N5

PROPERTIES OF MATTER

Practice Exam Questions

Physics
Section 1—Questions

DATA SHEET

Speed of light in materials

Material	*Speed* in m s^{-1}
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in J kg^{-1}
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
Water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in J kg^{-1}
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed* in m s^{-1}
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in J kg^{-1} °C^{-1}
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

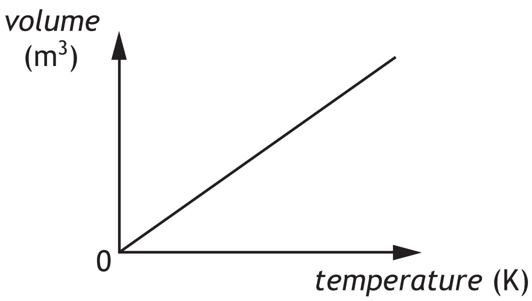
Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

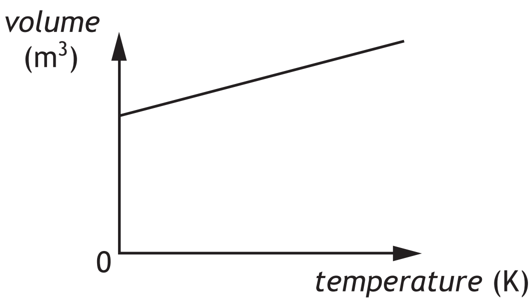
6. A student is investigating the relationship between the volume and the kelvin temperature of a fixed mass of gas at constant pressure.

Which graph shows this relationship?

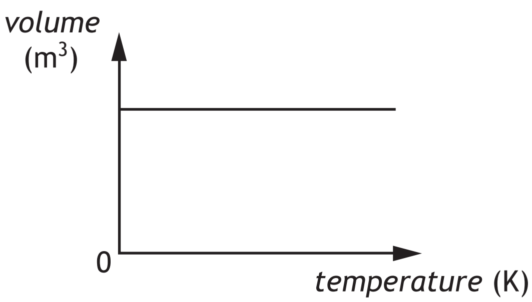
A



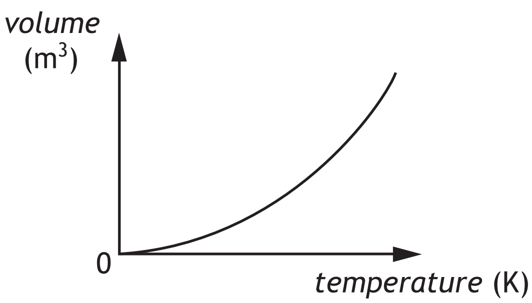
B



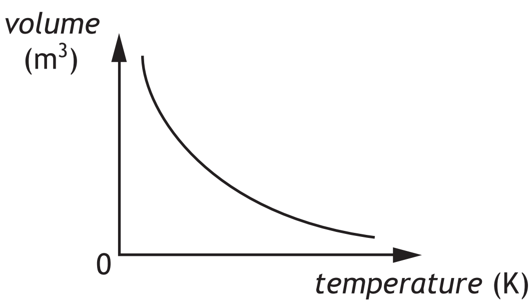
C



D



E



7. A liquid is heated from 17 °C to 50 °C. The temperature rise in kelvin is

A 33 K

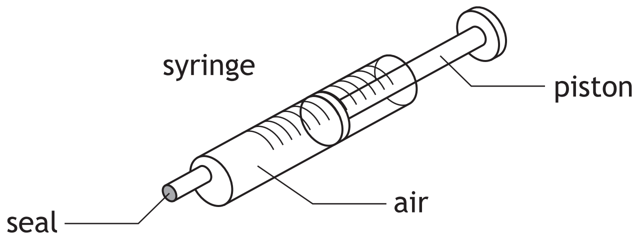
B 67 K

C 306 K

D 340 K

E 579 K.

5. A syringe containing air is sealed at one end as shown.



The piston is pushed in slowly.

There is no change in temperature of the air inside the syringe.

Which of the following statements describes and explains the change in pressure of the air in the syringe?

A The pressure increases because the air particles have more kinetic energy.

