Released Items
Science 30

Released Diploma Examination Items

2018

Alberta

For further information, contact

Stan Bissell, **Science 30 Exam Manager**, at
780-422-5730
Stan.Bissell@gov.ab.ca, or

Mark Haak, **Science 30 Examiner**, at
780-422-3337
Mark.Haak@gov.ab.ca, or

Deanna Shostak, **Director of Diploma Programs**, at
780-422-5160
Deanna.Shostak@gov.ab.ca, or

Provincial Assessment Sector: 780-427-0010.
To call toll-free from outside Edmonton, dial 310-0000.

The Alberta Education website is found at education.alberta.ca.

Contents

Introduction

The questions presented in this booklet are selected from the August 2014 Science 30 Diploma Examinations. This material, along with the program of studies and the *Science 30 Information Bulletin,* can assist you with instructional programming.

These examination items are released by the Provincial Assessment Sector. They may be used by the classroom teacher as an examination, a quiz, or a review for students.

Additional Documents

The Provincial Assessment Sector supports the instruction of Science 30 in classrooms with the following documents available online:

- School Reports and Instructional Group Reports
  available at https://phoenix.edc.gov.ab.ca/login
  Detailed statistical information is provided on provincial, group, and individual student performance on the entire examination.

- *Science 30 Information Bulletin*
  available at education.alberta.ca
  Contains information about the diploma examinations for the upcoming school year, sample questions, assessment samples for classroom use with student exemplars, and scoring criteria.

- Science 30 Previous Examinations
  A selection of items from the January 2008, June 2008, and January 2009 diploma examinations are released and are available in PDF format. The entire August 2015, August 2016, and April 2017 diploma examinations are also released and are available in PDF format. The August 2015 Diploma Examination is also posted on Quest A+ for student practice. https://questaplus.alberta.ca

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Science 30 Diploma Examination August 2014—Blueprint Summary

Key: MC—Multiple Choice; NR—Numerical Response

	Diff.*	Key	K	STS	Skill
MC1	0.596	B	A1.4k		A1.2s
MC2	0.746	B			B1.2s
MC3	0.622	C			B1.2s
MC4	0.668	B	B1.9k		
MC5	0.835	D		B2.1sts	
MC6	0.710	B	C1.1k		C1.2s
MC7	0.276	D	C1.3k, C1.4k		C1.3s
MC8	0.544	A	C1.6k		C1.3s
MC9	0.738	A	C1.9k		C1.3s
MC10	0.530	D	C2.4k		
MC11	0.672	C	C2.10k		
MC12	0.756	B	C2.6k		C2.1s
MC13	0.795	B	D1.2k		
MC14	0.457	C	D2.3k		
MC15	0.765	C	D2.4k, D2.13k		
MC16	0.729	A	D2.4k, B1.8k		
MC17	0.849	C			D2.3s
MC18	0.524	A	D2.5k, D2.8k		
MC19	0.548	C	D2.7k		D2.3s

*Difficulty—proportion of students answering the question correctly

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Key: MC—Multiple Choice; NR—Numerical Response

	Diff.*	Key	K	STS	Skill
NR1	0.587	5423, 5432			A1.1s, A1.2s
NR2	0.797	4132	A2.3k		
NR3	0.210	125 (any order)	A3.4k		
NR4	0.594	2413	A3.6k, A3.7k		
NR5	0.647	159, 247, 368	B2.3k, B2.4k, B2.5k		
NR6	0.891	9.96			C1.3s
NR7	0.652	2.73	C1.3s		
NR8	0.406	1367, 2457	D1.5k, D2.3k		
NR9	0.855	321	D2.10k, D2.11k		

*Difficulty—proportion of students answering the question correctly

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# Science 30 Diploma Examination August 2014— Released Items

Use the following information to answer question 1.

A laboratory technician collected a blood sample from a healthy person and a blood sample from a person with health problems, then observed their blood with a light microscope. The two samples are shown below.

