Physics

HSC Course

2011

Year 12 Half Yearly Assessment Task

Exam / Practical and Processes

Total marks 50

General Instructions

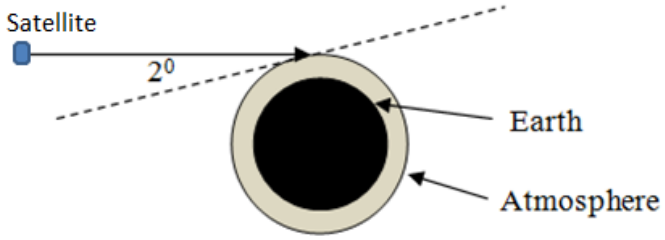
- Reading time – 5 minutes
- Working time – 1.5 hours

- Attempt all questions
- Write using blue or black pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your I.D. number on each answer sheet

Teachers: Mr Coombes (coordinator), Mr Trotter, Mr Pitt

Task Weighting: 30 %

1. What are the consequences of a space craft re-entering the atmosphere at the angle shown in the diagram?



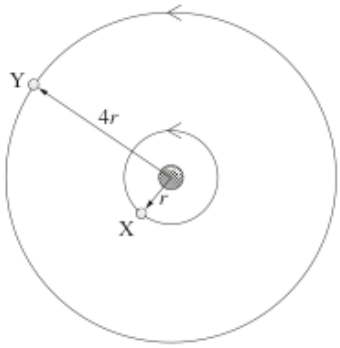
(A) The craft will break up due to excessive heat.

(B) Astronauts on the craft will experience excessive g-forces.

(C) The craft will bounce off the atmosphere and back into space.

(D) The craft will not be able to reduce speed sufficiently to land.

2. Two planets, X and Y, travel around a star in the same direction, in circular orbits. Planet Y completes one revolution about the star in time T. The radii of the orbits are in the ratio 1:4.



How many revolutions does planet X make about the star in the same time?

(A) 1/8 revolution

(B) 1/2 revolution

(C) 4 revolutions

(D) 8 revolutions

3. An observer measures the length of a spacecraft to be 1/3 of its rest length.
At what velocity is the space craft moving relative to the observer?

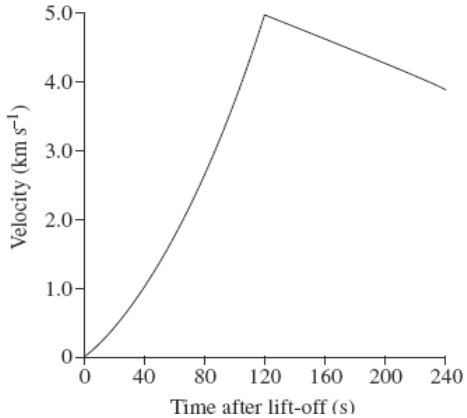
(A) 0.33c

(B) 0.67c

(C) 0.89c

(D) 0.94c

4. The following graph shows the velocity of a rocket launched vertically into the upper atmosphere.



What is the approximate altitude of the rocket after 4 minutes?

(A) 4 km

(B) 400 km

(C) 750 km

(D) 960 km

5. A distant planet is discovered and measured to have a radius that is double that of the Earth and a mass which is triple that of the Earth. Given that the radius of the Earth is 6400 km what would be the acceleration due to gravity on this planet?

(A) 29.4 m s^{-2}

(B) 14.7 m s^{-2}

(C) 7.35 m s^{-2}

(D) 4.9 m s^{-2}

6. Which of these statements best describes the relationship between the velocity of a satellite and the forces acting on a satellite in orbit around the Earth?

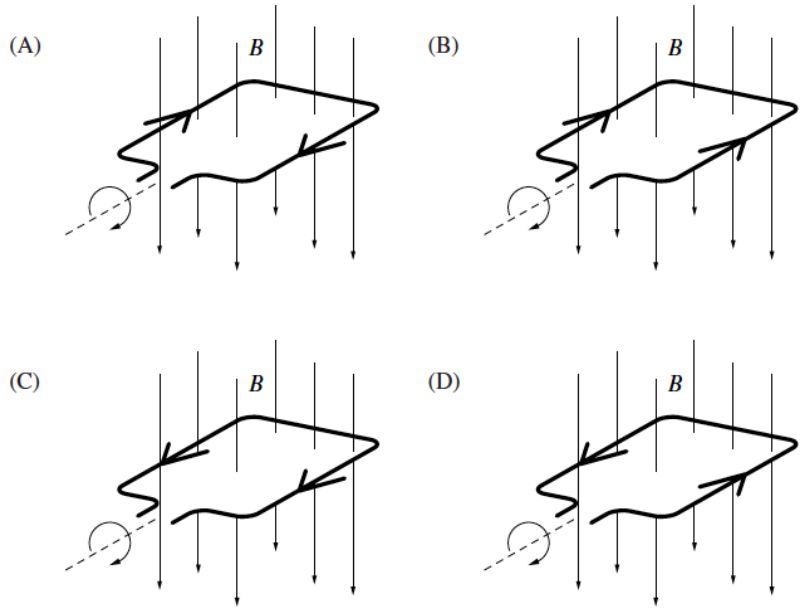
(A) The net force acting on the satellite is perpendicular to the velocity.

