# 12th INTERNATIONAL KANGAROO SCIENCE CONTEST 2019

**Junior Level (Class 9 & 10)**

**Time Allowed:** 90 minutes

## ALL QUESTIONS WORTH 4 POINTS

**Atomic weights:** *C*-12; *Al*-27; *Na*-23; *O*-16; *S*-32; *K*-39; *Cl*-35,5; *P*-31; *Mn*-55; *Cu*-64; *Zn*-65; *I*-127; *Mg*-24; *P*-31; *Ca*-40.

**1.** Which of the following does not affect the operation of a pendulum clock?

**A)** The length of the metal pendulum rod
**B)** The mass of pendulum
**C)** The ambient temperature
**D)** The position of the pendulum on the Earth
**E)** The altitude where the pendulum is located

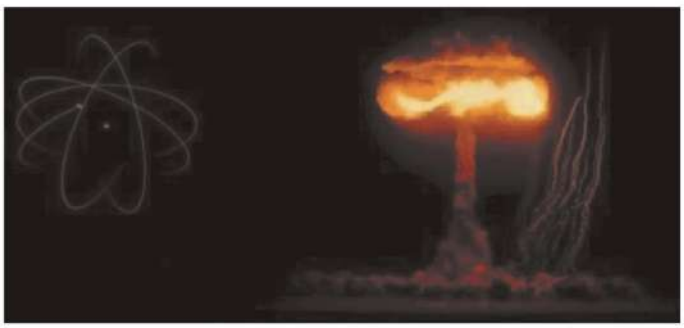
**2.** Oxygenation of the human body is based on the equilibrium process in which hemoglobin is involved:

$$Hem_{(aq)} + 4\ O_{2(g)} \leftrightarrow Hem(O_2)_{4(aq)}$$

At high altitude, the gas exchange in the lung is influenced by:

**A)** The decrease of the partial pressure of the gases
**B)** The increase of the partial pressure of the gases
**C)** The decrease of radiant energy
**D)** The increase of humidity
**E)** the fact that human body adapts quickly

**3.** In a nuclear reaction, the following is not valid:



**A)** the law of impulse conservation
**B)** the law of conservation of total relativistic energy
**C)** the law of charge conservation
**D)** the law of conservation of nucleon number
**E)** the law of conservation of mass

**4.** While running, a man consumes 2390*Kj*/day and a woman 2100*Kj*/day. A man can consume bananas to fill this energy gap. Knowing that the consumption of a medium banana of 100*g* produces 69*kcal*, find the number of medium bananas that a man has to consume in order to fill the energy gap:

**A)** a banana **B)** two bananas **C)** three bananas
**D)** four bananas **E)** five bananas

**5.** The movement law of an oscillator of mass $m$ =1 $kg$ is

$$x(t) = 4\left(sin\,20t + \sqrt{3}\,cos20t\right)(cm)$$

Then, the amplitude and the initial phase of this motion are:

**A)** 16 $cm$; $\pi/6$ **B)** 8 $cm$; $\pi/3$ **C)** 4 $cm$; $\pi/3$
**D)** 16 $cm$; $\pi/6$ **E)** 8 $cm$; $\pi/4$

**6.** Fog is a homogeneous mixture resulting from the dissolution of:

**A)** dust particles in the air **B)** air in water
**C)** drops of water in the air **D)** carbon dioxide in the air
**E)** white gases in the air

**7.** An elastic longitudinal wave of frequency $n = 1000Hz$ propagates through an elastic medium having the density $\rho = \frac{9000kg}{m^3}$ and the modulus of elasticity $E = 1{,}44 \cdot 10^9 N/m^2$. Which of the following is the phase difference between two points located 20$cm$ apart?

**A)** $\pi/2\ rad$ **B)** $\pi/3\ rad$ **C)** $\pi/4\ rad$
**D)** $\pi\ rad$ **E)** $2\pi\ rad$

**8.** The bluestone $CuSO_4 \times 5H_2O$, is used in agriculture. The concentration of a solution obtained by dissolving $25g$ of bluestone in $175g$ of water is:

**A)** 12.5% **B)** 10% **C)** 20%
**D)** 17.5% **E)** 8%

**9.** The movement of an octopus in water can be explained based on:

**A)** the principle of action and reaction
**B)** Newton's laws of motion
**C)** the principle of inertia
**D)** the principle of impulse conservation
**E)** the principle of conservation of energy

