

11th INTERNATIONAL KANGAROO SCIENCE CONTEST 2018

Junior Level (Class 9 & 10)

Time Allowed: 90 minutes

All questions worth 4 points.

Brief:

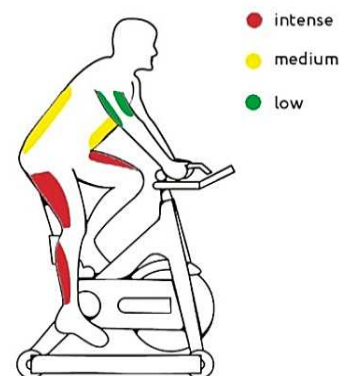
- atomic masses: $H - 1; C - 12; O - 16; Cu - 64; Zn - 65; I - 127; Cl - 35.5;$
 $S - 32; Fe - 56; K - 39; Al - 27; Na - 23; Pb - 207$
- $R = 0.082 \frac{L \times atm}{mol \times K}$
- $F = 96500C$.

1. A body is initially at rest on a horizontal surface. As soon as it starts sliding, the friction:

- A) increases
B) decreases
C) stays the same
D) becomes null
E) does not depend on the kind of surface

2. During fast pedalling, a person weighing $75kg$ burns 52.25 kJ/minute . It is known that a sample of $100g$ of cake will release 550 kcal when it is burned in a calorimetric bomb. How long would that person have to pedal to burn the energy created by eating $75g$ of cake?

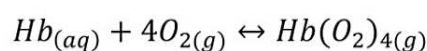
- A) 15 minutes
B) 35 minutes
C) 40 minutes
D) 43 minutes
E) 33 minutes



3. An electrical conductor allows the flow of an electrical current that varies by the formula $I(t) = 2 + 2t$. The electric charge which passes through the cross section of the conductor during the time interval of $[2s, 4s]$ is:

- A) $16C$
B) $12C$
C) $4C$
D) $6C$
E) $10C$

4. Hemoglobin is a metalloprotein containing ions of Fe^{2+} . The role of hemoglobin in the human body is to carry the gases O_2 and CO_2 during equilibrium processes like:



Knowing that there are 4 cations of ${}_{26}Fe^{2+}$ in the hemoglobin molecule, the number of e^- d of the iron in a heme is:

- A) $96e^-$
B) $1.44 \cdot 10^{23}e^-$
C) $6.26 \cdot 10^{25}e^-$
D) $5.78 \cdot 10^{25}e^-$
E) $1.44 \cdot 10^{25}e^-$

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5. When compared to the original object, the image viewed through an optical microscope is:
- A) upright and enlarged B) inverted and virtual
C) real and reduced in size D) upright, real and enlarged
E) upright and virtual
6. A mass of $2.3g$ of pure sodium is introduced into $200g$ of 5% $NaOH$ solution. To the prepared solution, $0.5L$ solution of $0.2M H_2SO_4$ is added. The amount of the excess substance is:
- A) 0.25 moles of $NaOH$ B) 0.2 moles of H_2SO_4
C) 0.15 moles of $NaOH$ D) 0.15 moles of H_2SO_4
E) 0.2 moles of $NaOH$
7. An electromagnetic coil is modified such that its length doubles. Then, an iron core having the relative magnetic permeability $\mu_r = 100$ is inserted inside it. How does the energy stored in the magnetic field of the electromagnetic coil change?
- A) remains constant B) increases 2 times C) increases 50 times
D) increases 200 times E) decreases 100 times
8. Oleum is produced by dissolving SO_3 in H_2SO_4 , which, by dilution with water, forms H_2SO_4 solutions of different concentrations. In order to prepare $300g$ of 49% H_2SO_4 solution at the temperature of $27^\circ C$, a mass m of oleum is mixed with $157.5g$ of water. What is the percentage concentration of SO_3 in the mass m of oleum?
- A) 6.05% B) 20% C) 10.15%
D) 14.035% E) 25%
9. An electrical resistance of 13.6Ω , crossed by an electric current of $5A$, is immersed in water. Knowing that the specific latent heat of water vaporization is $2256KJ/g$, how much time will it take for $90g$ of water to be vaporized after the boiling begins?
- A) 10 minutes B) 15 minutes C) 628 seconds
D) 12.5 minutes E) 20 minutes
10. In a crystallizer containing $200mL$ of distilled water, a sample of sodium of $5g$ with 8% impurities is added. What volume of CO_2 should be bubbled in this solution at the temperature of $47^\circ C$ and the pressure of $1.2 atm$ in order to obtain a neutral salt?
- A) $2.24L$ B) $1.64L$ C) $2.62L$
D) $4.48L$ E) $3.28L$

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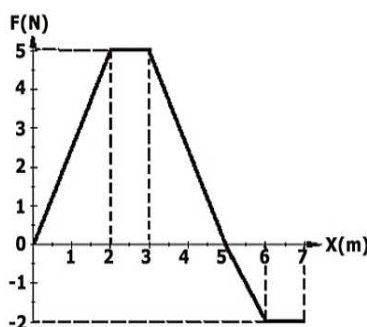
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16. A sample of brass is divided into two equal parts which are inserted into two different Berzelius beakers, each containing 100 mL solution of sulfuric acid with molar concentrations of 0.5M and 20M, respectively. Knowing that the reactions are total, calculate the mass of the brass sample.