(B) The net force is zero and the velocity is constant.

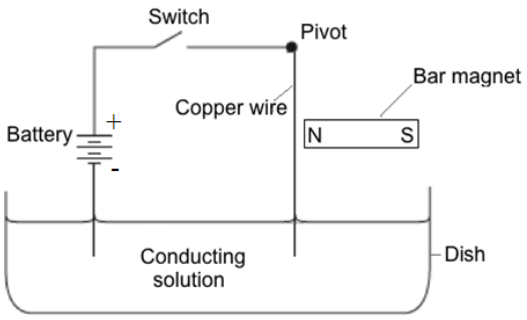
(C) There are no forces acting and the velocity is changing.

(D) The net force acts in the same direction as the velocity.

7. A single-turn coil of wire is placed in a uniform magnetic field *B* at right angles to the plane of the coil as shown in the diagrams. The coil is then rotated in a clockwise direction as shown. Which of the following shows the direction of current flow in the coil as it begins to rotate?



8. A circuit was set up as shown in the diagram below.



In what direction will the copper wire initially move when the switch is turned on?

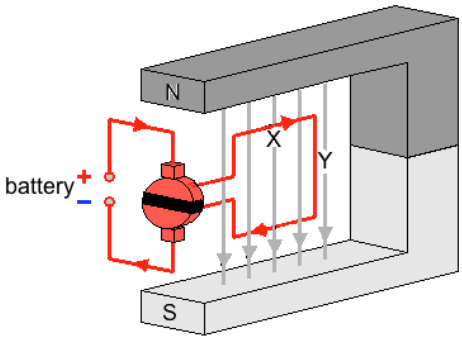
(A) Out of the page

(B) Into the page

(C) Toward the magnet

(D) Away from the magnet

9. Examine the diagram and answer the question below.



Which of the following takes place as the motor rotates through a position 180° beyond that shown in the diagram?

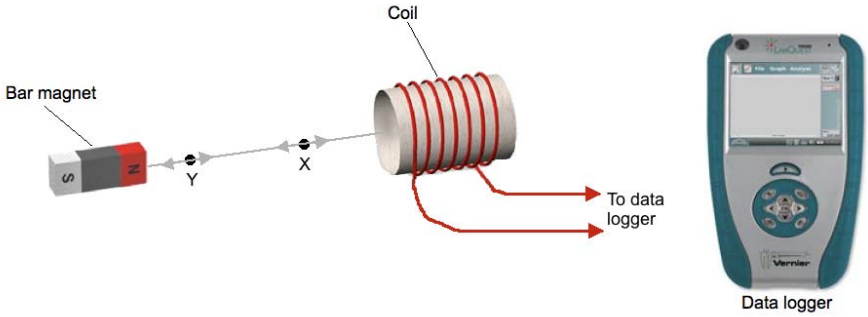
(A) The current through the coil reverses.

(B) The polarity of the battery reverses.

(C) The torque on the coil reverses.

(D) The magnetic field of the permanent magnet reverses.

10. The following apparatus was used to investigate Faraday's law.



The magnet was first moved to point Y, and then it was moved back and forth a distance of 1 cm 10 times per second. It was then moved to point X and the movement was repeated with the same frequency and amplitude.

The ends of the coil were connected to a voltage sensor and the voltage produced was displayed on the screen of the data logger for each of the two positions.

What was the purpose of this investigation?

(A) To investigate the effect of changing the strength of the magnet on the voltage produced.

(B) To model the generation of an alternating current.

(C) To investigate the effect on the voltage produced of varying the distance between the coil and magnet.

(D) To investigate the relationship between the direction of an induced current in a coil and the direction of movement of the magnet inducing the current.

