



PRELIMINARY EXAMINATION

AUGUST 2002

PHYSICS

**General Instructions:**

- Reading Time – 5 minutes
- Working Time – 2 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Periodic Table and Formulae Sheets are provided at the back of this paper

**Total marks: 65**

This paper has two parts, Part A and Part B

**Part A**

**Total marks: 15**

- Attempt Questions 1 – 15
- Allow about 30 minutes for this part

**Part B**

**Total marks: 50**

- Attempt questions 15 – 32
- Allow about 1 hour and 30 minutes for this part

**PART A**

**Total marks: 15**

**Attempt Questions: 1 – 15**

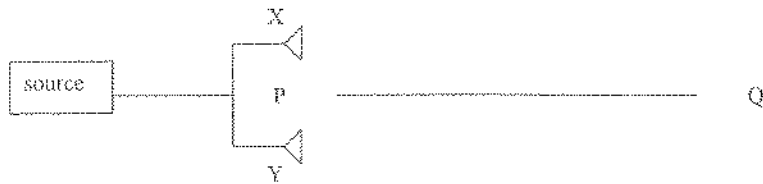
**Allow about 20 minutes for this part**

**Use the multiple choice answer sheet**

**Select the alternative A, B, C or D that best answers the question**

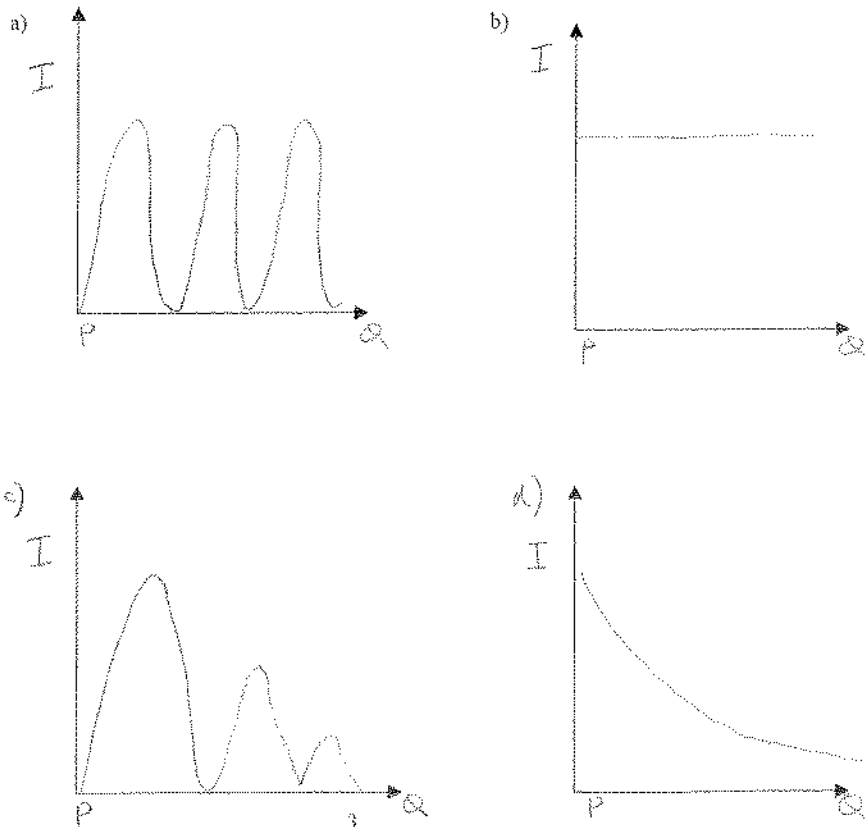
1. When the electricity authority supplies alternating current electrical energy to our homes, the net number of electrons entering and leaving the electricity supply cable to our homes is:
  - a) greater than  $10^{18}$  per second
  - b) between  $10^6$  and  $10^{18}$  per second
  - c) 0
  - d) impossible to calculate without knowing the exact number of amperes being used.
  