Healthy Person
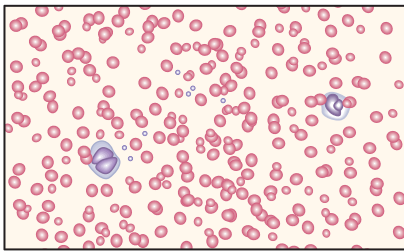
Person with Health Problems
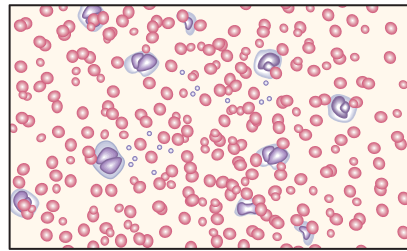
1. Based on the blood samples above, a reasonable conclusion that the technician could make is that the person with health problems has

    A.   hemophilia because there are fewer clotting enzymes present
    B.   a bacterial infection because there are more white blood cells present
    C.   a blood vessel blockage because there are fewer activated platelets present
    D.   sickle-cell anemia because there are more deformed red blood cells present

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Use the following information to answer numerical-response question 1.

Low-density lipoprotein (LDL) is a type of blood protein that allows cholesterol and fats to be transported in the bloodstream. Higher levels of LDL in the blood have been linked to increased incidences of cardiovascular diseases such as atherosclerosis.

Researchers conducted a six-month study to determine whether a high-fibre, low-fat diet would reduce a person's LDL levels. For the study, 100 people between the ages of 35 and 50 who had higher-than-average LDL levels were chosen. Fifty of the participants were asked to follow the diet, and 50 were asked to eat as they normally would. Blood tests were done at the beginning and the end of the trial, and the following results were observed.

	Average LDL Level Before Study (mmol/L)	Average LDL Level After Study (mmol/L)
Treatment Group— high-fibre, low-fat diet	4.3	3.3
Control Group— regular diet	4.4	4.0

Variables in the Study

1 Rate of atherosclerosis development
2 Age of the participants
3 Length of the study
4 LDL level
5 Diet

Numerical Response

1. Match the variables numbered above with the terms given below. (Use a number only once. There is more than one correct answer.)

Manipulated variable _____ (Record in the **first** column)

Responding variable _____ (Record in the **second** column)

Controlled variable _____ (Record in the **third** column)

Controlled variable _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Use the following information to answer numerical-response question 2.

Some Functions of Immune System Components

1 Attach to foreign proteins on pathogens and clump the pathogens together
2 Ensure a quick response to re-infection by pathogens
3 Destroy body cells infected with viruses
4 Produce antibodies

Numerical Response

2. Match the immune system functions numbered above to the immune system component listed below that carries out that function. (Use each number only once.)

Function: _____ _____ _____ _____
Component: **B cells** **Antibodies** **Killer T cells** **Memory cells**

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

_____

Use the following information to answer numerical-response question 3.

Some Cellular Components

1 Cytosine
2 Phosphate
3 Tryptophan
4 Chromosomes
5 Deoxyribose sugar

Numerical Response

3. The three components from the list above that could comprise a DNA nucleotide are _____, _____, and _____.

(Record all **three digits** of your answer **in any order** in the numerical-response section on the answer sheet.)

Use the following information to answer numerical-response question 4.

Descriptions of Terms Associated with Proteins

1 A type of protein that speeds up the rate of reactions in the body
2 The protein that enables red blood cells to transport oxygen
3 A section of DNA that codes for a particular protein
4 One of 20 possible protein building blocks

Numerical Response

4. Match each description numbered above with its associated term below.
(Use each number only once.)

Description: _____ _____ _____ _____
Term: **Hemoglobin**   **Amino acid**   **Enzyme**   **Gene**

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

A series of acid–base indicators were added to four separate samples of a solution with an unknown pH.

Resulting Indicator Colours After Addition to Sample

Indicator Added	Colour Observed
Methyl orange	Yellow
Phenolphthalein	Colourless
Chlorophenol red	Yellow
Methyl red	Orange

2. The pH of the unknown solution was approximately

    A.   3

    B.   5

    C.   7

    D.   8

A sample solution of $HNO_3(aq)$ and the indicator bromothymol blue were titrated with $NaOH(aq)$.