Section B: Attempt all questions in the spaces provided

11. Analyse evidence that has validated Einstein's theory of special relativity.
In your answer, refer to two specific examples. (H2) 4M

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12. A website reports that the maximum g-force that a well-trained astronaut can withstand during launch is 6000 N.
Assess the information presented on this website. 3M

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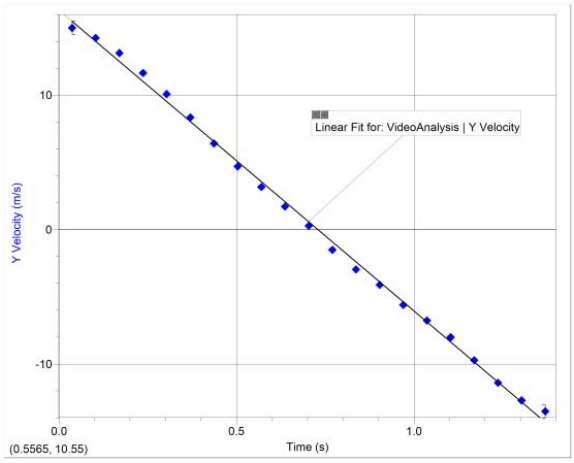
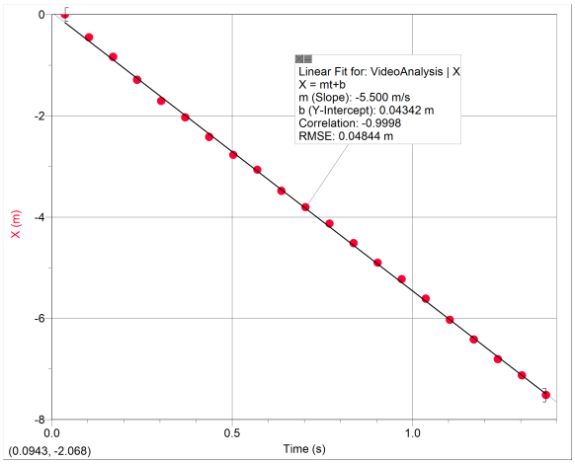
13. The following graphs were created using the video analysis of a projectile on planet Tran.

Graph A



Graph B



(a) Use graph A to calculate the acceleration due to gravity on planet Tran. 2M

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(b) Use information from both graphs to calculate the velocity of the projectile at t = 1 s. 3M

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14. Evaluate the importance of Galileo's analysis of projectile motion in changing the direction or nature of scientific thinking. 3M

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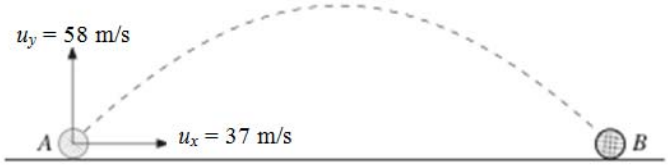
15. A projectile leaves the ground at point A with velocity components as shown in the diagram. It follows the trajectory indicated by the dotted line and lands at point B.



(i) Calculate the projectile's initial velocity. 1M

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(ii) Calculate the range of the projectile. 2M

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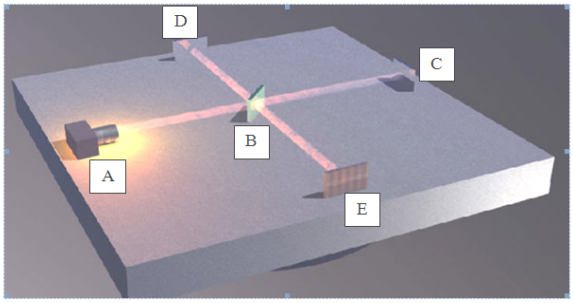
16. Outline, with reference to this diagram, the method used in the Michelson-Morley experiment. 3M



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17. Assess the impact of advances in physics on the development of electric motors. 4M

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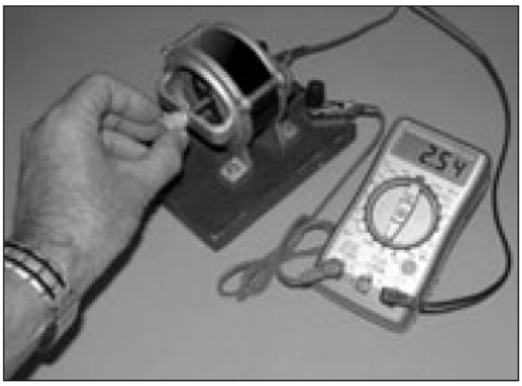
18. A small DC motor shown below consisted of a coil of 150 turns, each having an area of 6×10^{-4} m^2. The coils were in a uniform magnetic field of 2×10^{-2} T. An ammeter was used to measure the current through the motor. If the axle of the motor was held firmly, preventing it from rotating, a current of 2.54 A flowed through the motor. However when it was running freely, a current a 2.09 A was recorded.



