Information Document

Environmental Science and Technalogy

EST-400.A11

Theory Examination – Secondary 4

Creation Team: Sir Wilfrid Laurier School Board

Validation Team: Western Quebec School Board

Portal Validation: Lester B. Pearson and English Montreal School Boards

Structure

This theory examination evaluates mastery and use of subject-specific knowledge as well as competencies 2 and 3 of the *Environmental Science and Technology* program. It consists of 20 questions in two sections worth a total of 80 marks.

The following table provides a distribution of the questions in each content area of the program, a breakdown of the types of questions and the percentage value for the exam.

Content Area	The Material World	The Living World	The Earth and Space	The Technological World
Weighting	60 %	20 %	10 %	10 %
Part A Multiple-Choice 50 %	6 questions	2 questions	1 question	1 question
Part B Constructed-Response 50 %	6 questions	2 questions	1 question	1 question

NOTE: *Each question is worth four marks.*
        Significant figures will be evaluated in one question.

Competencies and Criteria Evaluated

Competencies:

· *Makes the most of his/her knowledge of science and technology.*

· *Communicates in the languages used in science and technology.*

Criteria:

· *Mastery of subject-specific knowledge*

· *Relevant use of scientific and technological knowledge*

· *Appropriate formulation of explanations or solutions*

Time Allotted

2 hours (*An additional 5 minutes per hour may be allotted if needed.*)

Provided Documents

· *Administration and Marking Guide*
· *Question Booklet*
· *Student Booklet*

Authorized Materials

The following materials are permitted during the examination:
· Calculators with or without graphic displays*
· Writing instruments
· Rulers

* Calculators with or without graphic displays designed mainly to perform mathematical calculations are authorized during official exams. **Before the exam starts**, data and programs stored in calculators' memories must be deleted. Calculators equipped with formal calculation software are not authorized for the exams. These models are allowed **under the sole condition** that the formal calculation functions are deactivated during the exam. Computers, tablet computers, electronic organizers and calculators with alphanumeric keyboards (QWERTY or AZERTY) are not authorized. All calculator peripherals, such as instruction manuals and memory expansion devices, are forbidden. It is strictly forbidden to use memory expansion cards or chips, as well as data or program libraries. Communication between calculators is not allowed during the exam. Using a calculator containing stored data or programs will be considered as cheating. Students may not share calculators.

[Adapted from: *MELS Information Document, Science and Technology, Applied Science and Technology, June/August 2012/January 2013*, and provided as a recommendation.]

NOTE: *Students may refer to the Periodic Table of Elements and the lists of Formulas and Physical Constants included in the Question Booklet (Appendices 2, 3 and 4 of this document).*

Appendix 1

Evaluation Tools[1]

In order to determine what is expected of the students and to ensure a uniform understanding of the evaluation tools, it is suggested that teachers in each school form a marking committee to analyze the work of a sample of students.

Guidelines for correcting questions requiring an explanation, a justification or a representation:

Analyze the student's work and determine if it is appropriate.

- An explanation, a justification or a representation is **appropriate** if most of the elements of the answer are correct and if appropriate terminology or symbolism is used.

- An explanation, a justification or a representation is **partially appropriate** if:

  ➢ Most of the elements of the answer are correctly indicated, **but** the terminology or symbolism used is not appropriate.
  ➢ Some elements of the answer are indicated, **and** some of the terminology or symbolism used is appropriate.

- An explanation, a justification or a representation is **inappropriate** if most of the elements of the answer are incorrect or missing, or if the terminology or symbolism used is inappropriate.

Guidelines for correcting questions requiring the use of formal mathematical solutions:

Step 1

Analyze the work to understand the procedure used by the student, and then decide if the procedure is appropriate or not.

- A procedure is **appropriate** if most of the steps are relevant and could lead to the correct answer.

- A procedure is **partially appropriate** if the steps presented do not lead to the correct answer, but include at least one step that is relevant and correct.

- A procedure is **inappropriate** if none of the steps presented are relevant or if the student has not shown any work.

Step 2

If the procedure is deemed **appropriate** or **partially appropriate,** then evaluate the answer. If the answer is incorrect, identify the type of error(s) made.

- An **error** is considered **minor** if it is an error in calculation or transcription, or if the unit of measurement is incorrect or missing.

- An **error** is considered **major** if a law, rule or formula has been applied incorrectly.

No marks are allotted for a correct answer when the procedure used is **inappropriate**, or no work is shown.

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1. Adapted from: *MELS, 555-410, Science and Technology, Marking Guide, June 2012,* and provided as a recommendation.

FORMULAS			
$C = \dfrac{m}{V}$	C: concentration m: mass V: volume	$W = \Delta E$	W: work ΔE: variation in energy
$V = RI$	V: potential difference R: resistance I: electric current intensity	$W = F\Delta d$	W: work F: force Δd: distance travelled
$R_{eq} = R_1 + R_2 + ...$	R_{eq}: equivalent resistance	$F_g = mg$	F_g: gravitational force m: mass g: gravitational field intensity
$\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ...$	R_{eq}: equivalent resistance	$E_p = mgh$	E_p: gravitational potential energy m: mass g: gravitational field intensity h: height
$E = P\Delta t$	E: energy consumed P: power Δt: change in time	$E_k = ½\, mv^2$	E_k: kinetic energy m: mass v: velocity
$P = VI$	P: power V: potential difference I: electric current intensity	$Q = mc\Delta T$	Q: quantity of heat m: mass c: specific heat capacity ΔT: change in temperature
$F_e = \dfrac{kq_1q_2}{r^2}$	F_e: electrical force k: Coulomb's constant q: charge of particle r: distance between two particles	$E = VI\Delta t$	E: energy consumed V: potential difference Δt: change in time I: electric current intensity

