N11/4/CHEMI/SPM/ENG/TZ0/XX

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CHEMISTRY
STANDARD LEVEL
PAPER 1

Monday 7 November 2011 (afternoon)

45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The periodic table is provided for reference on page 2 of this examination paper.

The Periodic Table

1	2											3	4	5	6	7	0
1 **H** 1.01																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.55	30 **Zn** 65.37	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** 98.91	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.40	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
55 **Cs** 132.91	56 **Ba** 137.34	57 † **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.21	77 **Ir** 192.22	78 **Pt** 195.09	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 ‡ **Ac** (227)															

†	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** 146.92	62 **Sm** 150.35	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.92	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
‡	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (242)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (254)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

1. How many oxygen **atoms** are in 0.100 mol of $CuSO_4 \cdot 5H_2O$?

A. 5.42×10^{22}

B. 6.02×10^{22}

C. 2.41×10^{23}

D. 5.42×10^{23}

2. What is the sum of the coefficients when the following equation is balanced using whole numbers?

$$\_\_\_ Fe_2O_3(s) + \_\_\_ CO(g) \rightarrow \_\_\_ Fe(s) + \_\_\_ CO_2(g)$$

A. 5

B. 6

C. 8

D. 9

3. 1.0 dm^3 of an ideal gas at 100 kPa and 25 °C is heated to 50 °C at constant pressure. What is the new volume in dm^3?

A. 0.50

B. 0.90

C. 1.1

D. 2.0

4. What is the amount, in moles, of sulfate ions in 100 cm^3 of 0.020 mol dm^{-3} $FeSO_4(aq)$?

A. 2.0×10^{-3}

B. 2.0×10^{-2}

C. 2.0×10^{-1}

D. 2.0

5. A sample of zinc has the following composition:

Isotope	% abundance
^{64}Zn	55
^{66}Zn	40
^{68}Zn	5

What is the relative atomic mass of the zinc in this sample?

A. 64.5

B. 65.0

C. 65.9

D. 66.4

6. Which statement about the electromagnetic spectrum is **not** correct?

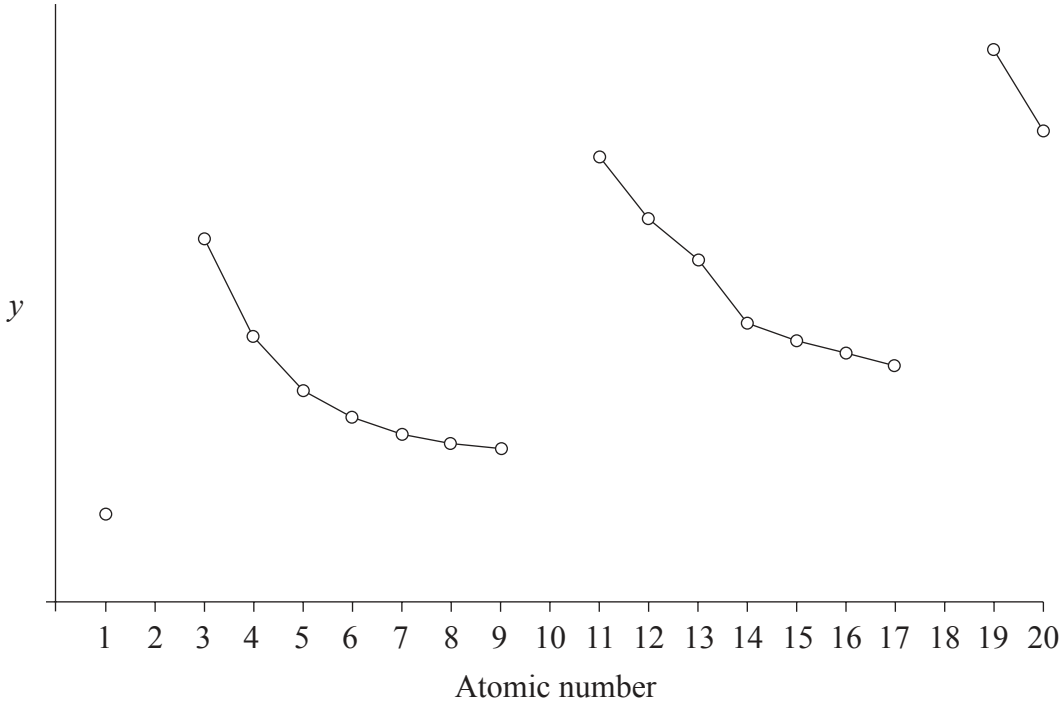
A. The wavelength of ultraviolet radiation is shorter than infrared radiation.