(a) Calculate the maximum torque that had to be counteracted when the motor was prevented from rotating. 2M

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(b) Why was the current less when the motor was running freely? 2M

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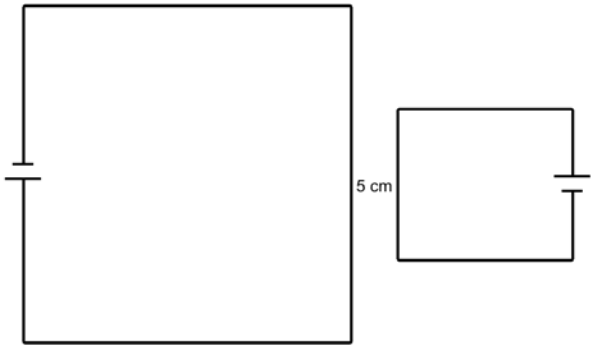
19. Two pieces of wire 80 cm long and 40 cm long were connected to batteries and formed into squares with their closest sides 5 cm apart as shown below. The current in the larger loop was 2 amperes and the current in the smaller loop was 0.5 amperes.



(a) Calculate the force between the wires. 2M

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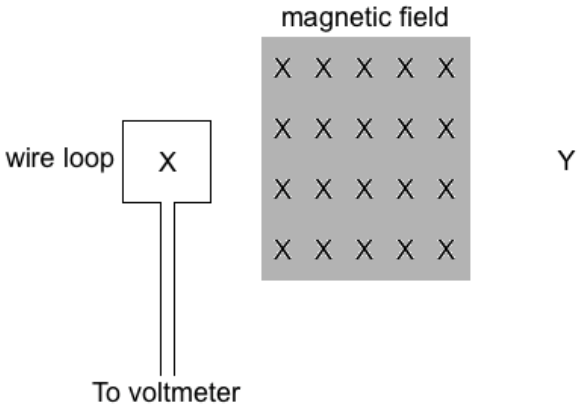
20. A student conducted an investigation as follows.

- A rectangular loop of wire made of copper wire was connected to a voltmeter.
- The loop of wire was moved at a constant speed through the magnetic field, with the plane of the loop perpendicular to the field, from the position X until the centre of the loop was at the point Y. The maximum reading on the voltmeter was recorded.
- This was repeated at different speeds and the maximum reading on the voltmeter was recorded for each repetition.



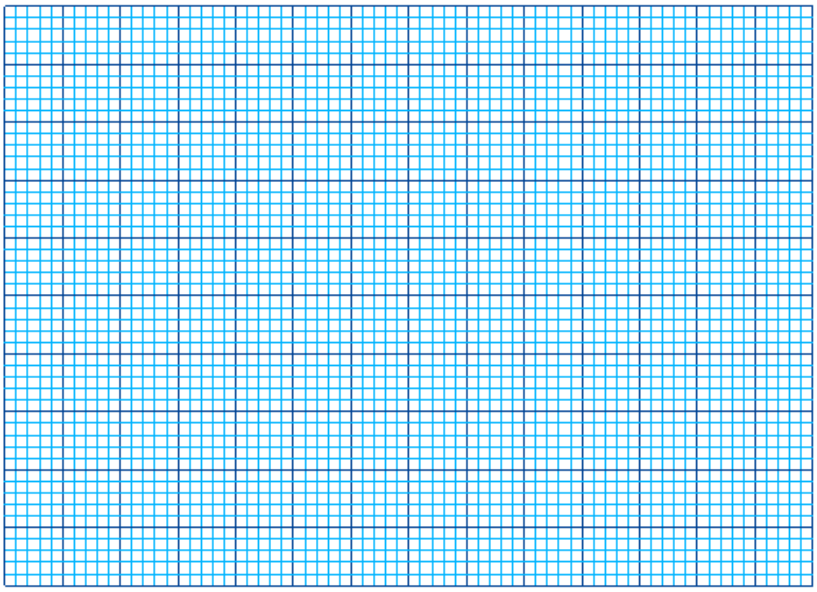
The loop and the field are drawn to the same scale

(a) Sketch a graph of the voltage if the loop moved from X to Y in 2 seconds and label significant points on the graph. 2M

(b) The following table shows the maximum voltage recorded at different speeds when the loop was moved through the magnetic field.