2. The resistance of a piece of conducting material depends on:
  - a) length, cross-sectional area, material and temperature
  - b) length, material and temperature
  - c) cross-sectional area, material and temperature
  - d) length, cross-sectional area and material

3. Two small loudspeakers X and Y are placed as shown in the diagram. They are fed by the same source and emit sound in phase and with the same intensity and the same frequency

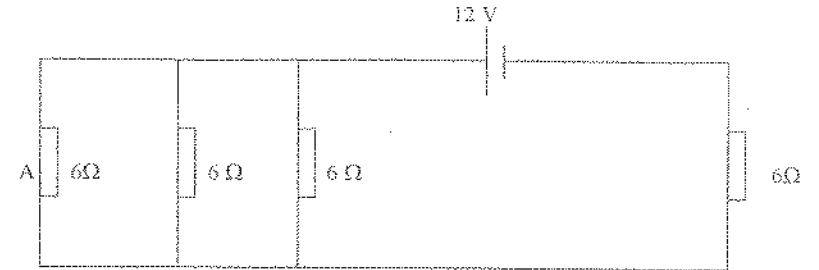


A microphone is moved along the line PQ that is the perpendicular bisector of XY.

Which diagram best indicates how the sound intensity varies along PQ?

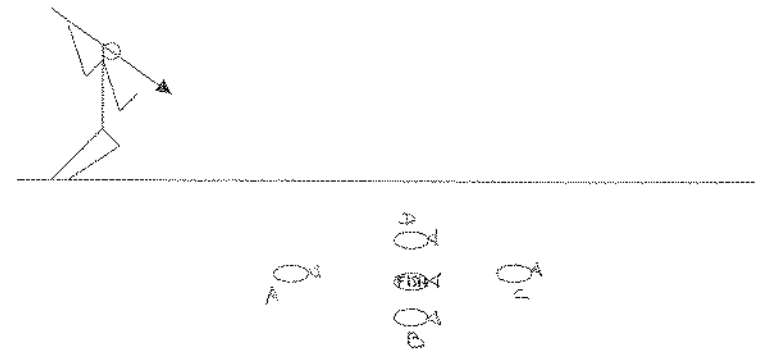


4. Consider the following circuit:



Given that all the resistors are 6 ohms the current through the resistor "A" is closest to:

- a) 2.6 A
  - b) 2.0 A
  - c) 1.5 A
  - d) 0.5 A
5. The pictures from the Sydney Olympics were beamed live to television receivers all around the world. Why did the TV waves have to be reflected from orbiting satellites?
- a) They do not travel in straight lines
  - b) They cannot follow the curved path around the Earth
  - c) They become too weak if they travel through a long distance
  - d) They are unable to travel through the vacuum of space.
6. A spear fisherman sees a fish in the water. The actual location of the fish is shown in the diagram (labelled "fish").



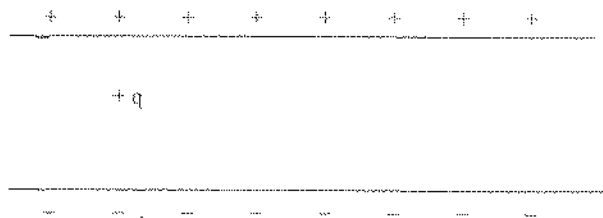
Which of the images best shows the location of where the fish appears to be, as seen by the spear fisherman?

