N5

SPACE

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

18. A spacecraft completes the last stage of its journey back to Earth by parachute, falling with constant speed into the sea.

The spacecraft falls with constant speed because

A the gravitational field strength of the Earth is constant near the Earth's surface

B it has come from space where the gravitational field strength is almost zero

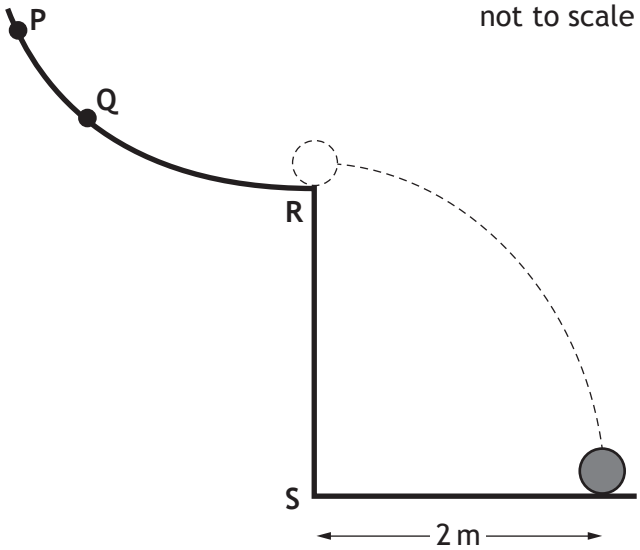
C the air resistance is greater than the weight of the spacecraft

D the weight of the spacecraft is greater than the air resistance

E the air resistance is equal to the weight of the spacecraft.

19. A ball is released from point **Q** on a curved rail, leaves the rail horizontally at R and lands 1 s later.

The ball is now released from point **P**.



Which row describes the motion of the ball after leaving the rail?

	Time to land after leaving rail	*Distance from S to landing point*
A	1 s	less than 2 m
B	less than 1 s	more than 2 m
C	1 s	more than 2 m
D	less than 1 s	2 m
E	more than 1 s	more than 2 m

19. The distance from the Sun to Proxima Centauri is 4·3 light years.

This distance is equivalent to

A $1{\cdot}4 \times 10^{8}$ m

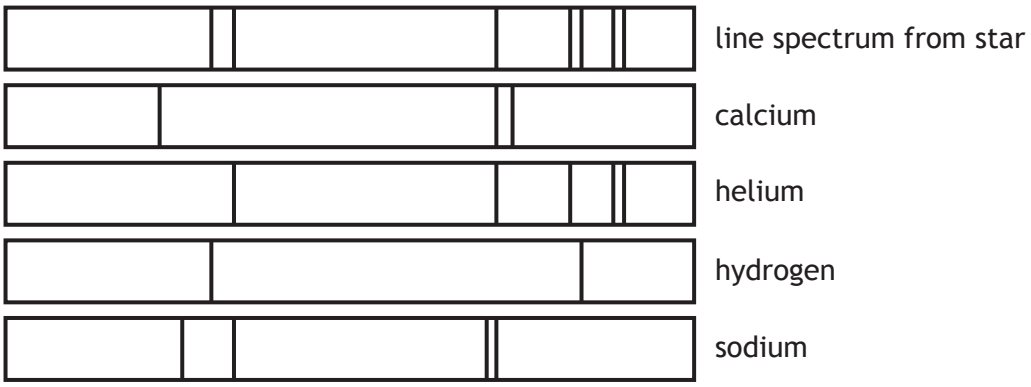
B $1{\cdot}6 \times 10^{14}$ m

C $6{\cdot}8 \times 10^{14}$ m

D $9{\cdot}5 \times 10^{15}$ m

E $4{\cdot}1 \times 10^{16}$ m.

20. Light from a star is split into a line spectrum of different colours. The line spectrum from the star is shown, along with the line spectra of the elements calcium, helium, hydrogen and sodium.



The elements present in this star are

A sodium and calcium

B calcium and helium

C hydrogen and sodium

D helium and hydrogen

E calcium, sodium and hydrogen.