B The pressure increases because the air particles hit the sides of the syringe more frequently.

C The pressure increases because the air particles hit the sides of the syringe less frequently.

D The pressure decreases because the air particles hit the sides of the syringe with less force.

E The pressure decreases because the air particles have less kinetic energy.

6. The pressure of a fixed mass of gas is 150 kPa at a temperature of 27 °C.

The temperature of the gas is now increased to 47 °C.

The volume of the gas remains constant.

The pressure of the gas is now

A 86 kPa

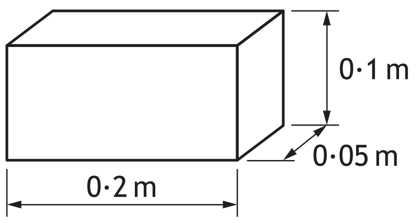
B 141 kPa

C 150 kPa

D 160 kPa

E 261 kPa.

5. A block has the dimensions shown.



The block is placed so that one of the surfaces is in contact with a smooth table top.

The weight of the block is 4·90 N.

The **minimum** pressure exerted by the block on the table top is

A 25 Pa

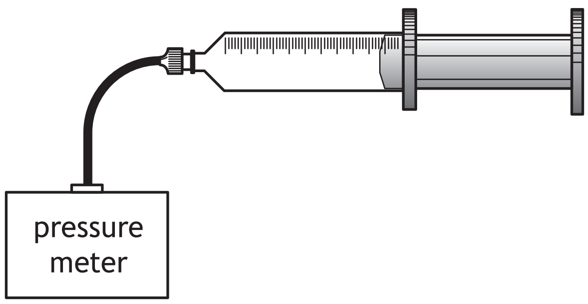
B 245 Pa

C 490 Pa

D 980 Pa

E 4900 Pa.

6. A syringe is connected to a pressure meter as shown.



The syringe contains a fixed mass of air of volume 150 mm^3.

The reading on the pressure meter is 120 kPa.

The volume of air inside the syringe is now changed to 100 mm^3.

The temperature of the air in the syringe remains constant.

The reading on the pressure meter is now

A 80 kPa

B 125 kPa

C 180 kPa

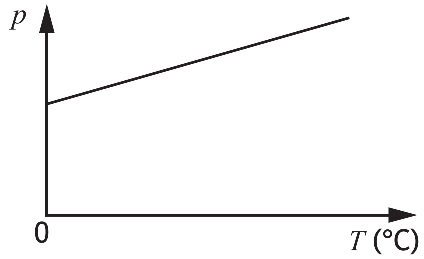
D 80 000 kPa

E 180 000 kPa.

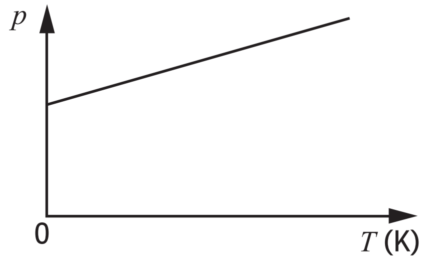
7. A sample of an ideal gas is enclosed in a sealed container.

Which graph shows how the pressure p of the gas varies with the temperature T of the gas?

