16th International Kangaroo Science Contest 2023

Junior Level (Class 9 & 10)

Time Allowed: 90 minutes

All Questions Worth 4 Points

1. Which of the following is a vector quantity?

A) Energy **B)** Mass **C)** Impulse
D) Mechanical work **E)** Density

2. Which of the following statements is true?

A) Solid solutions are heterogeneous mixtures of two or more metals.
B) Gas mixtures can be directly separated by distillation.
C) Brass is a solid solution.
D) Polystyrene is a solid solution.
E) Solubility of substances is a chemical property.

3. A mass of ideal gas undergoes a transformation in which the density ρ depends on the temperature T according to the relation: $\rho \sim \sqrt{T}$. If the temperature of the gas decreases four times, then its pressure will:

A) Increase by 8 times **B)** Increase by 4 times
C) double **D)** Decrease by 4 times
E) Decrease by 8 times

4. About $200\ g$ of caustic soda solution of $c = 20\%$ by mass, we can say that:

A) It contains 1 mole of caustic soda.

B) 20% is the proportion of water in the mass of mixture.

C) $200\ g$ is the water required for dissolution.

D) Adding $20\ g$ caustic soda will give a solution of $c = 30\%$.

E) By evaporating half the mass of the initial solution, we obtain a solution of $c = 30\%$ by mass.

5. Which of the following is a true statement about the electric shunt?

A) It is a battery that is mounted in parallel with the ammeter.

B) It is a resistor that is mounted in series with the ammeter to increase its measurement range.

C) It is a resistor that can occupy any position in a circuit.

D) The shunt's resistance that increases the range of an ammeter by n times is by $(n-1)$ times less than the resistance of the ammeter.

E) The shunt's resistance that increases the range of an ammeter by n times is $(n-1)$ times greater than the resistance of the ammeter.

6. Which of the following is an endothermic reaction?

A) Wood burning
B) Lighting the match
C) Decomposition of hydrogen peroxide
D) Dissolving sulphuric acid
E) Decomposition of potassium chlorate

7. Assume that the gravitational acceleration is $10ms^{-2}$ and a horizontal conductor, of length $l = 0.2\ m$ and mass $m = 4\ g$, is traversed by an electric current with intensity $I = 2A$. The conductor will remain at rest if it is left free in a magnetic field with magnetic induction (B) of

A) $0.5\ T$ **B)** $0.4\ T$ **C)** $0.3\ T$
D) $0.2\ T$ **E)** $0.1\ T$

8. Plastics cannot be used as:

A) Packaging **B)** Tyres
C) Disposable syringes **D)** Capsules
E) Pipes

9. A lens made of a material with refractive index $n = 1.5$ has, in air, the focal length equal to $+10\ cm$. If we immerse the lens in water $(n = 4/3)$, its focal length will be:

A) $40\ cm$ **B)** $2.5\ cm$ **C)** $50\ cm$
D) $2\ cm$ **E)** $unchanged$

10. Which of the following statements is true about carbohydrates?

A) Carbohydrates are substances from which the body's cells are built.
B) Proteins are part of the physiologically important carbohydrate class.
C) Carbohydrates give energy to the human body.
D) Carbohydrates generally taste bitter.
E) Fermentation of a carbohydrate produces methanol.

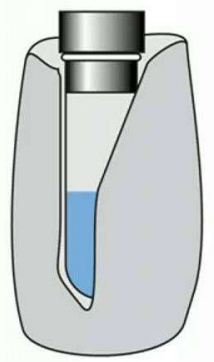
11. Which of the following statements is true about the sliding friction force?

A) It acts only on bodies in motion.
B) It depends on the value of the body's speed.
C) It is proportional to the normal pressure force on the sliding surface.
D) It is always proportional to body weight.
E) It is normal to the surface on which the sliding motion will take place.

12. Emulsion is a mixture of:

A) soda and water
B) water and oil
C) oil and animal fat
D) gelatine and water
E) water and vinegar

13. If the mechanical work performed on an adiabatic isolated thermodynamic system is positive, the internal energy of the system



A) Remains unchanged
B) Increases
C) Decreases
D) Increases or decreases depending on the initial temperature of the system
E) Increases or decreases depending on the initial system pressure

14. Which of the following is a true statement?

A) The crystalline substance has disordered particles.
B) The amorphous substance has the particles arranged in an orderly manner.
C) Glass, rubber and sand are amorphous substances.
D) Amorphous substances are allotropic substances.
E) Glass, plastics and rubber are crystalline substances.

15. Which of the following statements are true about voltmeters?

A) If they are mounted in series with the source, they indicate the electromotive force of the source.
B) By construction, they have a very low electrical resistance.
C) They indicate the intensity of the electric current that runs through them.
D) The measuring range of a voltmeter can be increased by connecting an additional resistance in series with it.
E) The physical quantity measured by them is measured in ohms.