B. The frequency of visible radiation is higher than the frequency of ultraviolet radiation.

C. The energy of infrared radiation is lower than the energy of ultraviolet radiation.

D. Wavelength is inversely proportional to frequency.

7. Which physical property of elements is represented by *y* on the graph below?



A. First ionization energy

B. Ionic radius

C. Atomic radius

D. Electronegativity

8. Which of the following redox reactions take place?

I. $Cl_2(aq) + 2NaI(aq) \rightarrow I_2(aq) + 2NaCl(aq)$

II. $Br_2(aq) + 2NaI(aq) \rightarrow I_2(aq) + 2NaBr(aq)$

III. $I_2(aq) + 2NaBr(aq) \rightarrow Br_2(aq) + 2NaI(aq)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. What are the correct formulas of the following ions?

	Nitrate	Phosphate	Carbonate	Ammonium
A.	NO_3^-	PO_4^{3-}	CO_3^-	NH_3^+
B.	NO_3^{2-}	PO_3^{2-}	CO_3^{2-}	NH_3^+
C.	NO_3^-	PO_4^{3-}	CO_3^{2-}	NH_4^+
D.	NO_3^{2-}	PO_3^{2-}	CO_3^{2-}	NH_4^+

10. Which row correctly describes the bonding type and melting point of carbon and carbon dioxide?

	Carbon		Carbon dioxide	
A.	covalent bonding	high melting point	covalent bonding	low melting point
B.	ionic bonding	low melting point	ionic bonding	high melting point
C.	ionic bonding	high melting point	ionic bonding	low melting point
D.	covalent bonding	low melting point	covalent bonding	high melting point

11. What is the correct order of **increasing** boiling points?

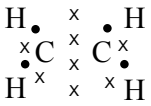
A. $CH_3CH_3 < CH_3CH_2Cl < CH_3CH_2Br < CH_3CH_2I$

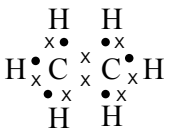
B. $CH_3CH_2Cl < CH_3CH_2Br < CH_3CH_3 < CH_3CH_2I$

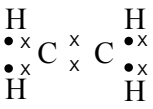
C. $CH_3CH_2I < CH_3CH_2Br < CH_3CH_2Cl < CH_3CH_3$

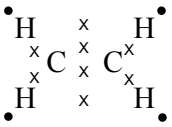
D. $CH_3CH_2Br < CH_3CH_2Cl < CH_3CH_2I < CH_3CH_3$

12. Which is the correct Lewis structure for ethene?

A. 

B. 

C. 

D. 