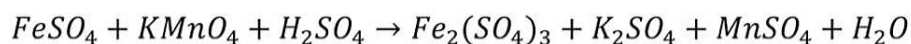
A) 129g B) 64.05g C) 128.1g
 D) 130.2g E) 134.5g

17. The value of a force acting on a body varies with the displacement as shown in the picture. The maximum speed that the body can achieve is reached at the point:



A) $x = 2m$ B) $x = 3m$ C) $x = 5m$
 D) $x = 6m$ E) $x = 7m$

18. A sample of 3.5g of iron ore is heated to volatilize the impurities. There is a 20% decrease in the mass of the sample. The sample contains iron (II) sulphate and iron (III) sulphate and it is titrated with 3mL solution of 0.3M $KMnO_4$, acidified with a solution of H_2SO_4 .



The percentage composition by mass of the iron (III) sulphate in the sample of iron ore is:

A) 20% B) 82.4% C) 80%
 D) 8.24% E) 60.45%

19. A copper conductor has an electrical resistance of 16KΩ. How much does its resistance become if its length increases by 25%?

A) 20KΩ B) 12KΩ C) 4KΩ
 D) 25KΩ E) 64KΩ

20. During the electrolysis of a solution of a divalent metal salt, a charge of 15,000C is introduced, and an amount of 4.8g is deposited. If the current loss is of 3.5%, then the electrochemical equivalent will be:

A) 32 B) 64 C) 28
 D) 20 E) 32.5

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21. A glass lens, located in water, is rotated through 180 degrees. Then its focal distance will:
- A) change the sign if the lens is convergent
B) stay the same
C) change the sign if the lens is divergent
D) double its value
E) increase 4 times
22. A small plate of zinc of 26g is placed in a vessel containing 1L solution of $Pb(NO_3)_2$. The reaction stops when the plate mass increases by 54.6%. The molar concentration of the solution of lead nitrate is:
- A) 1M
B) 2M
C) 0.2M
D) 0.01M
E) 0.1M
23. Two circular wires of radii R_1 and $R_2 = 2R_1$ are placed coplanar and concentric. For the magnetic induction at the center of the two spirals to be null, the electric currents I_1 and I_2 through the wires must satisfy the relation:
- A) $I_2 = I_1/2$, in the same sense of flow
B) $I_2 = I_1/2$, in opposite senses of flow
C) $I_2 = 2I_1$, in the same sense of flow
D) $I_2 = 2I_1$, in opposite senses of flow
E) $I_2 = I_1$
24. A sample of 5L of a gaseous mixture resulting from industrial processes and containing 82% (vol. %) SO_2 , is bubbled at the pressure of 3.2 atm and the temperature of 47°C in a solution of potassium iodate. The equation of the chemical reaction is:
- $$KIO_3 + SO_2 + H_2O \rightarrow KHSO_4 + I_2 + H_2SO_4$$
- The obtained mass of iodine is:
- A) 25.4g
B) 254g
C) 254mg
D) 127mg
E) 12.7g
25. A man is in a cosmic spacecraft rotating around the Earth ($R = 6400\text{ km}$), at height $h = 161\text{ km}$ above its surface. With what speed does the spacecraft have to move so that the man reaches a state of imponderability?



- A) 8 km/s
B) 7.9 km/s
C) 6.4 km/s
D) 11.2 km/s
E) 7 km/s

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26. A gaseous mixture of propane and butane, in a 2:3 molar ratio, is burnt and releases 3015.7Kj. The mass of water whose temperature increases from 10°C to 25°C due to the combustion of the mixture is:

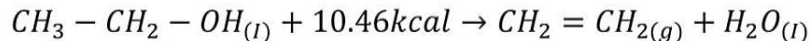
- A) 2.42Kg B) 48g C) 2.42g
D) 72g E) 48Kg

The standard enthalpies of combustion for C_3H_8 and C_4H_{10} are $-2043.87Kj/mol$ and $-2658.34Kj/mol$, respectively. The specific heat of water is $C_{H_2O} = 4.184J/g \times K$

27. Two equal mass bodies move in the same direction with constant speeds $v_1 = 5m/s$ and $v_2 = 3m/s$. The heat generated by their inelastic collision, represents a fraction f of the initial kinetic energy of the system, f is equal to:

- A) 85% B) 40% C) 15%
D) 28.5% E) 94.11%

28. Ethanol is dehydrated in the laboratory to prepare ethene according to the following thermochemical equation:



What mass of coal containing 95% graphite would be burned to obtain the required heat?

- A) 1.4g B) 1.2Kg C) 1.2g
D) 1.4Kg E) 2.4g

The enthalpy of formation for $CO_{2(g)}$ is $-393.3Kj/mol$.

29. A ball weighing $m = 100g$ and having the speed $v = 10 m/s$, hits, perfectly elastically, at an angle of 60 degrees with the surface normal, a vertical wall. The contact time between the wall and the ball is $\Delta t = 0.01s$. The average force with which the wall acts on the ball is:

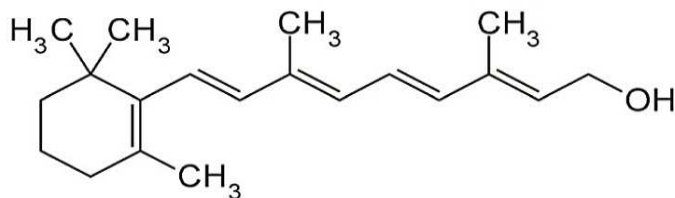
- A) 10N B) 20N C) 50N
D) 100N E) 200N

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30. Vitamin A or retinol is very important for eyesight, participating in the formation of rhodopsin.



The volume of H_2 needed to saturate one mole of retinol at the temperature of $117^\circ C$ and the pressure of 12160 mmHg is:

- A) 1L B) 20L C) 10L
D) 15L E) 5L

The specific heat of water is: 4.184 J/g .

