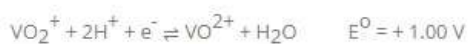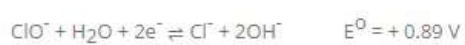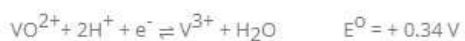1. From the list of standard electrode potentials shown below, what is the strongest oxidizing and reducing reagents?

$$VO^{2+} + 2H^+ + e^- \rightleftharpoons V^{3+} + H_2O \qquad E^o = +0.34\ V$$

$$S_2O_3^{2-} + 6H^+ + 4e^- \rightleftharpoons 2S + 3H_2O \qquad E^o = +0.47\ V$$

$$ClO^- + H_2O + 2e^- \rightleftharpoons Cl^- + 2OH^- \qquad E^o = +0.89\ V$$

$$VO_2^+ + 2H^+ + e^- \rightleftharpoons VO^{2+} + H_2O \qquad E^o = +1.00\ V$$

	Strongest oxidizing agent	Strongest reducing agent
1)	VO_2^+	$S_2O_3^{2-}$
2)	$S_2O_3^{2-}$	VO^{2+}
3)	VO^{2+}	ClO^-
4)	ClO^-	V^{3+}
5)	VO_2^+	V^{3+}

- [ ] 1
- [ ] 2
- [ ] 3
- [ ] 4
- [ ] 5

2. The graph above shows a relationship between vapor pressure and the temperature of ether, water, and mercury. Which substance has the lowest surface tension?
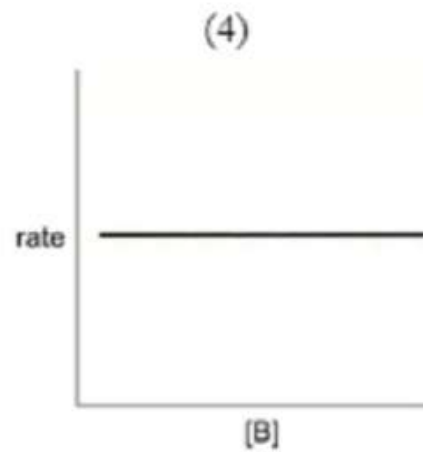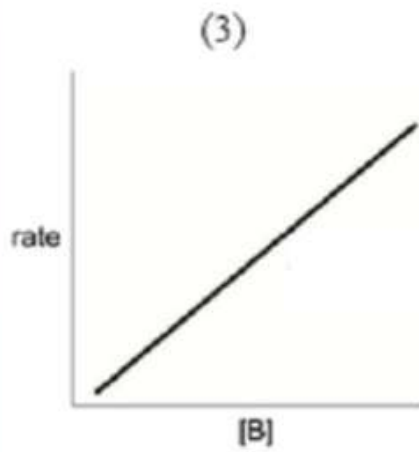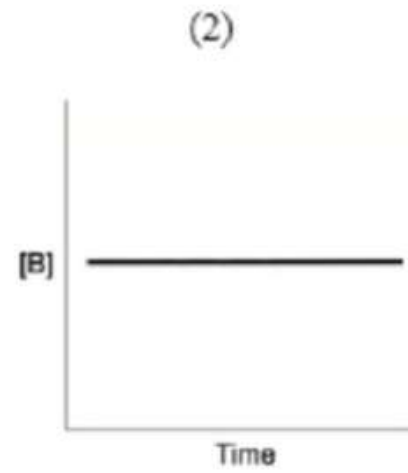
☐ Diethyl ether
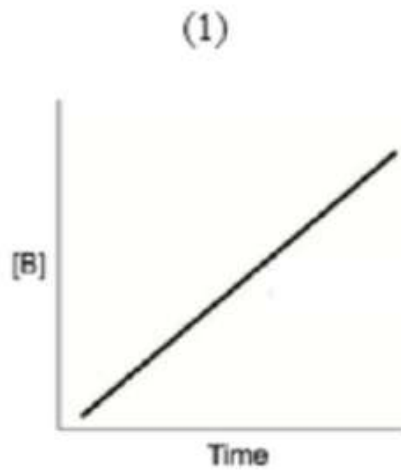
☐ Water

☐ Mercury

☐ More than two substances have the same lowest surface tension

☐ Insufficient information

3

(1)

[B] vs Time — increasing linear line

Time

(2)

[B] vs Time — horizontal line

Time

(3)

rate vs [B] — increasing linear line

[B]

(4)

rate vs [B] — horizontal line

[B]

☐ 1 and 3

☐ 1 and 4

☐ 2 and 3

☐ only 4

☐ All of the above is not correct

4. A balloon has a volume of 20.0 dm^3 at the mean sea level (1 atm and 27 °C). It rises to the top of the mountain, which is 1 km higher from the mean sea level, and explodes. At the top of the mountain, the external pressure is 0.5 atm and the temperature reduces to -23 °C. What is the largest volume of the balloon at the top of the mountain?

- [ ] 16.7 dm^3
- [ ] 33.3 dm^3
- [ ] 66.7 dm^3
- [ ] 133.3 dm^3
- [ ] 333.3 dm^3

5. What is the pH value of basic salt of 1.0 M Na$_2$X, when K_{a1} and K_{a2} of H$_2$X = 10^{-8} and 10^{-10}, respectively?