- (a) A
- (b) B
- (c) C
- (d) D

7. How does the velocity of sound wave A (of frequency 300 Hz) travelling in a medium compare with the velocity of sound wave B (of frequency 600 Hz) travelling in the same medium?
- half the velocity of B
  - the same as the velocity of B
  - twice the velocity of B
  - four times the velocity of B

8. Total internal reflection can occur when light passes from one medium into another medium
- which has a lower index of refraction
  - which has a higher index of refraction
  - which has the same index of refraction
  - at less than the critical angle

9. A charge +q is placed R metres from the positive plate of a pair of parallel plates, as in the diagram below:



The charge experiences a force of F newtons in this position. If the charge is doubled and its distance from the top plate is halved, the force it experiences is:

- F
  - $\frac{1}{2}F$
  - $2F$
  - dependent upon the size of the electric field
10. Fomalhaut is a star that is 25 light years away and is 17 times more luminous than the Sun. Bellatrix is 243 light years away and 1000 times the luminosity of the Sun. It would therefore be true to say:
- Formalhaut is 1.6 times brighter because it is closer.
  - They are of equal brightness
  - Bellatrix is brighter because it is more luminous
  - Bellatrix is brighter by a factor of  $17/25 \times 243/1000$

11. A newly formed main sequence star is mostly
- Uranium
  - Carbon
  - Helium
  - Hydrogen

12. Mass earth =  $6 \times 10^{24}$  kg  
Mass Saturn =  $570 \times 10^{24}$  kg

Average distance from sun (earth) =  $149 \times 10^6$  km  
" " " " (Saturn) =  $1420 \times 10^6$  km

Given the data above, Kepler's 3rd Law can be used to calculate the time for Saturn to orbit the sun as:

- 3478 days
  - 10751 days
  - 58970 days
  - 35478 days
13. An early supporter for the geocentric model of the universe was:
- Kepler
  - Aristotle
  - Galileo
  - Aristarchus
14. The size of a star is a balance between two forces. Those forces are:
- the gravity force and radiation pressure
  - the electrical force and the gravity force
  - the nuclear force and the radiation pressure
  - the electrical force and the nuclear force
15. As a black body becomes hotter, the peak of the intensity versus wavelength curve shifts towards :
- the red end
  - the high wavelength end
  - the blue end
  - the right

Student Number: .....

	A	B	C	D
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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**PART B**

Total marks: 50

Attempt Questions 16 – 33

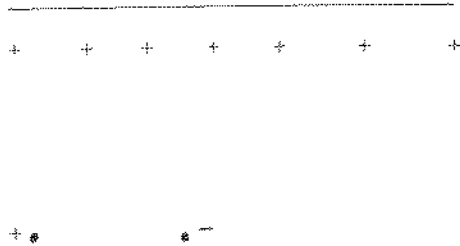
Allow about 1 hour and 40 minutes for this part

Answer questions 16 – 33 on the exam paper

Show all relevant working in questions involving calculations

Q16. Draw the electric field in each of the following situations:

a)  (1 mark)

b)  (1 mark)

Q17. Using coal as an example of an energy source, show briefly how society's use and access to it has changed in say, the last two hundred years. (2 marks)

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Q18. An electric toaster rated at 450 watts is used for ten (10) minutes at breakfast.  
If electricity costs 30 cents per kilowatt / hour, how much will cooking the toast cost? (nearest cent) (2 marks)

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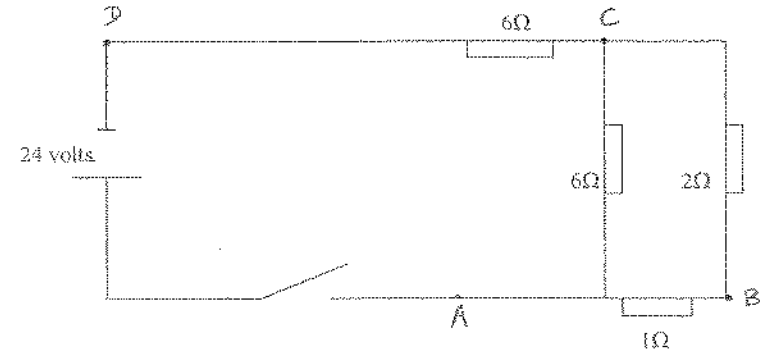
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Q19. Consider the following circuit:



When the current is switched on, find the voltages at points A, B, C and D. (4 marks)

A.....B.....

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C.....D.....