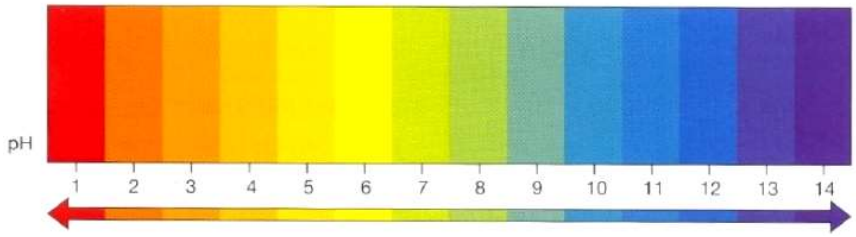
16. About the substance iodine, the following statements are true except:

A) It is a crystalline solid of a greyish-purple colour
B) It dissolves in alcohol
C) It is hardly soluble in water, it reacts with water
D) It gives off a greyish-purple vapour
E) It does not sublime

17. **A conducting coil of area $S = 10\ cm^2$ and electrical resistance $R = 1\Omega$ is placed perpendicularly to the lines of a magnetic field whose induction varies with the speed of $10^{-4}\ Ts^{-1}$. Then the coil is traversed by an induced current with the intensity of:**

A) $0.1\mu A$ **B)** $0.5\ mA$ **C)** $1\ mA$
D) $0.1\ mA$ **E)** $5\ mA$

18. **Which of the following is the colour indicating the neutral medium on a pH scale?**



A) Blue **B)** Red **C)** Green
D) Yellow **E)** Purple

19. **An electron with a kinetic energy of $10\ eV$ $(1\ eV = 1.6\ \cdot 10^{-19}\ J)$ describes a circular trajectory in a uniform magnetic field $B = 10^{-4}\ T$. Given that the mass of an electron is $9.11 \cdot 10^{-31} Kg$, determine which of the following is the radius of the trajectory described by the electron.**

A) $10\ cm$ **B)** $10.6\ cm$ **C)** $2.65\ cm$
D) $5.3\ cm$ **E)** $9\ cm$

20. **Which of the following substances, when dissolved in water, forms alkaline solutions:**

A) NH_3 **B)** $CaCO_3$ **C)** CH_3COOH
D) CO_2 **E)** SO_2

21. **The cross section of an optical prism is an equilateral triangle. If the minimum deviation angle of the prism is 60^o, which of the following will be the refractive index of the material from which the prism is made?**

A) 1.5 **B)** $\frac{4}{3}$ **C)** 1.8

D) $\sqrt{3}$ **E)** $\sqrt{\frac{3}{2}}$

22. **A pure sample of $4g$ magnesium oxide reacts with carbon dioxide to give $8.4g$ reaction product. Which of the following statements is true?**

A) The mass of carbon dioxide is $4.4\ g$.
B) The mass of magnesium carbonate is $4.4\ g$.
C) The volume of gas consumed under normal conditions is $1.12\ L$.
D) The compound obtained has the chemical formula Mg_2CO3.
E) A covalent compound is obtained.

23. **What is the SI unit of impulse?**

A) Nms^{-1} **B)** Ns^2 **C)** Ns
D) $Kg\ ms^2$ **E)** Nm

24. **A sample of $4\ g$ pure calcium left in contact with air forms $5.6\ g$ oxide. Which of the following statements is true?**

A) $2.24\ L\ O_2$ is consumed
B) $1.6\ gO_2$ is consumed
C) $3.2\ g\ O_2$ is consumed
D) CaO_2 is obtained
E) A covalent compound is obtained

25. **A mass of ideal gas undergoes an expansion described by the relation: V^{γ}, where γ represents the adiabatic exponent of the ideal gas. What happens to the gas?**

A) It warms up
B) It receives heat
C) It cools
D) It gives up heat
E) It undergoes an isothermal process

26. Grey iron corrodes in moist air and forms rust:

$$4Fe + O_2 + 6H_2O \rightarrow 4FeO(OH) + 4H_2$$

The following statement is true:

A) Rust contains 50% Fe, by mass
B) 22.4 g iron gives off 8.96 L of oxygen
C) 22.4 g iron gives off 8.96 L of hydrogen
D) 22.4 g iron consumes 8.96 L of oxygen
E) Rust contains 1.7% H, by mass

27. A group of n identical cells each of $EMFE$ and internal resistance r are connected in parallel. Then:

A) The EMF of the equivalent battery is nE.

B) The short-circuit current of the equivalent battery is equal to the one of any one of the cells.

C) The current through a resistance R connected to the terminals of the group of cells is $I = \frac{nE}{R+nr}$.

D) The current through a resistance R connected to the terminals of the group of cells is $I = \frac{nE}{nR+r}$.

E) The equivalent battery draws a maximum power in an external circuit of resistance R if $R = r$.

28. Choose the correct statement:

A) Acids form hydronium ions in aqueous solution by accepting protons.
B) Hydrochloric acid and acetic acid are stronger acids than carbonic acid.
C) Ammonia is a hard base, it dissociates completely in water.
D) The ammonium ion is the conjugate base of ammonia.
E) The pH value of an aqueous solution of acetic acid is in the range 0.5-1.

29. In a parallel plate capacitor with air between the plates, each plate has the area S and the distance between the plates is d. If the capacitor is connected to a battery of voltage U, then:

A) It will be charged with the same electric charge even if we double the distance between the plates.

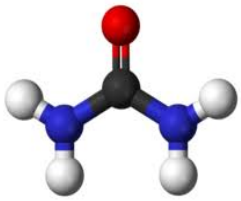
B) The intensity of the uniform electric field between its plates will be $E = \frac{Q}{\varepsilon_0 S}$.

C) The force of attraction between its plates will be $F = \frac{Q^2}{\varepsilon_0 S}$.

D) If we disconnect the capacitor from the battery and insert between its plates a dielectric plate having the same surface S, the electrostatic energy between the plates will increase.

E) If we insert between the plates a dielectric plate with the same area S and the capacitor remains connected to the battery, the energy of the system will decrease.

30. Compared to conventional urea production, green urea production can reduce fertiliser production costs and greenhouse gas emissions because:



A) Biomass is gasified.

B) The ammonia is used for the dry coal distillation.

C) Carbon dioxide is obtained by burning arenes.

D) Green urea can be easily synthesised in a simple production scheme without requiring high energy consumption.

E) Carbon monoxide is also converted into urea.