Titration Procedures

    I   Rinse the Erlenmeyer flask with $NaOH(aq)$.
    II   Rinse the burette with distilled water, then with $NaOH(aq)$.
   III   Rinse the burette with $NaOH(aq)$, then with distilled water.
    IV Expel air bubbles from the burette tip by allowing some $NaOH(aq)$ solution to run through it.

3. In preparation for titration with $NaOH(aq)$, the procedures that are part of proper titration technique are

    A.   I and II

    B.   I and III

    C.   II and IV

    D.   III and IV

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Some Environmental Effects

1   Stunted plant growth
2   Melting of the polar ice caps
3   Decrease in aquatic biodiversity
4   Leaching of heavy metals into soil
5   Increased frequency of severe storms and flooding

4. The effects listed above that can be directly linked to acid deposition are

    A.   1, 2, and 5

    B.   1, 3, and 4

    C.   2, 4, and 5

    D.   3, 4, and 5

5. *Climate change has been **most directly** linked to an increase in atmospheric levels of* ___*i*___ . *A major source of this type of gas emission is* ___*ii*___ .

The statements above are completed by the information in row

Row	*i*	*ii*
A.	hydrogen sulfide, $H_2S(g)$	old refrigerators and aerosol cans
B.	hydrogen sulfide, $H_2S(g)$	fossil fuel combustion
C.	carbon dioxide, $CO_2(g)$	old refrigerators and aerosol cans
D.	carbon dioxide, $CO_2(g)$	fossil fuel combustion

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Environmental Pollutant	Pollutant Source	Effect of Pollutant
1 Chlorofluorocarbons, CFCs	**4** Automobile emissions	**7** Causes respiratory issues
2 Nitrogen oxides, NO_x	**5** Refrigerants and propellants	**8** Biomagnifies in food chains
3 Polychlorinated biphenyls, PCBs	**6** Old electrical transformers	**9** Depletes ozone in upper atmosphere

Numerical Response

5. Using the numbers above, choose **one environmental pollutant** and match it with a source of that pollutant and with an effect of that pollutant. (There is more than one correct answer.)
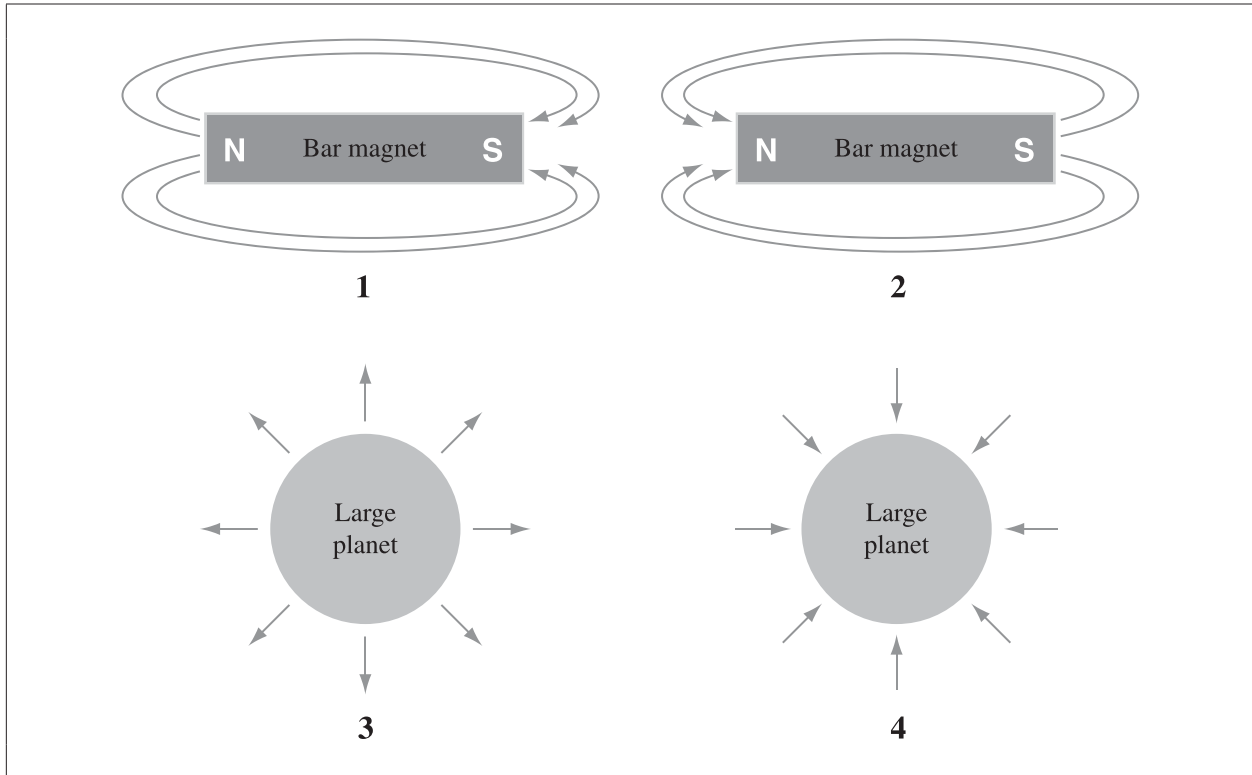
Environmental pollutant   _____ (Record in the **first** column)

