NESA | NATIONAL EXAMINATION AND SCHOOL INSPECTION AUTHORITY

TTC NATIONAL EXAMINATIONS, 2020-2021

SUBJECT: INTEGRATED SCIENCE: Content Knowledge &

Teaching Methods

OPTION: SCIENCE AND MATHEMATICS EDUCATION **(SME)**

DURATION: 3 HOURS

INSTRUCTIONS:

1) Write your names and index number on the answer booklet as written on your registration form, and **DO NOT write** your names and index number on additional answer sheets if provided.

2) Do not open this question paper until you are told to do so.

3) This paper consists of **three sections: A, B and C.**

- **Section A:** Attempt **all** questions.   **(45 marks)**

- **Section B:** Attempt any **three** questions.   **(30 marks)**

- **Section C:** Attempt **all** questions in this section.   **(25 marks)**

4) Use a **blue** or **black** pen.

5) Graphs must be drawn on graph paper provided.

SECTION A: ATTEMPT ALL QUESTIONS (45 MARKS)

1) a) State any two SI base units that make up 1 N as unit of force. **(1 mark)**

   b) A particle moves in a straight line according to the relation

   X=3t +2 where x is in metres and t in seconds. Determine:

   (i) The initial position of the particle. **(1 mark)**

   (ii) The speed of the particle. **(1 mark)**

2) During a flood a stone of mass 100 kg falls down a waterfall.

   The waterfall is 5 m high. Acceleration due to gravity g=9.81 m/s^2.

   Assume that air resistance is negligible;

   a) Calculate the gravitational potential energy of the stone at the top of the waterfall just before it falls down. **(2 marks)**

   b) The kinetic energy of the stone at the bottom of the waterfall. **(1 mark)**

3) Choose the number that corresponds to the correct statement.

   a) The ability of material to undergo plastic deformation without fracture when subjected to uniaxial tensile force (tensile force acting in one direction) is

   (1 mark)

   (i) Ductility

   (ii) Malleability

   (iii) Adhesion

   (iv) Cohesion

   b) Assuming that the temperature of the ideal gas remains constant.

   How can you increase the pressure of this gas? **(1 mark)**

   (i) Increase the container's volume.

   (ii) Add more molecules of the gas.

   (iii) Decrease the container's volume.

   (iv) None of the above.

c) When a pentavalent impurity is added to a pure semiconductor, it becomes

.... **(1 mark)**

      (i)   an insulator.

      (ii) an intrinsic semiconductor.

      (iii) p-type semiconductor.

      (iv) n-type semiconductor.

d) The equation of a progressive wave is given by

$$y = 5\sin(\frac{100\pi}{2}t - \frac{\pi}{2}x)$$ where y and x are in m and time t in s

The period of the wave in second is **(1 mark)**

      (i) 0.02

      (ii) 0.04

      (iii) $\pi/2$

      (iv) 50 π

4) A brass of length 100 m increases to 100.5 m when heated from 50°C to 100°C. Calculate its coefficient of linear expansion **(2 marks)**

5) How can you reduce global warming? **(2 marks)**

6) a) Propose any two ways by which the magnetic field strength created through a current carrying solenoid can be increased/strengthened. **(2 marks)**

b) Draw the magnetic field lines passing through a current carrying solenoid and indicate its magnetic poles. **(2 marks)**

7) A car moving at 25 m/s approaches a stationary whistle that emits a 350 Hz sound. The speed of sound in the air is 343 m/s.

What is the frequency of the sound heard by the driver of the car? **(2 marks)**

8) An organic acid X contains Carbon, Hydrogen and Oxygen elements.

The mass of 7.3 g of the sample of organic acid X is completely burned in oxygen.
It gives 13.2g of CO_2 and 4.5 g of H_2O. Its molecular mass is 146.

a) Determine the mass percentage of C, H and O in organic acid X.

(6 marks)

b) Determine the empirical formula of X. **(2 marks)**

c) Determine the molecular formula of X. **(2 marks)**

(Atomic mass: C=12, H=1, O=16)

9) List the similarities and differences between a typical animal and plant cell.