17. A rocket is taking off from the surface of the Earth. The rocket engines exert a force on the exhaust gases.

Which of the following is the reaction to this force?

A The force of the Earth on the exhaust gases.

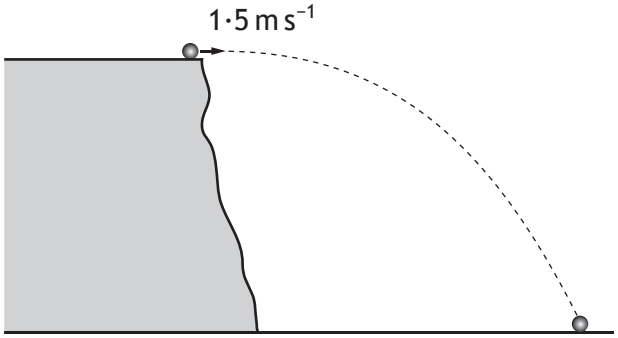
B The force of the Earth on the rocket engines.

C The force of the rocket engines on the Earth.

D The force of the exhaust gases on the Earth.

E The force of the exhaust gases on the rocket engines.

18. A ball is projected horizontally with a velocity of $1{\cdot}5\ m\ s^{-1}$ from a cliff as shown.



The ball hits the ground 1·2 s after it leaves the cliff.

The effects of air resistance are negligible.

Which row in the table shows the horizontal velocity and vertical velocity of the ball just before it hits the ground?

	Horizontal velocity ($m\ s^{-1}$)	*Vertical velocity* ($m\ s^{-1}$)
A	12	12
B	12	1·5
C	1·5	12
D	1·5	13
E	0	12

20. A student makes the following statements about the Universe.

I The Big Bang Theory is a theory about the origin of the Universe.

II The Universe is approximately 14 million years old.

III The Universe is expanding.

Which of these statements is/are correct?

A I only

B II only

C I and II only

D I and III only

E I, II and III.

17. A rocket accelerates vertically upwards from the surface of the Earth.

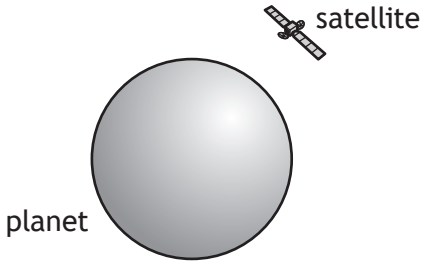
An identical rocket accelerates vertically upwards from the surface of Mars.

The engine thrust from each rocket is the same.

Which row in the table shows how the weight of the rocket and the unbalanced force acting on the rocket compares on Mars and Earth?

	Weight on Mars compared to weight on Earth	*Unbalanced force on Mars compared to unbalanced force on Earth*
A	greater	greater
B	same	same
C	same	less
D	less	greater
E	less	less

18. A satellite is in a circular orbit around a planet.



A group of students make the following statements about the satellite.

I The greater the altitude of a satellite the shorter its orbital period.

II The satellite has a constant vertical acceleration.

III As the satellite orbits the planet, its vertical velocity increases.

Which of these statements is/are correct?

A I only

B II only

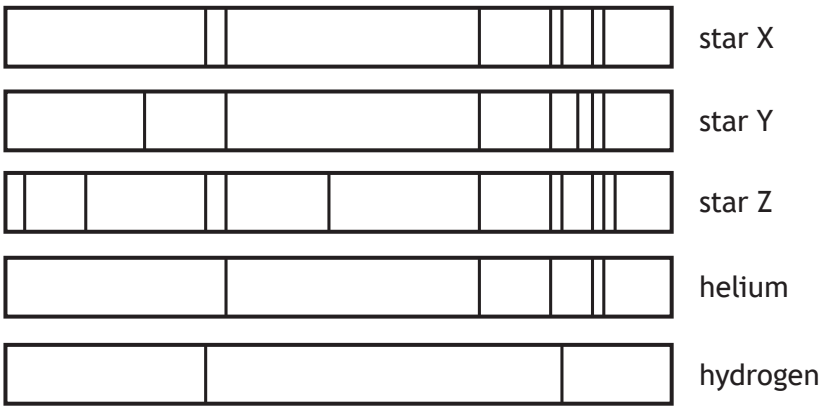
C III only

D I and II only

E II and III only

20. Light from stars can be split into line spectra of different colours.

The line spectra from three stars, X, Y and Z, are shown, along with the line spectra of the elements helium and hydrogen.