Pollutant source   _____ (Record in the **second** column)

Effect of pollutant   _____ (Record in the **third** column)

(Record your answer in the numerical-response section on the answer sheet.)

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Use the following information to answer question 6.

6. Which of the following rows identifies the diagram showing the direction of magnetic field lines and the diagram showing the direction of gravitational field lines?

Row	Magnetic Field Lines	Gravitational Field Lines
A.	1	3
B.	1	4
C.	2	3
D.	2	4

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A Charged Sphere

Metal sphere with charge q

A — r — $2r$ — B

Insulated stand
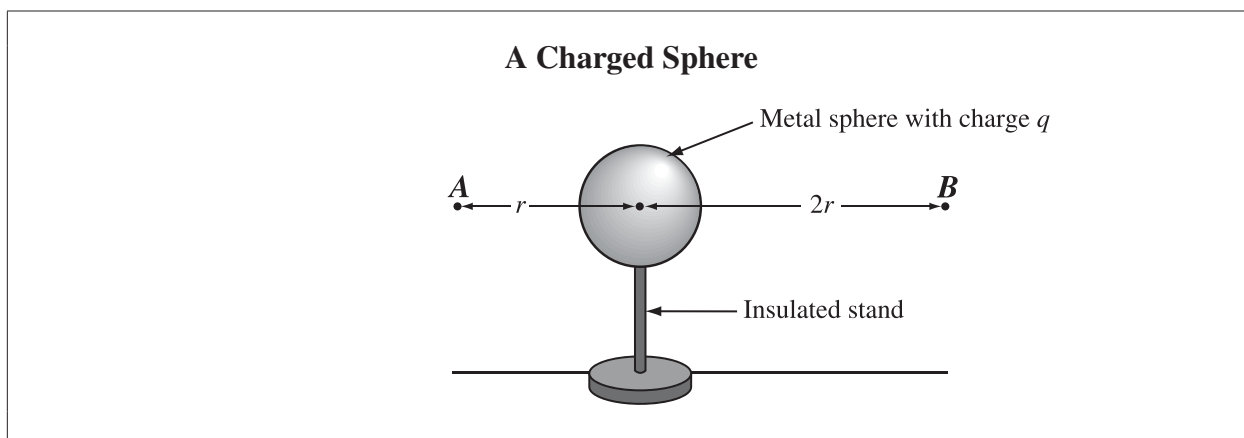
7. Compared to position A, the relative magnitude of the electric field strength of the charged sphere at position B is

    A. half the electric field strength at position A
    B. two times the electric field strength at position A
    C. four times the electric field strength at position A
    D. one-quarter the electric field strength at position A