13. Which bonds are arranged in order of **increasing** polarity?

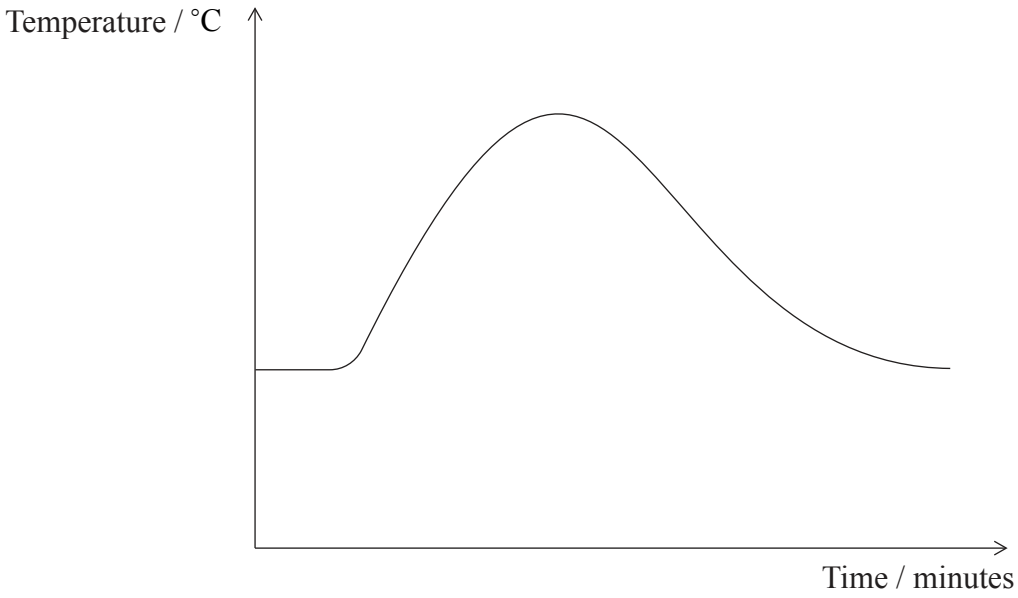
A. H–F < H–Cl < H–Br < H–I

B. H–I < H–Br < H–F < H–Cl

C. H–I < H–Br < H–Cl < H–F

D. H–Br < H–I < H–Cl < H–F

14. A student measured the temperature of a reaction mixture over time using a temperature probe. By considering the graph, which of the following deductions can be made?



I. The reaction is exothermic.

II. The products are more stable than the reactants.

III. The reactant bonds are stronger than the product bonds.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

15. Which process is endothermic?

A. $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

B. $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$

C. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

D. $H_2O(g) \rightarrow H_2O(l)$

16. Consider the following enthalpy of combustion data.

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H^{\ominus} = -x \text{ kJ mol}^{-1}$$

$$H_2(g) + \tfrac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H^{\ominus} = -y \text{ kJ mol}^{-1}$$

$$C_2H_6(g) + 3\tfrac{1}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) \qquad \Delta H^{\ominus} = -z \text{ kJ mol}^{-1}$$

What is the enthalpy of formation of ethane in kJ mol^{-1}?