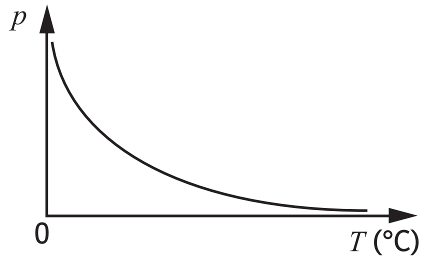
A



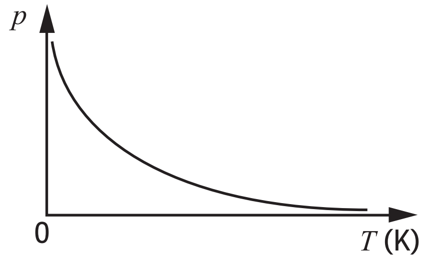
B



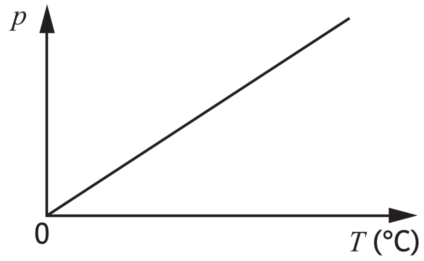
C



D

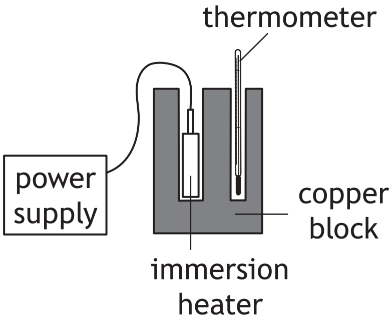


E

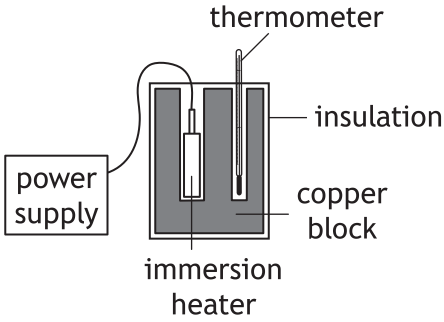


5. Five students each carry out an experiment to determine the specific heat capacity of copper. The setup used by each student is shown.

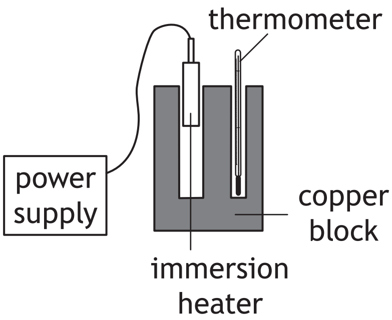
Student 1



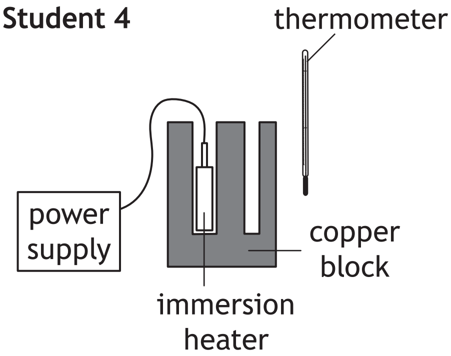
Student 2



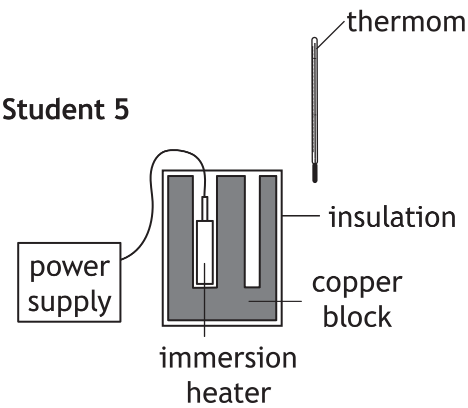
Student 3



Student 4



Student 5



The student with the setup that would allow the most accurate value for the specific heat capacity of copper to be determined is

A student 1

B student 2

C student 3

D student 4

E student 5.

6. The mass of a spacecraft is 1200 kg.

The spacecraft lands on the surface of a planet.

The gravitational field strength on the surface of the planet is $5{\cdot}0\,\text{N kg}^{-1}$.

The spacecraft rests on three pads. The total area of the three pads is $1{\cdot}5\,\text{m}^2$.

The pressure exerted by these pads on the surface of the planet is

A $1{\cdot}\ \times 10^4$ Pa

B $9{\cdot}\ \times 10^3$ Pa

C $7{\cdot}\ \times 10^3$ Pa

D $4{\cdot}\ \times 10^3$ Pa

E $8{\cdot}\ \times 10^2$ Pa.

7. A solid is heated from −15 °C to 60 °C. The temperature change of the solid is

A 45 K

B 75 K

C 258 K

D 318 K

E 348 K.