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**Q20.** To maximise the signal they receive, television antennae are designed to be half the length of the broadcasting wavelength. If a channel broadcasts at 120 MHz, calculate the length of a suitable antenna. (2 marks)

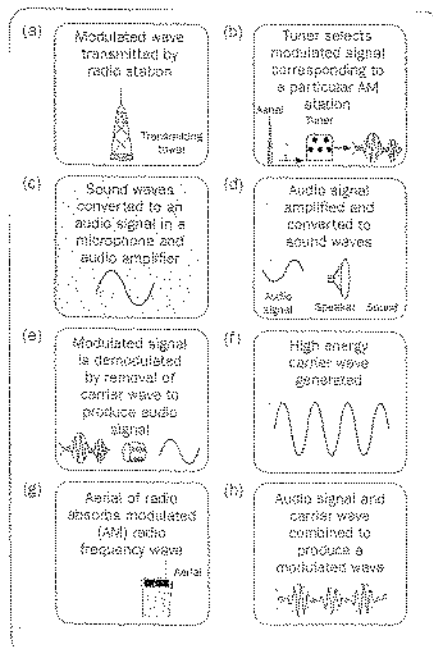
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**Q21.** AM Radio stations produce modulated radio waves. The diagrams in the figure summarise this process. (2 marks)



Write the letter of these diagrams in the correct order to show how modulation and demodulation work.

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**Q22.** Australia electricity supply voltage is 240V ac at 50 Hz. Outline the likely results of electric shock on the human body if contact is made between right hand and left foot and the skin is slightly wet (take  $R = 2000$  ohms). Justify your answer using the figures given.

(2 marks)

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**Q23.** Your task is to find the value of an unknown ohmic resistor by plotting its voltage/current characteristics. You have the following equipment available for use:

- fixed voltage supply of 12V DC
- ammeter
- voltmeter
- variable resistor
- leads
- unknown resistor X

You are to use a number of different voltages.

a) Draw a circuit diagram which will enable you to carry out your task (2 marks)

b) Sketch a typical graph of voltage vs current for the resistor (X) (1 mark)



23. continued

- c) Had your resistor been an incandescent lamp instead, sketch the voltage – current characteristics. (1 mark)



- d) In making your measurements for this experiment, how could you have improved your reliability? (1 mark)

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- e) What conclusion can you draw from graph (b)? (1 mark)

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Q24. These photos were taken by using visible light and x-rays.



- a) List two differences between these two types of waves (2 marks)

i.....  
ii.....

- b) List two similarities of these two types of waves (2 marks)

i.....  
ii.....

**Q25.** a) Why are microwaves and other radio waves used for communication in the outback in preference to optical fibres or coaxial cables? **(1 mark)**

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b) Explain how visible light is used to transmit sound information along optical fibres. Use a diagram to illustrate your explanation. **(3 marks)**

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**Q26.** Identify types of communication data that are stored or transmitted in digital form. **(2 marks)**

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**Q27.** A circuit breaker stops the current when it exceeds a pre-set value.

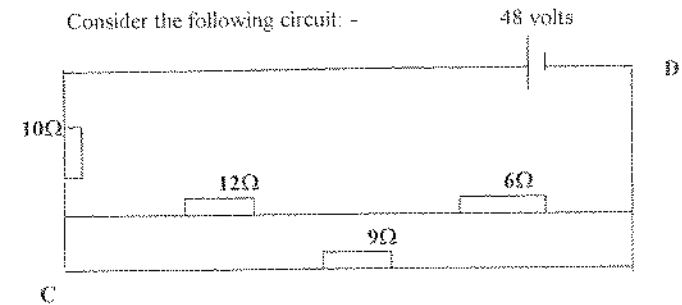
(a) What device is used in a circuit breaker to enable it to do this? **(1 mark)**

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(b) What advantage does a circuit breaker have over a fuse? **(1 mark)**

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**Q28.** Consider the following circuit: -



You are required to measure the current in the 9 ohm resistor and the voltage between points C and D.