$$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$$

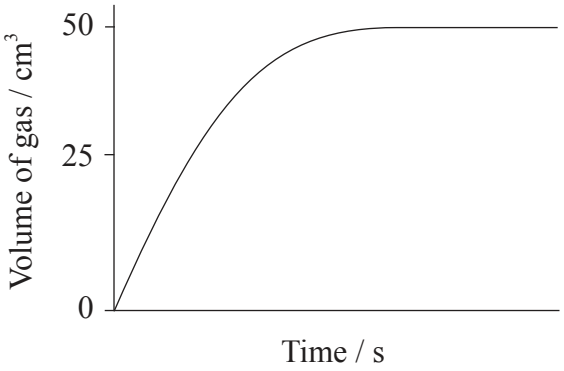
A. $[(-x) + (-y)] - (-z)$

B. $(-z) - [(-x) + (-y)]$

C. $[(-2x) + (-3y)] - (-z)$

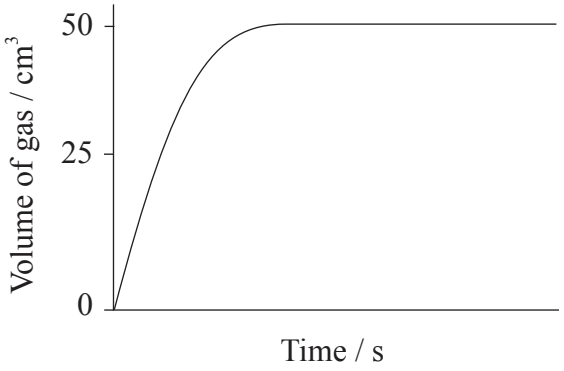
D. $(-z) - [(-2x) + (-3y)]$

17. A student added 0.20 g of calcium carbonate powder to 100 cm^3 of 1.0 $mol\,dm^{-3}$ hydrochloric acid (an excess) and measured the volume of the gas that was evolved. The graph of the results is shown below.

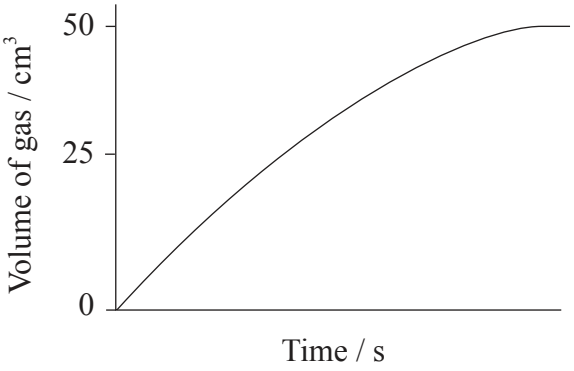


Which graph would be obtained if 0.20 g of calcium carbonate powder is added to 100 cm^3 of 0.5 $mol\,dm^{-3}$ hydrochloric acid (an excess)?

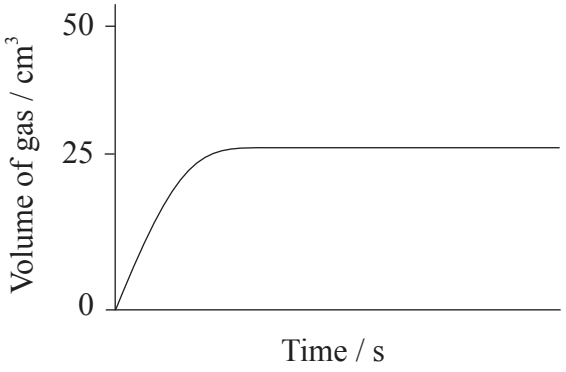
A.



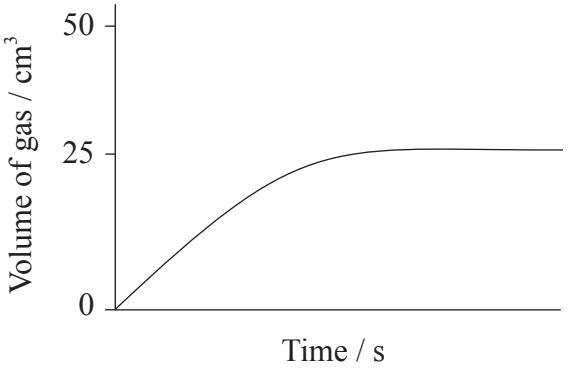
B.



C.



D.



18. Which statement about the kinetic theory is **not** correct?

A. The particles in ice vibrate about fixed points.

B. The particles in steam have more energy than the particles in ice.

C. All the particles in water have the same amount of energy at 298 K.

D. Evaporation of water occurs at all temperatures between 273 K and 373 K when the atmospheric pressure is 101 kPa.

19. Which are characteristics of a dynamic equilibrium?

I. Amounts of products and reactants are constant.

II. Amounts of products and reactants are equal.

III. The rate of the forward reaction is equal to the rate of the backward reaction.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. The following are K_c values for a reaction, with the same starting conditions carried out at different temperatures. Which equilibrium mixture has the highest concentration of products?