(7 marks)

10) a) Name any four characteristics of Fungi. **(4 marks)**

b) Give the main classes of Phylum Platyhelminthes. **(3 marks)**

c) What is the function of Golgi Apparatus? **(1 mark)**

SECTION B: ATTEMPT ANY THREE QUESTIONS (30 marks)

11) a) List any one application of convex lens in everyday life. **(1 mark)**

b) The index of refraction of a liquid is 1.9
   (i) What is the critical angle for a light ray travelling in the liquid toward a flat layer of air? **(2 marks)**

   Assume that the refractive index of air is 1
   (ii) What will happen to the light ray if the incident angle is greater than the critical angle? **(1 mark)**

b) A lens produces an image on a screen that is twice/double as large as the object. The image is located at 15 cm from the lens

      (i) Is image real or virtual? **(1 mark)**

      (ii) Is lens converging or diverging? **(1 mark)**

      (iii) Determine the object position **(2 marks)**

      (iv) Find the focal length of this lens **(2 marks)**

12) You are provided with 2 resistors R_1 and R_2 of 25 Ω and 100 Ω respectively, a battery of 12 V and negligible internal resistance, 3 voltmeters, 3 ammeters, a switch, and sufficient number of connecting wires.

  a) Use all given electrical components to design a reasonable electric circuit comprising the given resistors in parallel and a closed switch. **(4 marks)**

  b) Determine

      (i) The resultant resistance of the entire electrical circuit **(2 marks)**

      (ii) The electric currents through each resistor **(4 marks)**

13) a) Briefly describe the type of bonds in MgO. **(2 marks)**

  b) State 2 differences in physical properties of metal and non-metal.

      (2 marks)

  c) (i) State 2 differences between organic and inorganic compounds.

      (2 marks)

    (ii) Write a balanced chemical equation (use molecular formulae) for the reaction of complete combustion of propane, C_3H_6 in excess air.

      (1 mark)

    (iii) Write a balanced equation (use molecular formulae) for the reaction between pent-2-ene and H_2O in concentrated H_2SO_4 to give the products of the reaction. **(1 mark)**

(iv) You are given solution X that contains ethane, CH_3CH_3 and Z which contains propene $CH_3CH=CH_2$.

Give a reagent test you can use to distinguish between X and Z and state the observable change in each case. **(2 marks)**

14) C_6H_{14} is an organic compound which is a member of the homologous series of alkanes.

a) Write the IUPAC name of C_6H_{14} compound with a branched chain. **(1 mark)**

b) Write a semi-developed formula of an alkane with 8 carbon atoms.

(1 mark)

c) Alkanes are aliphatic hydrocarbons.
State 2 uses of alkanes on a large scale. **(2 marks)**

d) An alcohol has the molecular formulae of $C_4H_{10}O$:

(i) Write a formula of the functional group in alcohols. **(1 mark)**

(ii) Write a structural formulae of two possible isomers of $C_4H_{10}O$ alcohol.

(2 marks)

e) Consider the following chemical species and their symbols: Mg^{2+}, Cl_2

(i) Write the electronic configuration of Mg^{2+} in terms of s, p, d and f notation.

(1 mark)

(ii) Write a balanced chemical equation of the reaction between magnesium Mg and chlorine, Cl_2 **(2 marks)**

(Atomic number: Mg=12, Cl=17)

15) Discuss the various effects of Insulin hormone in man. **(10 marks)**

16) a) Define transpiration **(2 marks)**

b) List both positive and negative effects of transpiration. **(8 marks)**

SECTION C: TEACHING METHODOLOGY (25 marks)

17) Lesson planning is an important and time–consuming responsibility for a teacher and very critical for enhancing learner learning and the teacher's confidence. Classroom management matters are also greatly assisted by careful lesson planning. Explain ten (10) points to consider in advance when planning a lesson plan. **(15 marks)**

18) You are requested to teach an experimental dominated lesson in EST. Explain the steps you will go through to handle the task. **(10 marks)**

-END-

BLANK PAGE