a) On the circuit diagram above place meters (correctly labelled) in appropriate places to make the measurements required. **(2 marks)**

b) i) What is the reading on the ammeter? **(1 mark)**

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.....

ii) What is the reading on the voltmeter? **(1 mark)**

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# Physics

## DATA SHEET

Charge on the electron, $q_e$	$-1.602 \times 10^{-19} \text{ C}$
Mass of electron, $m_e$	$9.109 \times 10^{-31} \text{ kg}$
Mass of neutron, $m_n$	$1.675 \times 10^{-27} \text{ kg}$
Mass of proton, $m_p$	$1.673 \times 10^{-27} \text{ kg}$
Speed of sound in air	$340 \text{ m s}^{-1}$
Earth's gravitational acceleration, $g$	$9.8 \text{ m s}^{-2}$
Speed of light, $c$	$3.00 \times 10^8 \text{ m s}^{-1}$
Magnetic force constant, $\left(k \equiv \frac{\mu_0}{2\pi}\right)$	$2.0 \times 10^{-7} \text{ N A}^{-2}$
Universal gravitational constant, $G$	$6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
Mass of Earth	$6.0 \times 10^{24} \text{ kg}$
Planck's constant, $h$	$6.626 \times 10^{-34} \text{ J s}$
Rydberg's constant, $R_H$	$1.097 \times 10^7 \text{ m}^{-1}$
Atomic mass unit, $u$	$1.661 \times 10^{-27} \text{ kg}$ $931.5 \text{ MeV}/c^2$
1 eV	$1.602 \times 10^{-19} \text{ J}$
Density of water, $\rho$	$1.00 \times 10^3 \text{ kg m}^{-3}$
Specific heat capacity of water	$4.18 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$