A 15 Ω microwave oven, a 12 Ω toaster, and a 60 Ω blender are all wired in parallel with a 120 V power source. For safety, the circuit includes a circuit breaker with a 15 A limit. A circuit diagram representing this household circuit is shown below.
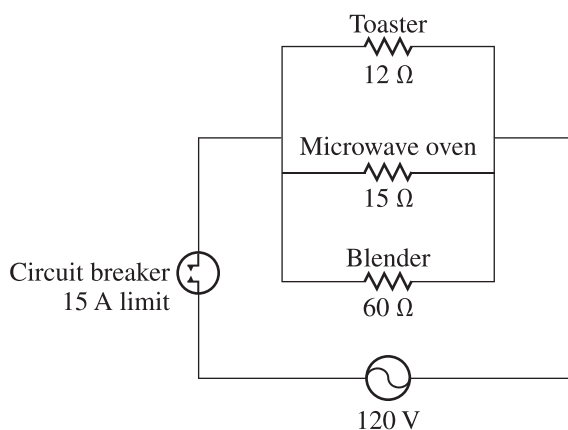
8. Which of the following rows identifies the total current if all three devices are switched on at the same time and how this current would affect the circuit breaker?

Row	Total Current	Effect of Current on Circuit Breaker
A.	20 A	The circuit breaker will trip and stop the flow of current.
B.	20 A	The circuit breaker will allow the current to flow.
C.	1.4 A	The circuit breaker will trip and stop the flow of current.
D.	1.4 A	The circuit breaker will allow the current to flow.

_____

Numerical Response

6. If a cellphone charging pad has an output voltage of 12.0 V and a current of 0.830 A, then the power provided by the cellphone charging pad is _____ W.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

7. If a water treatment plant uses 3.16×10^6 W of power, then the energy the plant uses in 1.00 day is _____ $\times 10^{11}$ J.

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Use the following information to answer question 9.

During travel to countries with different power sources, a transformer within a travel adapter can be used to adapt the foreign power source to work with appliances the traveller has brought from home.

Schematic Diagram of a Travel-adapter Transformer
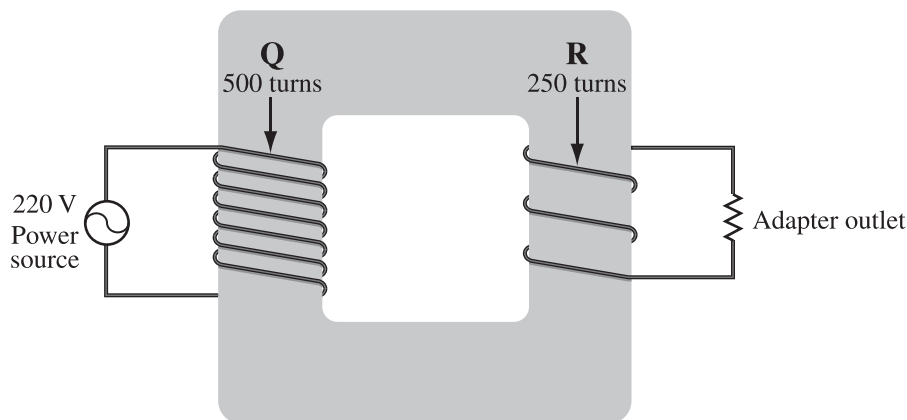
9. *The primary coil of the transformer in the diagram is labelled ____i____ , and the output voltage from the secondary coil is ____ii____ V.*

The statement above is completed by the information in row

Row	*i*	*ii*
A.	Q	110
B.	Q	440
C.	R	110
D.	R	440

10. *When light bounces off water or snow, it undergoes* ____*i*____ *. When sunglass lenses allow light through that is vibrating in only one direction, it is an effect of* ____*ii*____ *.*

The statements above are completed by the information in row

Row	*i*	*ii*
A.	refraction	diffraction
B.	refraction	polarization
C.	reflection	diffraction
D.	reflection	polarization

11. *Doppler-shift technology can be used to determine a star's* ____*i*____ *and this technology has provided evidence that the universe is* ____*ii*____ *.*

The statement above is completed by the information in row

Row	*i*	*ii*
A.	surface temperature	expanding
B.	surface temperature	contracting
C.	relative velocity	expanding
D.	relative velocity	contracting

12. Radio EMR with a frequency of 6.0×10^7 Hz has a wavelength of

A. 0.050 m
B. 5.0 m
C. 1.5×10^9 m
D. 1.8×10^{16} m

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Comparison of Two Fuels

Type of Fuel	Classification of Fuel	Net Carbon Dioxide, $CO_2(g)$, Emission Levels Produced by Fuel	Original Source of Energy in Fuel
1 Biomass	3 Renewable	5 High	7 Solar
2 Fossil fuels	4 Non-renewable	6 Low	8 Non-solar

Numerical Response

8. Using the numbers above, choose **one type of fuel** and match it with its classification, its **net** $CO_2(g)$ emission levels, and the original source of the energy for that fuel. (There is more than one correct answer.)

