Physical Science Exam Questions

1. A sample mass of 40 grams is placed into a beaker of water in a large bucket to measure its volume, from a to b in the diagram. If $\rho_{water} = 1000\ kg/m^3$, $g = 10\ m/s^2$, and $V_{beaker} = 0.5\ m^3$:
   a) Determine ρ_{sample} in kg/m^3, to the nearest whole number.
   b) Calculate the number of kilograms of water displaced by the sample.
2. A rectangular organic pool has the compartments by means 20.0, 5.0 and 8.0 m, 1.0 m, the pool is the original the hours of the world. 3 meters
   a) Calculate the volume of water displaced by the sample, to the nearest whole number. Hint: 1 m³ = 1000 liters and 1 m = 100 cm. Show your calculation, the destination. (4 marks)
   b) Calculate the mass of water displaced in 2.5 dives or the temperature of nothing, to 2.5 litres, of 100 °C and 5.00 dives on the dives and 1.00 dives of the water. Show your calculation. (4 marks)
3. A uniform steel rod of length 0.4 m and cross-sectional area of $2.0 \times 10^{-4}\ m^2$ is extended by 1 mm. Calculate the energy stored in the extended rod. Show your calculation. (4 marks) Hint: Young's modulus for steel is $2.0 \times 10^{11}\ Pa$.
4. Consider a neutral subatomic particle in a beam. Beam stops. Beam stops. Beam stops

67. 1. Explain the main difference between an acid and a base and give any two properties of each. Tabulate. [6]
2. Enumerate the chemical processes involved in the purification of water for a city. [5]

68. Describe how radioactive waste is disposed under the following categories:
a. Low level waste [5]
b. Intermediate waste [5]
c. High level waste [5]

69. 1. Give a chemical equation for the complete combustion of methane (3 marks)
2. Methane and ethane are saturated, other hydrocarbons are unsaturated. Describe a chemical test to distinguish an alkane and alkene (5 marks).

70. 1. A person standing on a bus is thrown towards the rear of the bus as it begins to move and to the front as it slows down. Explain why? (3 marks)
2. State Newton's third law of motion (2 marks)
3. Methane is a hydrocarbon. Explain what is meant by the term hydrocarbon. (2 marks)

71. Write balanced chemical equations for the reactions between the following acids and bases:
a. Sodium hydroxide and hydrochloric acid (3 marks)
b. Sulphuric acid and potassium hydroxide (3 marks)
Define the following terms as they are used in chemistry: Element, Isotopes, Electronegativity, Solvent, Bond (2 marks each)

72. Illustrate the principle of operation and any one application of an NPN transistor. (10 marks)

73. Describe the following using semi-conductor theory:
a. P-type semiconductors (3 marks)
b. N-type semiconductors (3 marks)
Sketch the (I-V) current voltage characteristics of a silicon junction diode, explain the cut-in voltage (4 marks)

74. Describe radioactive emissions and outline properties of these emissions (12 marks)

75. State the following laws:
a. Archimedes principle (2 marks)
b. Bernoulli's principle (3 marks)
Explain the principle of operation and use of the hydraulic lift (5 marks)

76. Explain the following and state units where necessary:
a. Specific heat capacity (3 marks)
b. Heat energy (3 marks)
Explain the following:
a. Plastic deformation (3 marks)
b. Creep (2 marks)

77. 1. State the nature of the oxides of the following elements: Potassium, Aluminium, Sulphur. (3 marks)
2. Outline the differences between accuracy and precision (4 marks)
3. Distinguish random and systematic errors (4 marks)

78. Aluminium sulphate is a salt used in water treatment. It is often prepared by reacting an acid and a base.
a. Name an appropriate acid and a base used (2 marks)
b. State the type of reaction (1 mark)
Give an example of each of the following reactions:
a. Addition reaction (1 mark)
b. Cis-trans isomerism (2 marks)
c. Polar compound (1 mark)
Explain the meanings of the terms hydrophilic and hydrophobic with reference to a soap molecule. (2 marks)

79. 1. Describe any two tests for water, stating the expected results (4 marks)
2. Explain the meaning of the term "hard water" and its undesirable effects when it is used for laundry (3 marks)
3. One compound widely used in the home is sodium chloride:
a. Write the formula for sodium chloride (1 mark)
b. Name the type of bond in sodium chloride. Explain the choice of your answer (2 marks)

80. 1. Describe and explain how the metal lid on a glass jam jar can be uncrewed easily (3 marks)
2. State the differences between a longitudinal wave and a transverse wave. Which type is sound? (2 marks)
3. State the law which gives the relationship between current and voltage for a current carrying wire. (1 mark)

81. Define the terms:
a. Isotope (2 marks)
b. Mole of a substance (2 marks)
c. Hydrocarbon (2 marks)
d. Homologous series (2 marks)
e. Isomerism (2 marks)
Write balanced chemical equation for the reaction between solid iron (III) oxide and hydrogen to form solid iron and liquid water. Name the type of reaction (4 marks).