A. 1×10^{-2}

B. 1

C. 1×10^{1}

D. 1×10^{2}

21. Which descriptions are correct for both a Brønsted–Lowry acid and a Lewis acid?

	Brønsted–Lowry acid	Lewis acid
A.	proton donor	electron pair donor
B.	proton donor	electron pair acceptor
C.	proton acceptor	electron pair donor
D.	proton acceptor	electron pair acceptor

22. What is the pH of the solution formed when 10 cm^3 of HCl(aq) with pH 1.0 is added to 990 cm^3 of water?

A. 1.5

B. 2.0

C. 2.5

D. 3.0

23. What is the correct **decreasing** order of reactivity of the metals X, Y and Z based on the following equations?

$$XCl + Y \rightarrow YCl + X$$
$$YCl + Z \rightarrow YCl + Z$$
$$ZCl + X \rightarrow XCl + Z$$

A. X > Y > Z

B. Y > Z > X

C. Z > Y > X

D. Y > X > Z

24. What is produced at the positive electrode (anode) and negative electrode (cathode) during the electrolysis of molten lithium chloride and molten lead bromide?

	LiCl (l)		**$PbBr_2$ (l)**	
	+	–	+	–
A.	lithium	chlorine	lead	bromine
B.	lithium	chlorine	bromine	lead
C.	chlorine	lithium	lead	bromine
D.	chlorine	lithium	bromine	lead

25. Which equation represents the initiation reaction when methane reacts with chlorine in the presence of ultraviolet light?

A. $CH_4 \rightarrow CH_3\bullet + H\bullet$

B. $Cl_2 \rightarrow 2Cl\bullet$

C. $Cl_2 \rightarrow Cl^+ + Cl^-$

D. $CH_3\bullet + Cl_2 \rightarrow CH_3Cl + Cl\bullet$

26. Which molecule contains an ester group?

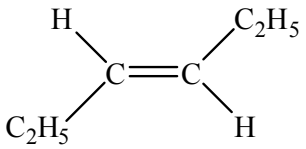
A. CH_3CH_2COOH

B. CH_3COOCH_3

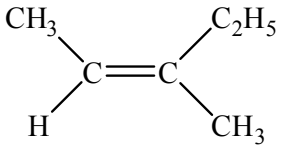
C. $CH_3COCH_2CH_2OH$

D. $OHCCH_2CHO$

27. Which molecules are isomers of hex-1-ene?



I.



II.

III.

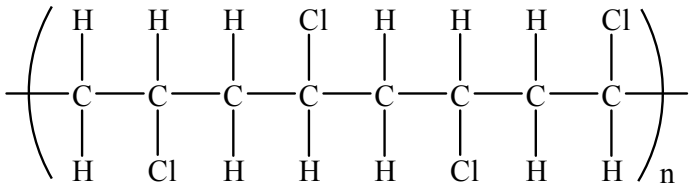
A. I and II only

B. I and III only

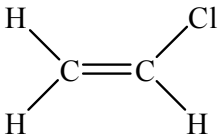
C. II and III only

D. I, II and III

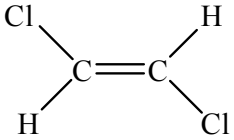
28. From which monomer is this polymer made?



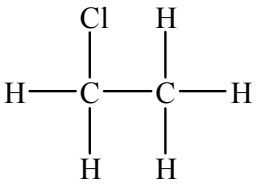
A.



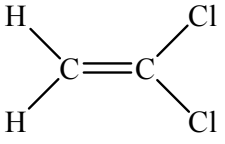
B.



C.



D.



29. What is the organic product of the reaction between 2-chlorobutane and sodium hydroxide solution?

A. Butan-1-ol

B. Butan-2-ol

C. Butanal

D. Butanone

30. A student heated a solid in a crucible. The student measured the mass of the solid and crucible before and after heating and recorded the results.

Mass of crucible and solid before heating = 101.692 g

Mass of crucible and solid after heating = 89.312 g

What value should the student record for the mass lost in grams?

A. 12.4

B. 12.38

C. 12.380

D. 12.3800