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PROPERTIES OF MATTER

Practice Questions

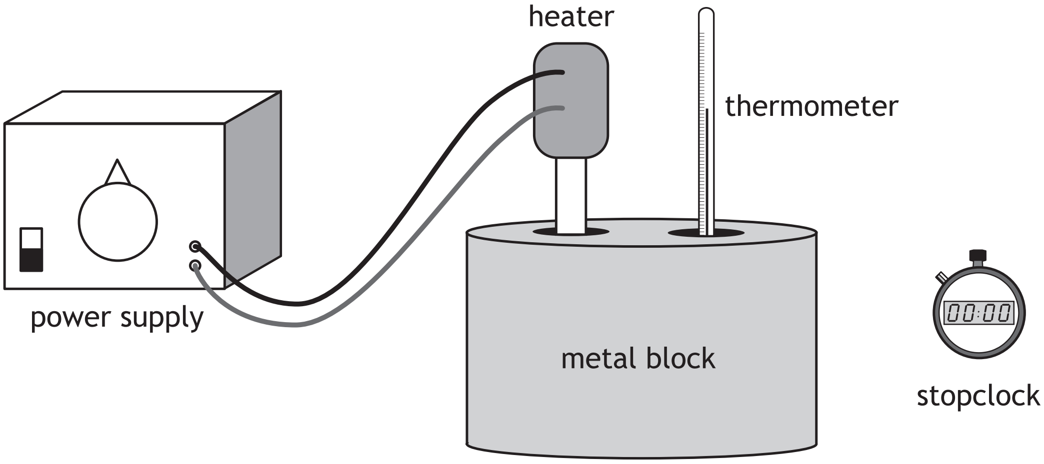
Physics
Section 2

MARKS DO NOT WRITE IN THIS MARGIN

3. A student is investigating the specific heat capacity of three metal blocks X, Y and Z.

Each block has a mass of 1·0 kg.

A heater and thermometer are inserted into a block as shown.



The heater has a power rating of 15 W.

The initial temperature of the block is measured.

The heater is switched on for 10 minutes and the final temperature of the block is recorded.

This procedure is repeated for the other two blocks.

The student's results are shown in the table.

Block	*Initial temperature* (°C)	*Final temperature* (°C)
X	15	25
Y	15	85
Z	15	34

(a) Show that the energy provided by the heater to each block is 9000 J. **2**

Space for working and answer

MARKS DO NOT WRITE IN THIS MARGIN

3. (continued)

(b) (i) By referring to the results in the table, identify the block that has the greatest specific heat capacity. **1**

(ii) Calculate the specific heat capacity of the block identified in (b)(i). **3**

Space for working and answer

(c) Due to energy losses, the specific heat capacities calculated in this investigation are different from the accepted values.

The student decides to improve the set up in order to obtain a value closer to the accepted value for each block.

(i) Suggest a possible improvement that would reduce energy losses. **1**

(ii) State the effect that this improvement would have on the final temperature. **1**

Total marks 8

MARKS DO NOT WRITE IN THIS MARGIN

4. A science technician removes two metal blocks from an oven. Immediately after the blocks are removed from the oven the technician measures the temperature of each block, using an infrared thermometer. The temperature of each block is 230 °C.

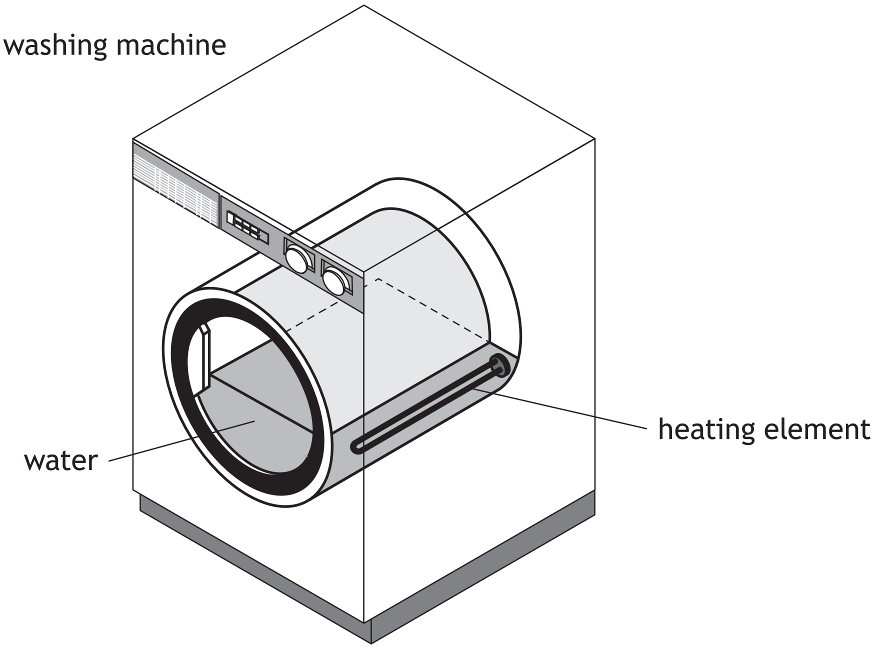
After several minutes the temperature of each block is measured again. One block is now at a temperature of 123 °C and the other block is at a temperature of 187 °C.