## PERIODIC TABLE OF THE ELEMENTS

KEY		Atomic Number	Symbol of element	Name of element
1	H	1.008	H	Hydrogen
2	He	4.003	He	Helium
3	Li	6.941	Li	Lithium
4	Be	9.012	Be	Beryllium
5	B	10.81	B	Boron
6	C	12.01	C	Carbon
7	N	14.01	N	Nitrogen
8	O	16.00	O	Oxygen
9	F	19.00	F	Fluorine
10	Ne	20.18	Ne	Neon
11	Na	22.99	Na	Sodium
12	Mg	24.31	Mg	Magnesium
13	Al	26.98	Al	Aluminium
14	Si	28.09	Si	Silicon
15	P	30.97	P	Phosphorus
16	S	32.07	S	Sulfur
17	Cl	35.45	Cl	Chlorine
18	Ar	39.95	Ar	Argon
19	K	39.10	K	Potassium
20	Ca	40.08	Ca	Calcium
21	Sc	44.96	Sc	Scandium
22	Ti	47.87	Ti	Titanium
23	V	50.94	V	Vanadium
24	Cr	52.00	Cr	Chromium
25	Mn	54.94	Mn	Manganese
26	Fe	55.85	Fe	Iron
27	Co	58.93	Co	Cobalt
28	Ni	58.69	Ni	Nickel
29	Cu	63.55	Cu	Copper
30	Zn	65.39	Zn	Zinc
31	Ga	69.72	Ga	Gallium
32	Ge	72.61	Ge	Germanium
33	As	74.92	As	Arsenic
34	Se	78.96	Se	Selenium
35	Br	79.90	Br	Bromine
36	Kr	83.80	Kr	Krypton
37	Rb	85.47	Rb	Rubidium
38	Sr	87.62	Sr	Strontium
39	Y	88.91	Y	Yttrium
40	Zr	91.22	Zr	Zirconium
41	Nb	92.91	Nb	Niobium
42	Mo	95.94	Mo	Molybdenum
43	Tc	[98.91]	Tc	Technetium
44	Ru	101.1	Ru	Ruthenium
45	Rh	102.9	Rh	Rhodium
46	Pd	106.4	Pd	Palladium
47	Ag	107.9	Ag	Silver
48	Cd	112.4	Cd	Cadmium
49	In	114.8	In	Indium
50	Sn	118.7	Sn	Tin
51	Sb	121.8	Sb	Antimony
52	Te	127.6	Te	Tellurium
53	I	126.9	I	Iodine
54	Xe	131.3	Xe	Xenon
55	Cs	132.9	Cs	Cesium
56	Ba	137.3	Ba	Barium
57-71	Lanthanides			
72	Hf	178.5	Hf	Hafnium
73	Ta	180.9	Ta	Tantalum
74	W	183.8	W	Tungsten
75	Re	186.2	Re	Rhenium
76	Os	190.2	Os	Osmium
77	Ir	192.2	Ir	Iridium
78	Pt	195.1	Pt	Platinum
79	Au	197.0	Au	Gold
80	Hg	200.6	Hg	Mercury
81	Tl	204.4	Tl	Thallium
82	Pb	207.2	Pb	Lead
83	Bi	208.98	Bi	Bismuth
84	Po	[209.0]	Po	Polonium
85	At	[210.0]	At	Astatine
86	Rn	[222.0]	Rn	Radon
87	Fr	[223.0]	Fr	Francium
88	Ra	[226.0]	Ra	Radium
89-103	Actinides			
104	Rf	[261.1]	Rf	Rutherfordium
105	Db	[262.1]	Db	Dubnium
106	Sg	[263.1]	Sg	Seaborgium
107	Bh	[264.1]	Bh	Berkelium
108	Hs	[265.1]	Hs	Hassium
109	Mt	[268]	Mt	Moscovium
110	Uun	—	Uun	Ununnilium
111	Uuh	—	Uuh	Ununhassium
112	Uuq	—	Uuq	Ununquadium
113	Ulu	—	Ulu	Ununliverm
114	Uuq	—	Uuq	Ununquadium
115	Uub	—	Uub	Ununbium
116	Uuo	—	Uuo	Ununoctium
117	Uue	—	Uue	Ununseptium
118	Uuo	—	Uuo	Ununoctium
119	Uue	—	Uue	Ununseptium
120	Uuo	—	Uuo	Ununoctium

### Lanthanides

57	La	138.9	La	Lanthanum
58	Ce	140.1	Ce	Cerium
59	Pr	140.9	Pr	Praseodymium
60	Nd	144.2	Nd	Neodymium
61	Pm	[146.9]	Pm	Promethium
62	Sm	150.4	Sm	Samarium
63	Eu	152.0	Eu	Eurium
64	Gd	157.3	Gd	Gadolinium
65	Tb	158.9	Tb	Terbium
66	Dy	162.5	Dy	Dysprosium
67	Ho	164.9	Ho	Holmium
68	Er	167.3	Er	Erbium
69	Tm	168.9	Tm	Thulium
70	Yb	173.0	Yb	Ytterbium
71	Lu	175.0	Lu	Lutetium

### Actinides

89	Ac	[227.0]	Ac	Actinium
90	Th	232.0	Th	Thorium
91	Pa	231.0	Pa	Protactinium
92	U	238.0	U	Uranium
93	Np	[237.0]	Np	Neptunium
94	Pu	[239.1]	Pu	Plutonium
95	Am	[241.1]	Am	Americium
96	Cm	[244.1]	Cm	Curium
97	Bk	[249.1]	Bk	Berkelium
98	Cf	[251.1]	Cf	Californium
99	Es	[252.1]	Es	Einsteinium
100	Fm	[257.1]	Fm	Fermium
101	Md	[258.1]	Md	Mendelevium
102	No	[259.1]	No	Nobelium
103	Lr	[262.1]	Lr	Livermorium

Where the atomic weight is not known, the relative atomic mass of the most common radioactive isotope is shown in brackets. The atomic weights of Np and Pu are given for the isotopes  $^{237}\text{Np}$  and  $^{244}\text{Pu}$ .