Hydrogen and helium are both present in

A star X only

B star Y only

C stars X and Y only

D stars X and Z only

E stars X, Y and Z.

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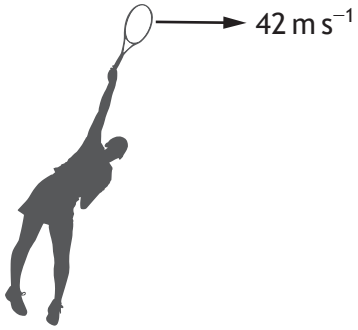
SPACE

Practice Questions

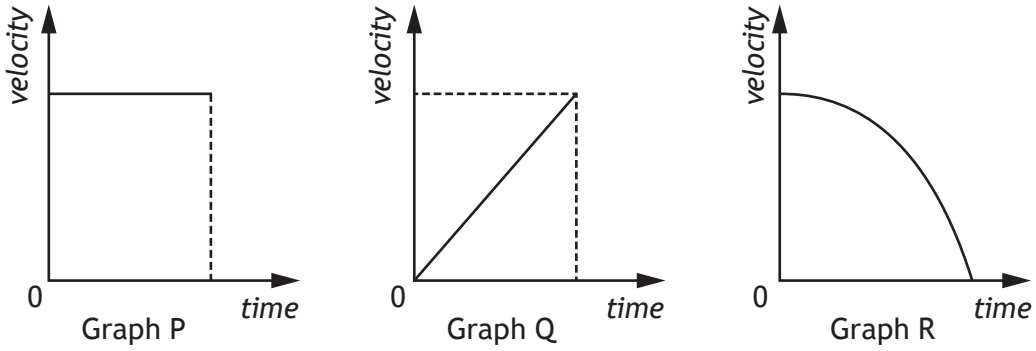
Physics
Section 2

11. A tennis player serves a tennis ball horizontally at a velocity of 42 ms^{-1}.



The effects of air resistance are negligible.

(a) State which of the following graphs P, Q or R shows the vertical velocity of the ball after it leaves the player's racquet. **1**



Graph: _____

(b) In a second serve the player hits the ball horizontally with a smaller velocity from the same height.

State whether the time taken for the ball to reach the ground is less than, equal to, or greater than the time taken in the first serve.

Justify your answer. **2**

11. (continued)

(c) The tennis court has a retractable roof to allow play to continue in all weather conditions.

It requires 5·5 kJ of energy to move one section of the roof a distance of 25 m.

Calculate the average force acting on this section of the roof while it is being moved. **3**

Space for working and answer

12. The star Wolf 359 is at a distance of 7·8 light-years from Earth.

A radio signal from Wolf 359 is detected by a radio telescope on Earth.

(a) (i) State the speed of the radio waves. **1**

(ii) Calculate the distance, in metres, from Wolf 359 to Earth. **3**

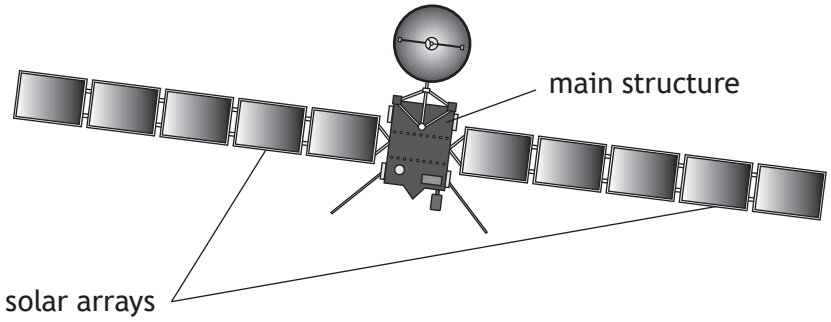
Space for working and answer

(b) Another telescope is used to observe the same star in the visible part of the spectrum.