Using your knowledge of physics, comment on possible explanations for this difference in temperature. **3**

[Turn over

3. A washing machine fills with water at a temperature of 15·0 °C.

The water is heated by a heating element.



(a) The mass of the water in the washing machine is 6·00 kg.

Show that the minimum energy required to increase the temperature of the water from 15·0 °C to 40·0 °C is 627 000 J. **2**

Space for working and answer

3. (continued)

(b) The heating element has a power rating of 1800 W.

(i) Calculate the time taken for the heating element to supply the energy calculated in (a). **3**

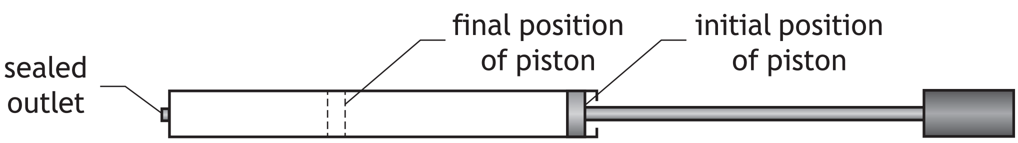
Space for working and answer

(ii) Explain why, in practice, it takes longer to heat the water from 15 °C to 40 °C than calculated in (b)(i). **1**

3. A bicycle pump with a sealed outlet contains $4 \cdot 0 \times 10^{-4}\,m^3$ of air.

The air inside the pump is at an initial pressure of $1 \cdot 0 \times 10^5$ Pa.

The piston of the pump is now pushed slowly inwards until the volume of air in the pump is $1 \cdot 6 \times 10^{-4}\,m^3$ as shown.



During this time the temperature of the air in the pump remains constant.

(a) Calculate the final pressure of the air inside the pump. **3**

Space for working and answer

(b) Using the kinetic model, explain what happens to the pressure of the air inside the pump as its volume decreases. **3**

MARKS DO NOT WRITE IN THIS MARGIN

3. (continued)

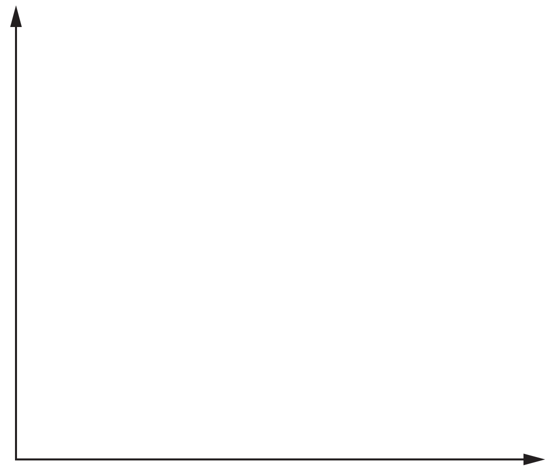
(c) The piston is now released, allowing it to move outwards towards its original position.

During this time the temperature of the air in the pump remains constant.

Using the axes provided, sketch a graph to show how the pressure of the air in the pump varies as its volume increases.