82. 1. Define density and state its SI unit (2 marks)
2. State 2 ways by which engineers try to reduce friction to minimum in the moving parts of machinery (2 marks)
3. State any 3 uses of radioactivity (3 marks)

83. State the differences between:
a Speed and velocity (4 marks)
b Mass and weight (4 marks)

84. Discuss the causes of hardness in water and explain how the removal of hardness is done (15 marks).

85. 1. Distinguish between reflection and refraction. (5 marks). Tabulate
2. Explain the term REDOX reaction (3 marks)
3. Define an amphoteric substance and give an example. (2 marks)

86. 1. Explain the following terms:
a. Catalyst (2 marks)
b. Formality (2 marks)
2. Describe the type of bonding that occurs when magnesium fluoride is formed (3 marks)
3. Write the chemical formula of magnesium fluoride (1 mark)

87. 1. Write the energy conversions that occur at a thermal power station (5 marks)
2. Name the particles found in the nucleus of an atom (2 marks)

88. 1. Define oxidation and reduction in terms of electron transfer. [4]
2. Iron is extracted from its ore (iron (III) oxide) by reacting it with coke (carbon) according to the reaction below:
$Fe_2O_3 + C \rightarrow Fe + CO$
a. Balance the chemical equation. [2]
b. State an oxidizing agent and a reducing agent in the equation above. Give a reason for your answer. [8]

89. 1. Describe the type of bonding that occurs when magnesium combines with fluorine. [4]
2. State two main uses of ethanol. [4]
3. Propane has the formula C_3H_8. Draw its structure and describe how it reacts with bromine. [4]
4. Give the properties of the following particles:
a. Alpha [5]
b. Beta [5]
c. Gamma [5]

90. 1. Explain the occupational hazards related to high sound levels and give the protective measures which could be put in place to minimize the effects. [15]
2. Explain the following terms as they are used in science:
a. Double covalent bond [3]
b. Combustion [3]

91. 1. Describe how soap is made from fats and oils. [3]
2. Explain how soap can dissolve a grease spot. [5]
3. Draw a flowchart to show how sewage can be converted into water that can be safely drunk. [8]
4. Name two gases that can cause the greenhouse effect. [2]

92. 1. State Newton's three laws of motion. [9]
2. Define the following terms:
a. Power
b. Work done
3. State Hooke's law. [2]
4. List 4 factors on which the methods employed on disposal of radioactive waste depend upon. [4]

93. 1. State any 3 base quantities and 3 derived quantities used in physics. [6]
2. Define the term momentum. [2]
3. Give functional groups of the following organic compounds:
a. Alkane [2]
b. Alkene [2]
c. Arene [2]
d. Halogenoalkane [2]
e. Alcohol [2]

94. 1. Define the following terms:
a. Joule [2]
b. Kinetic energy [2]
c. Friction [2]
d. Density [2]
e. Weight [2]
2. Define substitution reaction and give examples. [2]
3. Explain the following methods of heat transfer:
a. Convection [3]
b. Conduction [3]
c. Radiation [4]

95. 1. Explain the term wave. [2]
2. Differentiate transverse wave from longitudinal wave. [4]
3. Explain the following types of bonding and give examples:
a. Covalent [5]
b. Electrovalent [5]

96. 1. Outline the four uses of oxygen. [4]
2. Butane is a gas used as a fuel in gas stoves. Write the balanced chemical equation for the complete combustion of butane. [4]
3. Describe how you could prepare Copper (III) sulphate crystals in the laboratory. [8]
4. Explain how simple machines such as levers and pulleys make work easier. [3]

97. Balance the following equations:
i. $H_2SO_4(aq) + NaOH(aq) \rightarrow H_2O(l) + Na_2SO_4(aq)$ [3 marks]
ii. $H_3PO_4(aq) + NaOH(aq) \rightarrow H_2O(l) + Na_3PO_4(aq)$ [3 marks]
iii. $Al(OH)3(s) + HCl(aq) \rightarrow AlCl3(aq) + H_2O(l)$ [3 marks]
iv. $HNO_3(aq) + Mn(OH)2 \rightarrow H2O(l) + Mn(NO_3)_2(aq)$ [3 marks]

98. Balance the following equations:
i. $Al + NaOH + H_2O \rightarrow$ (3 marks)
ii. $H_3PO_4 + Ba(OH)_2 \rightarrow$ (3 marks)
iii. $(NH_2)2CO3 + M_g(NO_3)_2 \rightarrow$ (3 marks)
Write down a condensed structural formula for each structural formula. (2 marks each)

99. Briefly explain the following terms:
a. Centre of gravity [2 marks]
b. Potential energy [2 marks]
c. Kinetic energy [2 marks]
d. Power [2 marks]
e. Buffer solution [2 marks]
f. Ion [2 marks]
g. Neutralization reaction [2 marks]
Describe how lightning is formed and state the precautions that should be taken to reduce the adverse effects of lightning. [4 marks]