Speed (cm s^{-1})	2	4	8	10	13
Voltage (mV)	140	300	530	730	900

Graph this data with the dependent variable on the vertical axis and draw a line of best fit. 3M



(c) Predict the voltage that would be produced if the velocity were 6 cm s^{-1}.
Show your working or reasoning clearly. 2M

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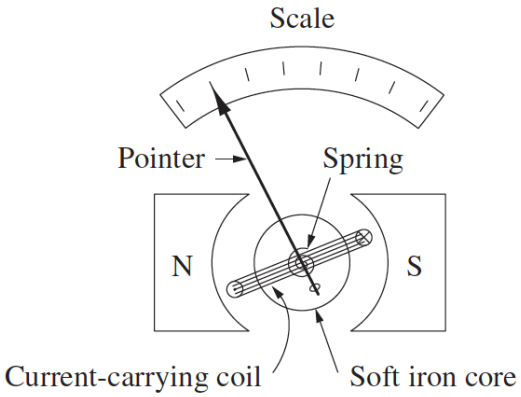
21. The diagram below represents an electrical device that had a significant impact on scientific research carried out during the 20th century.



Identify the device and outline the principle upon which its operation depends. 2M

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END OF EXAM

Physics

DATA SHEET

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

FORMULAE SHEET

$$v = f\lambda$$

$$I \propto \frac{1}{d^2}$$

$$\frac{v_1}{v_2} = \frac{\sin i}{\sin r}$$

$$E = \frac{F}{q}$$

$$R = \frac{V}{I}$$

$$P = VI$$

$$\text{Energy} = VIt$$

$$v_{av} = \frac{\Delta r}{\Delta t}$$

$$a_{av} = \frac{\Delta v}{\Delta t} \text{ therefore } a_{av} = \frac{v-u}{t}$$

$$\Sigma F = ma$$

$$F = \frac{mv^2}{r}$$

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

$$W = Fs$$

$$p = mv$$

$$\text{Impulse} = Ft$$

$$E_p = -G\frac{m_1 m_2}{r}$$

$$F = mg$$

$$v_x^2 = u_x^2$$

$$v = u + at$$

$$v_y^2 = u_y^2 + 2a_y\Delta y$$

$$\Delta x = u_x t$$

$$\Delta y = u_y t + \frac{1}{2}a_y t^2$$

$$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$

$$F = \frac{Gm_1 m_2}{d^2}$$

$$E = mc^2$$

$$l_v = l_0\sqrt{1-\frac{v^2}{c^2}}$$

$$t_v = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$m_v = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

FORMULAE SHEET

$$\frac{F}{l} = k\frac{I_1 I_2}{d}$$

$$F = BIl\sin\theta$$

$$\tau = Fd$$

$$\tau = nBIA\cos\theta$$

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

$$d = \frac{1}{p}$$

$$M = m - 5\log\left(\frac{d}{10}\right)$$

$$\frac{I_A}{I_B} = 100^{(m_B - m_A)/5}$$

$$m_1 + m_2 = \frac{4\pi^2 r^3}{GT^2}$$

$$F = qvB\sin\theta$$

$$E = \frac{V}{d}$$

$$E = hf$$

$$c = f\lambda$$

$$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$\lambda = \frac{h}{mv}$$

$$Z = \rho v$$

$$\frac{I_r}{I_0} = \frac{\left[Z_2 - Z_1\right]^2}{\left[Z_2 + Z_1\right]^2}$$

$$A_0 = \frac{V_{\text{out}}}{V_{\text{in}}}$$

$$\frac{V_{\text{out}}}{V_{\text{in}}} = -\frac{R_{\text{f}}}{R_{\text{i}}}$$

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	79	Symbol of element
	Au	
Atomic Weight	197.0	
	Gold	Name of element

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223] Francium	88 Ra [226] Radium	89–103 Actinoids	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium

For elements that have no stable or long-lived nuclides, the mass number of the nuclide with the longest confirmed half-life is listed between square brackets.

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (October 2005 version) is the principal source of data. Some data may have been modified.

Multiple-choice Answer Sheet

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ⬭ (B) ⬬ (C) ⬭ (D) ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ⬬ (B) ⊗ (C) ⬭ (D) ⬭

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows:

correct ↓

(A) ⊗ (B) ⊗ (C) ⬭ (D) ⬭

Part A

1.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
2.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
3.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
4.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
5.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
6.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
7.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
8.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
9.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
10.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