(i) State a suitable detector of visible light that may be used in this telescope. **1**

(ii) State whether the time taken for the visible light from the star to reach Earth is less than, equal to, or greater than the time taken for the radio waves from the star to reach Earth. **1**

12. On 12th November 2014, on a mission known as Rosetta, the European Space Agency successfully landed a probe on the surface of a comet.



The main structure of the Rosetta spacecraft consists of an orbiter, a lander and propellant.

Rosetta spacecraft data		
Launch mass	Orbiter Lander Propellant	$1{\cdot}23 \times 10^3$ kg $0{\cdot}10 \times 10^3$ kg $1{\cdot}67 \times 10^3$ kg
	Total	$3{\cdot}00 \times 10^3$ kg
Energy source	Solar array output	850 W at 3·4 AU 395 W at 5·25 AU
Trajectory control	24 Thrusters	10 N of force each

(a) Calculate the total weight of the spacecraft on Earth. **3**

Space for working and answer

(b) The solar arrays contain photovoltaic cells.

(i) State the energy change in a photovoltaic cell. **1**

(ii) Suggest why the solar arrays were designed so that they can rotate. **1**

12. (b) (continued)

(iii) Calculate the total energy output of the solar arrays when operating at 5·25 AU for 2 hours. **3**

Space for working and answer

(c) At a point on its journey between Earth and the comet, the spacecraft was travelling at a constant velocity.

(i) The spacecraft switched on four of its thrusters to accelerate it in the direction of travel.

The four thrusters exerted a force on the spacecraft in the same direction.

Determine the total force produced by these thrusters. **1**

Space for working and answer

(ii) At this point, the spacecraft had used $1{\cdot}00 \times 10^3$ kg of propellant.

Calculate the acceleration of the spacecraft. **4**

Space for working and answer

13. Read the passage and answer the questions that follow.

Supernova explosion

The average temperature of the surface of the Sun is 5778 K. In the core of the Sun energy is produced by nuclear fusion. Once the Sun has used all its nuclear fuel it will collapse to form a white dwarf.

A star with a mass much larger than that of the Sun will end its life in an enormous explosion called a supernova. The energy released in a supernova explosion is more than a hundred times the energy that the Sun will radiate over its entire 10 billion year lifetime.

In our galaxy, the star Betelgeuse is predicted to explode in a supernova. Betelgeuse has a mass of around 8 times the mass of the Sun. Even though Betelgeuse is 640 light-years from Earth, the supernova will be as bright as a full moon at night in our sky.

(a) State what is meant by the term *nuclear fusion*. **1**

(b) Determine the average temperature of the surface of the Sun in degrees Celsius. **1**

Space for working and answer

13. (continued)

(c) Show that the distance from Earth to Betelgeuse is $6{\cdot}1 \times 10^{18}$ m. **3**

Space for working and answer

(d) Betelgeuse may have already exploded in a supernova.
Explain this statement. **1**

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Physics
Relationships Sheet

$$E_p = mgh$$

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

$$Q = It$$

$$V = IR$$

$$R_T = R_1 + R_2 + \ldots$$

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

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

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

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

$$P = IV$$

$$P = I^2R$$

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

$$E_h = cm\Delta T$$

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

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

$$p_1V_1 = p_2V_2$$

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

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

$$d = vt$$

$$v = f\lambda$$

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

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

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

$$H = Dw_R$$

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

$$s = vt$$

$$d = \bar{v}t$$

$$s = \bar{v}t$$

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

$$W = mg$$

$$F = ma$$

$$E_w = Fd$$

$$E_h = ml$$

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

Group 1 (1)	Group 2 (2)	Transition Elements (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