100. Calculate the oxidation number of the elements circled in the following compounds:
i. $H_2 \; O_2$ (2 marks)
ii. $\bar{C} \; H_4$ (2 marks)
iii. $\bar{P} \; O_4^{3-}$ (2 marks)
iv. $Na \; \bar{O} \; H$ (2 marks)

101. 1. State whether the following is a scalar or vector quantity:
* Current [1 mark]
* Force [1 mark]
* Momentum [1 mark]
* Temperature [1 mark]
* Acceleration [1 mark]
2. Discuss the methods used to soften hard water with the aid of relevant equations where necessary. [8 marks]
3. Briefly describe any four factors that affect the rate of dissolving a substance. [8 marks]

102. 1. Explain how the ion exchange method is used in removing water hardness. [4 marks]
2. List any three bases used in hospitals and give one medical use for each. [6 marks]
3. Explain why acids are usually stored in glass containers. [2 marks]

103. 1. Define the following terms:
(a) Homologous series [2 marks]
(b) Saponification [2 marks]
(c) Hypertonic solution [2 marks]
2. Using stearic acid $(C_{17}H_{35}COOH)$ as an example, write down the general equation of how a soap molecule is produced. (use a base of your choice) [3 marks]
3. What characteristic of light determines its:
(a) Color
(b) Intensity

104. 1. Explain why ionising power decreases from alpha, beta to gamma particles while penetration increases. [2 marks]
2. What are polar compounds? Give an example. [4 marks]
3. What is the oxidation number of Manganese (Mn) in $KMnO_4$? Show your working. [3 marks]

105. Given the following reaction, find the masses of oxygen and sulphur dioxide formed from $3 \; g$ of sulphur, x and y $grams$ respectively.
$S + O_2 \rightarrow SO_2$
(The reaction must be balanced first) [6 marks]

106. What is meant by the term organic chemistry? [3 marks]

107. Give the two isomers with the formula C_3H_8O. [2 marks]

108. Name the three classes of lipids. [3 marks]

109. Write down the structure of glycerol. [2 marks]

110. State the nature of the oxides of the following elements:
Sodium (Na)
Aluminium (Al)
Sulphur (S) [3 marks]

111. Define specific heat capacity (s.h.c) of a substance. [1 mark]

112. State Snell's law of refraction. [2 marks]

113. Use Snell's law to explain why a pool appears shallower than it is, with the aid of a sketch ray diagram. [5 marks]

114. Outline the principle of operation of a lift pump. State the role played by atmospheric pressure in the pumping process. [8 marks]

115. Differentiate between physical and chemical changes. [2 marks]

116. Group the following in either physical or chemical change:
(a) Rusting [1 mark]
(b) Melting of a candle wax [1 mark]
(c) Coal gas explosion [1 mark]

117. (a) Calculate the number of moles of sodium hydroxide $(NaOH)$ in $80 \; g$. [2 marks]
(b) 6.02×10^{23} atoms weigh $0.44 \; g$. Calculate the formula mass of the compound. [3 marks]
(c) If the compound in (b) above contains carbon and oxygen only, what could be the identity of the compound? [2 marks]

118. Give three categories of chemicals that are used in water and wastewater treatment. [2 marks]

119. State the use of carbon in water and sewage treatment. [2 marks]

120. Explain the meaning of the following terms:
(a) Osmosis [1 mark]
(b) Hypertonic solution [1 mark]
(c) Physiologic saline solution [1 mark]

121. State why distance and displacement have the same unit, but are not equivalent. [2 marks]

122. It is suggested that the pressure at a depth h in a liquid of density ρ is given by $p = \rho g h$. Use base SI units to show that the equation is consistent. [2 marks]

123. Define wavelength. [1 mark]

124. Define period T of wave motion with the aid of a diagram. [3 marks]

125. What is the nature of the following radioactive emissions:
(a) Alpha rays
(b) Beta rays
(c) Gamma rays [3 marks]

126. What is the electromotive force (emf) of $6, 1.5 \; V$ cells connected to form a battery in series? [1 mark]

127. Distinguish between reflection and refraction with the aid of a diagram. [2 marks]

128. Give an example of an acidic or basic buffer and explain how it functions. [5 marks]

129. Describe briefly how the following intermolecular forces arise:
(a) Van der Waals forces [2 marks]
(b) Hydrogen bonds [3 marks]

130. Calculate the formula of a compound with the following percentage composition: Sodium 43.4, Carbon 11.3, Oxygen 45.3. [4 marks]

131. Trioses, Pentoses, and Hexoses are classes of monosaccharide sugars. What is the difference between the above-mentioned monosaccharide sugars? [3 marks]

132. Explain the principle of operation of a barometer. [5 marks].

133. Explain how the principles of heat transfer are applied in solar water heaters. [5 marks]

134. Show the effects of a:
(a) Convex lens
(b) Concave lens
on a parallel beam of light normal to the plane of the lens. [6 marks total]

135. State the difference between a first-order and a second-order lever. Give an example of each class. [4 marks]