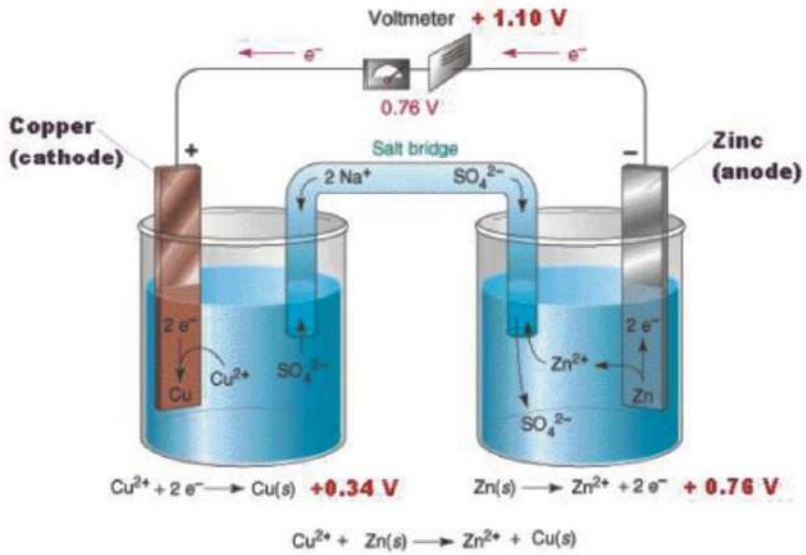
**10.** The number of chemical elements represented by chemical symbols in the name of the element "*CARBON*" is

**A)** 6 **B)** 5 **C)** 4
**D)** 7 **E)** 0

**11.** Three identical electric batteries are connected in parallel. If the positive and the negative terminals of the group are connected through a conductor of negligible resistance, the intensity of the current flow in the circuit will be $24A$. If we disconnect one battery, the current through the circuit will be:

**A)** $16A$ **B)** $8A$ **C)** $24A$
**D)** $32A$ **E)** $4A$

**12.** The assembly in the next image is used to:




**A)** convert electricity into chemical energy
**B)** heat the metal plates
**C)** deposit metals on the two plates
**D)** transform the chemical energy into electricity
**E)** dissolve the two metal plates

**13.** An afocal system is formed by a converging lens followed by a diverging lens. A beam of rays which is parallel to the main optical axis falls on the convergent lens. Which of the following statements is true about a beam that leaves the diverging lens?

**A)** It is convergent
**B)** It is divergent
**C)** There is no such beam
**D)** It is parallel to the optical axis and it is much wider than the incident one
**E)** It is parallel to the optical axis and it is much narrower than the incident one

**14.** In order to balance the chemical equation

$$H_2O_2 + KMnO_4 + HCl \rightarrow MnCl_2 + KCl + H_2O + O_2$$

we have to use the stoichiometric coefficients

**A)** 5,2,2,2,2,8,2
**B)** 2,5,2,5,5,8,2
**C)** 5,2,6,2,2,8,5
**D)** 2,2,5,2,2,5,1
**E)** 5,2,8,2,2,8,5

**15.** Which of the following is a closed thermodynamical system?

**A)** a leaf of a flower **B)** a beetle **C)** a cup of tea
**D)** the liquid in a thermometer **E)** a meteorological balloon

**16.** Sulfur dioxide is bubbled into a flask containing $100mL$ of sodium iodate solution of $c_M = 2mol/L$. Knowing that the phenomenon follows the chemical reaction:

$$NaIO_3 + SO_2 + H_2O \rightarrow NaI + H_2SO_4$$

Find the volume of the gas which is bubbled under normal conditions and the mass of the resulting sodium iodide.

**A)** $13.44L$ and $30g$ **B)** $22.4L$ and $150g$ **C)** $22.4L$ and $15g$
**D)** $22.4L$ and $30g$ **E)** $13.44L$ and $15g$

**17.** About plane mirrors it is not true that:

**A)** They are afocal systems
**B)** They give virtual images of real objects **C)** They have real foci
**D)** The magnitude of linear magnification (transverse magnification) is less than 1
**E)** The size of the image changes as the position of the reflected object changes

**18.** The concentration of hydrochloric acid in the gastric juice of a healthy person is 0.3%. In the case of a person with gastric acidity, this value is doubled. For a sample of $250mL$ gastric juice ($\rho$=$1g/mL$) taken from a person with gastric acidity, the sodium bicarbonate mass needed to normalize the concentration of gastric juice is:

**A)** $1g$ **B)** $1.74g$ **C)** $8.4g$
**D)** $1.68g$ **E)** $4.8g$

**19.** The prisms with total reflection:

**A)** are prisms whose cross-section is an equilateral triangle
**B)** are used in the construction of the microscope
**C)** have the property that the light rays may leave the prism through any of its faces
**D)** regarding functionality, are equivalent to plane mirrors
**E)** are strong absorbing media

**20.** Choose the substance or the group of substances which, by dissolution, form alkaline *pH* solutions:

**A)** $Na_2SO_4$, $CaCO_3$ **B)** $HCN$ **C)** $NaCl$, $KNO_3$,$CaCl_2$
**D)** $KCl$ **E)** $NaHCO_3$, $NH_3$

**21.** A monochromatic light wave propagates in a transparent, homogeneous and isotropic medium. During its propagation:

**A)** the wave length changes along the path of light
**B)** The beam of light changes its direction of propagation
**C)** The shape of the wave front depends on the form of the source
**D)** The frequency of the wave is constantly changing
**E)** The refractive index depends on the wave propagation direction

**22.** Consider the following four equations:

**I.** $HS^- + H_2O \leftrightarrow S^{2-} + H_3O^+$
**II.** $HS^- + H_3O^+ \leftrightarrow H_2S + H_2O$
**III.** $NO_3^- + H_2O \leftrightarrow HNO_3 + HO^-$
**IV.** $HCO_3^- + H_2O \leftrightarrow H_2CO_3 + HO^-$

Water has an acid character in ecuations:

**A)** I, II, III, IV **B)** I, II, III **C)** II, III, IV
**D)** I, II **E)** III, IV

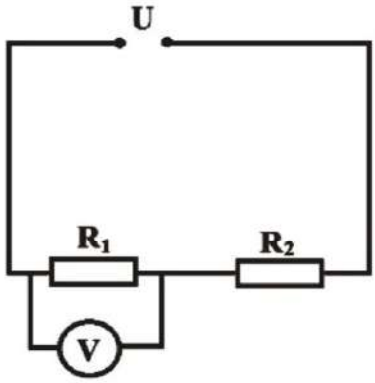
**23.** What is the distance between an object and its image when the object is viewed at normal incidence through a plane glass ($n = 1.5$) of thickness 9 *mm*?

**A)** 9 *mm* **B)** 3 *mm* **C)** 18 *mm*
**D)** 0 **E)** 4.5 *mm*

**24.** Which of the following sequences contain only polar substances?

**A)** $H_2O$; $CS_2$; $CHCl_3$ **B)** $CO_2$; $H_2S$; $HCl$ **C)** $NH_3$; $CS_2$; $CH_4$
**D)** $N_2$; $CCl_4$; $CHCl_3$ **E)** $HCl$; $NH_3$; $H_2O$

**25.** Consider the electrical circuit in the next figure.
We know that U =100$V$, the indication of voltmeter is $U_1$ =50$V$, $R_1$=50Ω and $R_2$=25Ω.
Find the resistance of the voltmeter.




**A)** $R_V \to \infty$
**B)** $R_V = 0$
**C)** $R_V = 25\Omega$
**D)** $R_V = 100\Omega$
**E)** $R_V = 50\Omega$

**26.** Starch is:

**A)** a vegetable fat with a role of supporting the plant
**B)** a polysaccharide with a sweet taste
**C)** a protein
**D)** a vegetable polysaccharide serving as a food reserve for the plant
**E)** an animal polysaccharide serving as a food reserve

**27.** What pressure does an iron ($\rho = 7800\ \frac{kg}{m^3}$) cube of side 20$cm$ exert, when it is placed on a ramp that makes an angle of $60^0$ with the horizontal?

**A)** 7.8 $kPa$
**B)** 3.9 $kPa$
**C)** 15.6 $kPa$
**D)** $7.8\sqrt{3}$ $kPa$
**E)** $7.8\sqrt{2}$ $kPa$

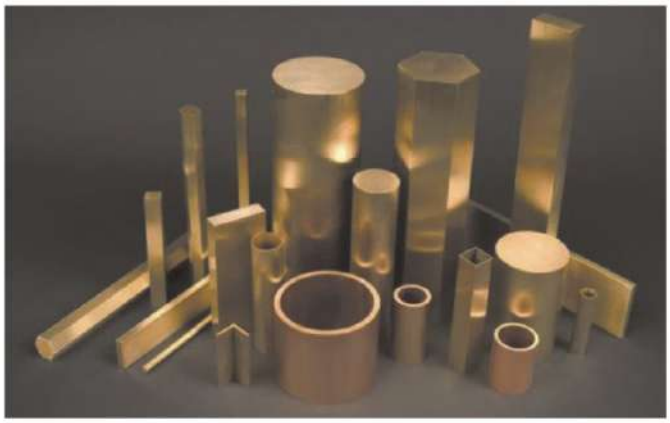
**28.** Cellulose is:

**A)** a vegetable polysaccharide with a role in supporting the plant
**B)** a polysaccharide with a sweet taste
**C)** a protein
**D)** a vegetable polysaccharide serving as a food reserve for the plant
**E)** an animal polysaccharide serving as a food reserve

**29.** When a sound wave travels through a medium:

**A)** Particles are transferred from one place to another
**B)** The sound waves are transverse waves
**C)** A healthy human ear can hear sounds of frequencies bellow 20 $Hz$
**D)** Energy is transferred from one place to another
**E)** The speed of sound is greater than that of light

**30.** Brass is an alloy of two metals: copper and zinc.



A sample of brass has a mass of 24 $g$ and contains 40% copper. The zinc mass in the brass sample in grams is:

**A)** 9.6 $g$ **B)** 14.4 $g$ **C)** 6.4 $g$
**D)** 20 $g$ **E)** 4.8 $g$