QUANTITIES		
NAME	**SYMBOL**	**VALUE**
Coulomb's constant	k	$9 \times 10^9 \; \dfrac{Nm^2}{C^2}$
Gravitational field intensity on Earth	g	9.8 N/kg
Specific heat capacity for water	c	$4.19 \; J/(g \bullet {}^\circ C)$

PERIODIC TABLE OF THE ELEMENTS

Key

Element symbol

Atomic number
1
H
Atomic mass
1.01

I A 1	II A 2												III A 13	IV A 14	V A 15	VI A 16	VII A 17	VIII A 18
1 **H** hydrogen 1.01								VIII B									2 **He** helium 4.00
3 **Li** lithium 6.94	4 **Be** beryllium 9.01											5 **B** boron 10.81	6 **C** carbon 12.01	7 **N** nitrogen 14.01	8 **O** oxygen 16.00	9 **F** fluorine 19.00	10 **Ne** neon 20.18
11 **Na** sodium 22.99	12 **Mg** magnesium 24.31	III B 3	IV B 4	V B 5	VI B 6	VII B 7	8	9	10	I B 11	II B 12	13 **Al** aluminum 26.98	14 **Si** silicon 28.09	15 **P** phosphorus 30.97	16 **S** sulphur 32.07	17 **Cl** chlorine 35.45	18 **Ar** argon 39.95
19 **K** potassium 39.10	20 **Ca** calcium 40.08	21 **Sc** scandium 44.96	22 **Ti** titanium 47.90	23 **V** vanadium 50.94	24 **Cr** chromium 52.00	25 **Mn** manganese 54.94	26 **Fe** iron 55.85	27 **Co** cobalt 58.93	28 **Ni** nickel 58.71	29 **Cu** copper 63.55	30 **Zn** zinc 65.39	31 **Ga** gallium 69.72	32 **Ge** germanium 72.59	33 **As** arsenic 74.92	34 **Se** selenium 78.96	35 **Br** bromine 79.90	36 **Kr** krypton 83.80
37 **Rb** rubidium 85.47	38 **Sr** strontium 87.62	39 **Y** yttrium 88.91	40 **Zr** zirconium 91.22	41 **Nb** niobium 92.91	42 **Mo** molybdenum 95.94	43 **Tc** technetium 98.91	44 **Ru** ruthenium 101.07	45 **Rh** rhodium 102.91	46 **Pd** palladium 106.40	47 **Ag** silver 107.87	48 **Cd** cadmium 112.41	49 **In** indium 114.82	50 **Sn** tin 118.71	51 **Sb** antimony 121.75	52 **Te** tellurium 127.60	53 **I** iodine 126.90	54 **Xe** xenon 131.30
55 **Cs** caesium 132.91	56 **Ba** barium 137.33	57-71 lanthanoids	72 **Hf** hafnium 178.49	73 **Ta** tantalum 180.95	74 **W** tungsten 183.85	75 **Re** rhenium 186.21	76 **Os** osmium 190.20	77 **Ir** iridium 192.22	78 **Pt** platinum 195.09	79 **Au** gold 196.97	80 **Hg** mercury 200.59	81 **Tl** thallium 204.37	82 **Pb** lead 207.20	83 **Bi** bismuth 208.98	84 **Po** polonium (209)	85 **At** astatine (210)	86 **Rn** radon (222)
87 **Fr** francium (223)	88 **Ra** radium (226)	89-103 actinoids	104 **Rf** rutherfordium (267)	105 **Db** dubnium (268)	106 **Sg** seaborgium (271)	107 **Bh** bohrium (272)	108 **Hs** hassium (270)	109 **Mt** meitnerium (276)	110 **Ds** darmstadtium (281)	111 **Rg** roentgenium (280)	112 **Cn** copernicium (285)	113 **Uut** ununtrium (284)	114 **Fl** flerovium (289)	115 **Uup** ununpentium (288)	116 **Lv** livermorium (293)	117 **Uus** ununseptium (292)	118 **Uuo** ununoctium (294)

6	57 **La** lanthanum 138.91	58 **Ce** cerium 140.12	59 **Pr** praseodymium 140.91	60 **Nd** neodymium 144.24	61 **Pm** promethium (145)	62 **Sm** samarium 150.36	63 **Eu** europium 151.96	64 **Gd** gadolinium 157.25	65 **Tb** terbium 158.93	66 **Dy** dysprosium 162.50	67 **Ho** holmium 164.93	68 **Er** erbium 167.26	69 **Tm** thulium 168.93	70 **Yb** ytterbium 173.05	71 **Lu** lutetium 174.97
7	89 **Ac** actinium (227)	90 **Th** thorium 232.04	91 **Pa** protactinium 231.04	92 **U** uranium 238.03	93 **Np** neptunium (237)	94 **Pu** plutonium (244)	95 **Am** americium (243)	96 **Cm** curium (247)	97 **Bk** berkelium (247)	98 **Cf** californium (251)	99 **Es** einsteinium (252)	100 **Fm** fermium (257)	101 **Md** mendelevium (258)	102 **No** nobelium (259)	103 **Lr** lawrencium (262)