Type of fuel _____ (Record in the **first** column)

Classification _____ (Record in the **second** column)

Net $CO_2(g)$ emission levels _____ (Record in the **third** column)

Original source of energy _____ (Record in the **fourth** column)

(Record your answer in the numerical-response section on the answer sheet.)

Comparison of Two Developing Countries with Similar Gross Domestic Products (2010)

Country	Gross Domestic Product (billions of USD)[1]	Population (millions)	Electrical Energy Consumption (TW·h)
Angola	24.45	18.02	3.41
Belarus	24.04	9.68	33.17

—Data from the International Energy Association, 2010

[1]Gross domestic product (GDP) is an indicator of a country's economic activity and is usually reported in United States dollars (USD) so that comparisons between countries with different currencies can be made.

13. Which of the following rows compares the per capita electrical energy use of the two countries above for 2010 and accurately predicts Canada's per capita energy use relative to these two countries in 2010?

Row	Comparison of Electrical Energy Consumption of Angola and Belarus	Canada's Predicted Electrical Energy Consumption
A.	Angola had a lower per capita consumption than Belarus.	Canada had a lower per capita consumption than either country.
B.	Angola had a lower per capita consumption than Belarus.	Canada had a higher per capita consumption than either country.
C.	Angola had a higher per capita consumption than Belarus.	Canada had a lower per capita consumption than either country.
D.	Angola had a higher per capita consumption than Belarus.	Canada had a higher per capita consumption than either country.

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Energy Sources

I	Wind
II	Hydro
III	Biomass
IV	Geothermal
V	Nuclear fission
VI	Photovoltaic cells

14. Radiant solar energy received by Earth is the original source of energy for

    A. I, II, and III only

    B. II, III, and VI only

    C. I, II, III, and VI

    D. II, III, IV, and V

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15. An energy conversion technology that relies on gravitational potential energy in order to produce kinetic energy is a

    A. photovoltaic cell

    B. geothermal plant

    C. hydroelectric dam

    D. nuclear fission reactor

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Animal fats and vegetable oils can be reacted with methanol and sodium hydroxide to produce biodiesel. Compared with conventional diesel, biodiesel contains significantly less sulfur.

16. One advantage of using biodiesel over using conventional diesel is that

    A. a source of acid deposition would be reduced

    B. a source of ozone depletion would be reduced

    C. water vapour would not be a combustion product

    D. carbon dioxide would not be a combustion product
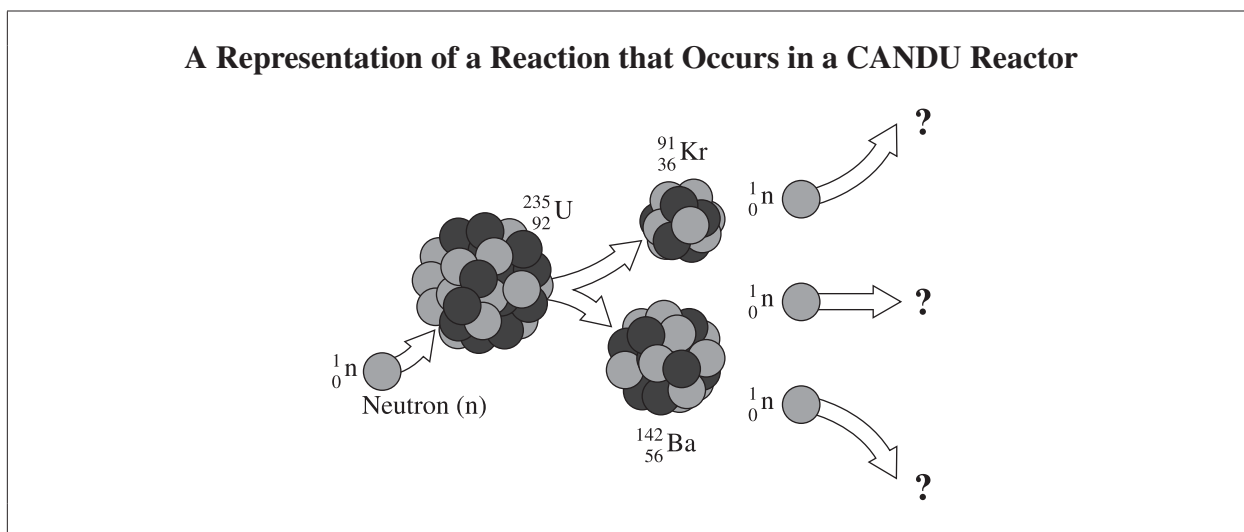
Use the following information to answer question 17.