- [ ] 8
- [ ] 9
- [ ] 10
- [ ] 11
- [ ] 12

6. Which of the following substances has the highest boiling point? (Relative atomic mass of H = 1, C = 12, O = 16)

☐ 0.25 g of Lactose ($C_{12}H_{22}O_{11}$) in 100 cm^3 of water

☐ 0.25 g of Galactose ($C_6H_{12}O_6$) in 50 cm^3 of water

☐ 0.25 g of Ribose ($C_5H_{10}O_5$) in 25 cm^3 of water

☐ Pure water

☐ All of the above are equal boiling point

7. A reversible reaction A + B $\rightleftharpoons$ 2C has the equilibrium constant, K, equals to 9. A and B have the same initial concentrations of 0.02 M. What is the concentration of B at equilibrium?

☐ 0.0012 M

☐ 0.008 M

☐ 0.01 M

☐ 0.012 M

☐ 0.022 M

8. Dimethandrolone undecanoate (DMAU) is a compound being developed for use as a potential male hormonal contraceptive, specifically as a birth control pill for men. From the molecular structure of DMAU shown below, which geometry can be found the most in carbon atoms of this molecule?

- ☐ Linear
- ☐ Bent
- ☐ Trigonal planar
- ☐ Trigonal bipyramidal
- ☐ Tetrahedral

9. A student carried out an experiment by adding an unknown substance B to a test-tube containing Benedict's solution. When the test-tube was heated, the solution remained blue. In a separate test-tube containing dilute hydrochloric acid, substance B was added to the test-tube, which was then heated in boiling water for 10 minutes. The solution was neutralised before being added to a test-tube containing Benedict' solution, which was then heated. Brick red precipitates were observed. What could the unknown B be?

- ☐ Honey
- ☐ Milk
- ☐ Corn syrup
- ☐ Tapioca flour
- ☐ None of the above

10. Element X has a relative atomic mass 14 times greater than that of tritium and the number of neutrons 22 times greater than that of deuterium. What is the property of the oxide of X?

- [ ] Acidic
- [ ] Basic
- [ ] Neutral
- [ ] Amphoteric
- [ ] None of the above

11. What is the electronic configuration of cobalt in the compound $[Co(NH_3)_4SO_4]NO_3$?
(Proton number of Co = 27)

- [ ] span>[Ar] $3d^5$
- [ ] span>[Ar] $3d^6$
- [ ] span>[Ar] $3d^7$
- [ ] span>[Ar] $3d^8$
- [ ] span>[Ar] $4s^2$

12. What is the density, in the unit of kg m^{-3}, of this metal with the mass of 31.5 g?

- [ ] 3.15 kg m^{-3}
- [ ] 6.3 kg m^{-3}
- [ ] 3,150 kg m^{-3}
- [ ] 6,300 kg m^{-3}
- [ ] 630 kg m^{-3}

13. The table below shows some radioisotopes with their half-life.

Radioisotope	Half-life (days)
Cobalt-57	271.79
Einsteinium-254	275.7
Berkelium-249	330
Californium-248	333.5

Mass of oisotope Z decreases from 5.44 g to 0.34 g after 3.655 years.

Given that a year has 365 days. What is the identity of the radioisotope Z?

- [ ] Cobalt-57
- [ ] Einstenium-254
- [ ] Berkelium-249
- [ ] Californium-248
- [ ] Cacium-42

14. Which five gases are compressed into each balloon which contains 2 liters. Which one of the following gases makes the balloons still the largest size when hanging each balloon at room temperature after passing two weeks? (Relative atomic mass of H = 1, He = 4, Ne = 10, N = 14, O = 16, Ne = 20)

- [ ] O_2

- [ ] N_2

- [ ] He

- [ ] Ne

- [ ] H_2

15. Which of the following statements about absolute zero is NOT TRUE?

- [ ] The absolute zero is the temperature at which molecular motion ceases

- [ ] The absolute zero is the temperature where nothing could be colder and no heat energy remains in a substance

- [ ] The temperature at absolute zero is -273.15 C

- [ ] The entropy of all substances at absolute zero is exactly equal to zero

- [ ] All of the above is true

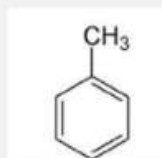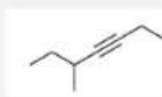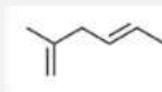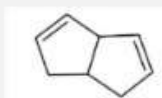16. What is the major difference between DNA and RNA?

- [ ] Base
- [ ] Sugar
- [ ] Phosphate
- [ ] Hydrogen bond
- [ ] London dispersion force

17. Which of the following is the molecular formula C_7H_{10}?

18. Which of the following pairs of substances can form a buffer solution when being mixed?

☐ CH$_3$COOH and NaOH

☐ CH$_3$COOH and HCOOH

☐ HClO$_3$and KOH

☐ 1) HClO$_4$and NaClO$_4$

☐ None of the above

19. What is the chemical formula of limestone?

☐ CaCO$_3$

☐ CaSO$_4$

☐ Ca$_3$(PO$_4$)$_2$

☐ CaO

☐ Ca(OH)$_2$

20. Consider the following reaction;

$$2A + (5/2)B_2 \rightarrow A_2B_5$$

If the rate of formation of A$_2$B$_5$ is r M/s, what is the rate at which B$_2$ is consumed?

☐ 5r/2

☐ 2r/5

☐ 2r

☐ 5r

☐ 4r/5