Numerical values are not required on either axis. **2**

(An additional diagram, if required, can be found on *Page 28*)



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Physics
Relationships Sheet

$E_p = mgh$

$E_k = \frac{1}{2}mv^2$

$Q = It$

$V = IR$

$R_T = R_1 + R_2 + \ldots$

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

$V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_s$

$\frac{V_1}{V_2} = \frac{R_1}{R_2}$

$P = \frac{E}{t}$

$P = IV$

$P = I^2R$

$P = \frac{V^2}{R}$

$E_h = cm\Delta T$

$p = \frac{F}{A}$

$\frac{pV}{T} = \text{constant}$

$p_1V_1 = p_2V_2$

$\frac{p_1}{T_1} = \frac{p_2}{T_2}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$d = vt$

$v = f\lambda$

$T = \frac{1}{f}$

$A = \frac{N}{t}$

$D = \frac{E}{m}$

$H = Dw_R$

$\dot{H} = \frac{H}{t}$

$s = vt$

$d = \bar{v}t$

$s = \bar{v}t$

$a = \frac{v-u}{t}$

$W = mg$

$F = ma$

$E_w = Fd$

$E_h = ml$

Additional Relationships

Circle

circumference $= 2\pi r$

area $= \pi r^2$

Sphere

area $= 4\pi r^2$

volume $= \frac{4}{3}\pi r^3$

Trigonometry

$$\sin \Theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos \Theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan \Theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin^2 \Theta + \cos^2 \Theta = 1$$

Electron Arrangements of Elements

Key

Atomic number
Symbol
Electron arrangement
Name

Transition Elements

Group 1 (1)	Group 2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Group 3 (13)	Group 4 (14)	Group 5 (15)	Group 6 (16)	Group 7 (17)	Group 0 (18)
1 **H** 1 Hydrogen																	2 **He** 2 Helium
3 **Li** 2,1 Lithium	4 **Be** 2,2 Beryllium											5 **B** 2,3 Boron	6 **C** 2,4 Carbon	7 **N** 2,5 Nitrogen	8 **O** 2,6 Oxygen	9 **F** 2,7 Fluorine	10 **Ne** 2,8 Neon
11 **Na** 2,8,1 Sodium	12 **Mg** 2,8,2 Magnesium											13 **Al** 2,8,3 Aluminium	14 **Si** 2,8,4 Silicon	15 **P** 2,8,5 Phosphorus	16 **S** 2,8,6 Sulfur	17 **Cl** 2,8,7 Chlorine	18 **Ar** 2,8,8 Argon
19 **K** 2,8,8,1 Potassium	20 **Ca** 2,8,8,2 Calcium	21 **Sc** 2,8,9,2 Scandium	22 **Ti** 2,8,10,2 Titanium	23 **V** 2,8,11,2 Vanadium	24 **Cr** 2,8,13,1 Chromium	25 **Mn** 2,8,13,2 Manganese	26 **Fe** 2,8,14,2 Iron	27 **Co** 2,8,15,2 Cobalt	28 **Ni** 2,8,16,2 Nickel	29 **Cu** 2,8,18,1 Copper	30 **Zn** 2,8,18,2 Zinc	31 **Ga** 2,8,18,3 Gallium	32 **Ge** 2,8,18,4 Germanium	33 **As** 2,8,18,5 Arsenic	34 **Se** 2,8,18,6 Selenium	35 **Br** 2,8,18,7 Bromine	36 **Kr** 2,8,18,8 Krypton
37 **Rb** 2,8,18,8,1 Rubidium	38 **Sr** 2,8,18,8,2 Strontium	39 **Y** 2,8,18,9,2 Yttrium	40 **Zr** 2,8,18,10,2 Zirconium	41 **Nb** 2,8,18,12,1 Niobium	42 **Mo** 2,8,18,13,1 Molybdenum	43 **Tc** 2,8,18,13,2 Technetium	44 **Ru** 2,8,18,15,1 Ruthenium	45 **Rh** 2,8,18,16,1 Rhodium	46 **Pd** 2,8,18,18,0 Palladium	47 **Ag** 2,8,18,18,1 Silver	48 **Cd** 2,8,18,18,2 Cadmium	49 **In** 2,8,18,18,3 Indium	50 **Sn** 2,8,18,18,4 Tin	51 **Sb** 2,8,18,18,5 Antimony	52 **Te** 2,8,18,18,6 Tellurium	53 **I** 2,8,18,18,7 Iodine	54 **Xe** 2,8,18,18,8 Xenon
55 **Cs** 2,8,18,18,8,1 Caesium	56 **Ba** 2,8,18,18,8,2 Barium	57 **La** 2,8,18,18,9,2 Lanthanum	72 **Hf** 2,8,18,32,10,2 Hafnium	73 **Ta** 2,8,18,32,11,2 Tantalum	74 **W** 2,8,18,32,12,2 Tungsten	75 **Re** 2,8,18,32,13,2 Rhenium	76 **Os** 2,8,18,32,14,2 Osmium	77 **Ir** 2,8,18,32,15,2 Iridium	78 **Pt** 2,8,18,32,17,1 Platinum	79 **Au** 2,8,18,32,18,1 Gold	80 **Hg** 2,8,18,32,18,2 Mercury	81 **Tl** 2,8,18,32,18,3 Thallium	82 **Pb** 2,8,18,32,18,4 Lead	83 **Bi** 2,8,18,32,18,5 Bismuth	84 **Po** 2,8,18,32,18,6 Polonium	85 **At** 2,8,18,32,18,7 Astatine	86 **Rn** 2,8,18,32,18,8 Radon
87 **Fr** 2,8,18,32,18,8,1 Francium	88 **Ra** 2,8,18,32,18,8,2 Radium	89 **Ac** 2,8,18,32,18,9,2 Actinium	104 **Rf** 2,8,18,32,32,10,2 Rutherfordium	105 **Db** 2,8,18,32,32,11,2 Dubnium	106 **Sg** 2,8,18,32,32,12,2 Seaborgium	107 **Bh** 2,8,18,32,32,13,2 Bohrium	108 **Hs** 2,8,18,32,32,14,2 Hassium	109 **Mt** 2,8,18,32,32,15,2 Meitnerium	110 **Ds** 2,8,18,32,32,17,1 Darmstadtium	111 **Rg** 2,8,18,32,32,18,1 Roentgenium	112 **Cn** 2,8,18,32,32,18,2 Copernicium						