A homeowner is considering replacing the water heater in his home. He determines that his conventional water heater uses 250 J of energy to give the water 60 J of heat. He compares this with a tankless water heater that uses 80 J of energy to give the water 60 J of heat.

17. Which of the following rows identifies the percent efficiency of the water heaters?

Row	Efficiency of Conventional Water Heater	Efficiency of Tankless Water Heater
A.	20%	75%
B.	20%	32%
C.	24%	75%
D.	24%	32%

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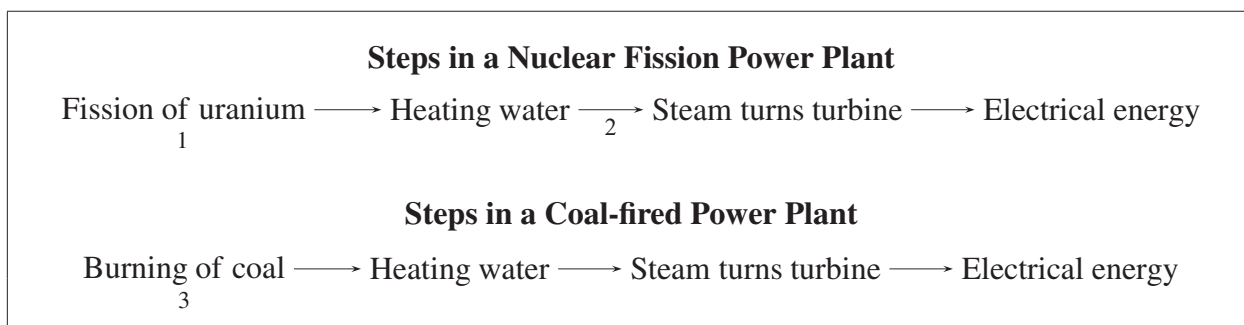**A Representation of a Reaction that Occurs in a CANDU Reactor**

18. Which of the following rows identifies the type of reaction illustrated above and the isotope each free neutron will interact with to sustain a chain reaction?

Row	Type of Reaction Illustrated	Isotope That the Free Neutrons Interact With
A.	Nuclear fission	Uranium-235
B.	Nuclear fission	Krypton-91
C.	Radioactive decay	Uranium-235
D.	Radioactive decay	Krypton-91

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19. If 3.89×10^{-9} kg of matter is completely converted to energy in a nuclear reaction the quantity of energy produced is

    A.   1.17 J

    B.   1.36 J

    C. 3.50×10^8 J

    D. 1.17×10^{18} J

Use the following information to answer numerical-response question 9.

Steps in a Nuclear Fission Power Plant

Fission of uranium $\xrightarrow{1}$ Heating water $\xrightarrow{2}$ Steam turns turbine $\longrightarrow$ Electrical energy

Steps in a Coal-fired Power Plant

Burning of coal $\xrightarrow{3}$ Heating water $\longrightarrow$ Steam turns turbine $\longrightarrow$ Electrical energy

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Numerical Response

9. Match each of the steps numbered above with the type of energy change that occurs in that step given below.

                Step Number: _____   _____   _____

    Type of Energy Change: **Chemical**   **Phase**   **Nuclear**

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

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