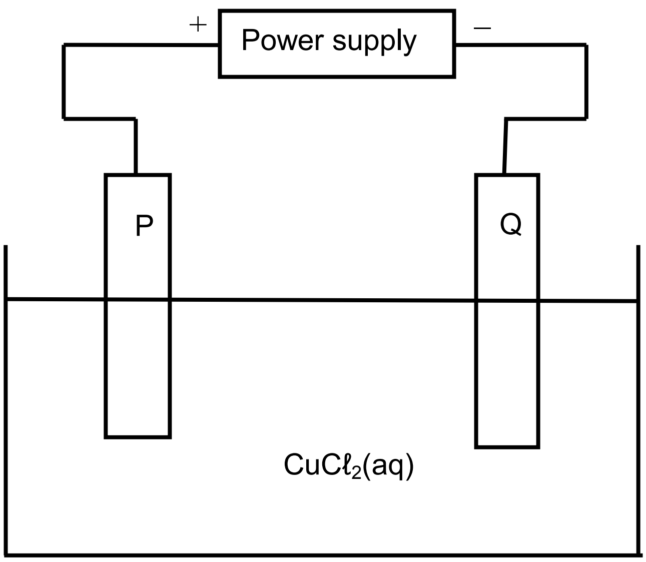
$2MgO \rightarrow 2Mg + O_2$

Identify the substance which is:

8.3.1 Oxidised (2)

8.3.2 Reduced (2)

8.4 The experimental set up below was used by a teacher to demonstrate the electrolysis of a copper chloride solution ($CuC\ell_2(aq)$).



8.4.1 Define the term *electrolysis*. (2)

8.4.2 Why is carbon preferred as electrodes? (2)

8.4.3 What observations will be made at electrodes P and Q? (4)

8.4.4 Which ONE, electrode P or Q, is the anode and which ONE, electrode P or Q, is the cathode? (2)

8.4.5 Write down the half-reaction that will take place at electrode Q. (2)

8.4.6 Write down the half-reaction that will take place at electrode P. (2)

8.4.7 State TWO uses of electrolysis in technology. (2)
[30]

TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 11
PAPER 2

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 11
VRAESTEL 2

TABLE 1: SPECIFIC HEAT CAPACITIES/*TABEL 1: SPESIFIEKE HITTEKAPASITEITE*

Name	Values ($J.kg^{-1}.K^{-1}$)
Water	4 200
Copper	400
Aluminium	900
Glass	700
Ethyl alcohol	2 460
Iron	460
Zinc	380
Lead	130
Ice	2 100
Brass	380
Mercury	140
Methylated spirits	2 400

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

HEAT AND THERMODYNAMICS/HITTE EN TERMODINAMIKA

$C = c\,m$	$Q = c\,m\,\Delta T$	$\Delta Q = \Delta U + \Delta W$

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$f = \frac{1}{T}$	$\Delta v = \frac{\Delta x}{\Delta t}$
$T = \frac{1}{f}$	$v = f\,\lambda$

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/*TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE*

KEY/*SLEUTEL*

Atomic number / ***Atoomgetal***	29
Electronegativity / ***Elektronegatiwiteit***	1,9
Symbol / ***Simbool***	Cu
Approximate relative atomic mass / ***Benaderde relatiewe atoommassa***	63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 **H** 1																	2 **He** 4
3 1,0 **Li** 7	4 1,5 **Be** 9											5 2,0 **B** 11	6 2,5 **C** 12	7 3,0 **N** 14	8 3,5 **O** 16	9 4,0 **F** 19	10 **Ne** 20
11 0,9 **Na** 23	12 1,2 **Mg** 24											13 1,5 **Aℓ** 27	14 1,8 **Si** 28	15 2,1 **P** 31	16 2,5 **S** 32	17 3,0 **Cℓ** 35,5	18 **Ar** 40
19 0,8 **K** 39	20 1,0 **Ca** 40	21 1,3 **Sc** 45	22 1,5 **Ti** 48	23 1,6 **V** 51	24 1,6 **Cr** 52	25 1,5 **Mn** 55	26 1,8 **Fe** 56	27 1,8 **Co** 59	28 1,8 **Ni** 59	29 1,9 **Cu** 63,5	30 1,6 **Zn** 65	31 1,6 **Ga** 70	32 1,8 **Ge** 73	33 2,0 **As** 75	34 2,4 **Se** 79	35 2,8 **Br** 80	36 **Kr** 84
37 0,8 **Rb** 86	38 1,0 **Sr** 88	39 1,2 **Y** 89	40 1,4 **Zr** 91	41 **Nb** 92	42 1,8 **Mo** 96	43 1,9 **Tc**	44 2,2 **Ru** 101	45 2,2 **Rh** 103	46 2,2 **Pd** 106	47 1,9 **Ag** 108	48 1,7 **Cd** 112	49 1,7 **In** 115	50 1,8 **Sn** 119	51 1,9 **Sb** 122	52 2,1 **Te** 128	53 2,5 **I** 127	54 **Xe** 131
55 0,7 **Cs** 133	56 0,9 **Ba** 137	57 **La** 139	72 1,6 **Hf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 1,8 **Tℓ** 204	82 1,8 **Pb** 207	83 1,9 **Bi** 209	84 2,0 **Po**	85 2,5 **At**	86 **Rn**
87 0,7 **Fr**	88 0,9 **Ra** 226	89 **Ac**															

58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm**	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173	71 **Lu** 175
90 **Th** 232	91 **Pa**	92 **U** 238	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**