Lanthanides	57 **La** 2,8,18,18,9,2 Lanthanum	58 **Ce** 2,8,18,20,8,2 Cerium	59 **Pr** 2,8,18,21,8,2 Praseodymium	60 **Nd** 2,8,18,22,8,2 Neodymium	61 **Pm** 2,8,18,23,8,2 Promethium	62 **Sm** 2,8,18,24,8,2 Samarium	63 **Eu** 2,8,18,25,8,2 Europium	64 **Gd** 2,8,18,25,9,2 Gadolinium	65 **Tb** 2,8,18,27,8,2 Terbium	66 **Dy** 2,8,18,28,8,2 Dysprosium	67 **Ho** 2,8,18,29,8,2 Holmium	68 **Er** 2,8,18,30,8,2 Erbium	69 **Tm** 2,8,18,31,8,2 Thulium	70 **Yb** 2,8,18,32,8,2 Ytterbium	71 **Lu** 2,8,18,32,9,2 Lutetium
Actinides	89 **Ac** 2,8,18,32,18,9,2 Actinium	90 **Th** 2,8,18,32,18,10,2 Thorium	91 **Pa** 2,8,18,32,20,9,2 Protactinium	92 **U** 2,8,18,32,21,9,2 Uranium	93 **Np** 2,8,18,32,22,9,2 Neptunium	94 **Pu** 2,8,18,32,24,8,2 Plutonium	95 **Am** 2,8,18,32,25,8,2 Americium	96 **Cm** 2,8,18,32,25,9,2 Curium	97 **Bk** 2,8,18,32,27,8,2 Berkelium	98 **Cf** 2,8,18,32,28,8,2 Californium	99 **Es** 2,8,18,32,29,8,2 Einsteinium	100 **Fm** 2,8,18,32,30,8,2 Fermium	101 **Md** 2,8,18,32,31,8,2 Mendelevium	102 **No** 2,8,18,32,32,8,2 Nobelium	103 **Lr** 2,8,18,32,32,9,2 Lawrencium