GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

Engineering Science 2
5155

JUNE 2022 **INTERMEDIATE LEVEL**

Specialty Name and Acronym	**All Industrial Specialties**
Subject Title	**ENGINEERING SCIENCE 2**
Subject Code No.	**5155**
Paper No.	**2**

Duration: 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

This Paper has Eight Questions. Answer Any Six.

All Questions carry equal marks

Paper Two carries 60% of the total mark.

Where necessary, take the value of the acceleration due to gravity as $10m/s^2$ and π as 22/7.

Calculators are allowed

You are reminded of the necessity for good English and orderly presentation in your answers.

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1. (a) A truck of mass 3600 kg collides with a lorry of mass 2800 kg. The truck had a velocity of 20 m/s and the lorry 30m/s. The two got stuck together and moved in one direction before coming to rest.

(i) State the law of conservation of momentum. **(2 marks)**

(ii) What is the common velocity after collision? **(3 marks)**

(b) Figure 1 shows a car moving in the forward direction with forces A, B, C and D acting on it.

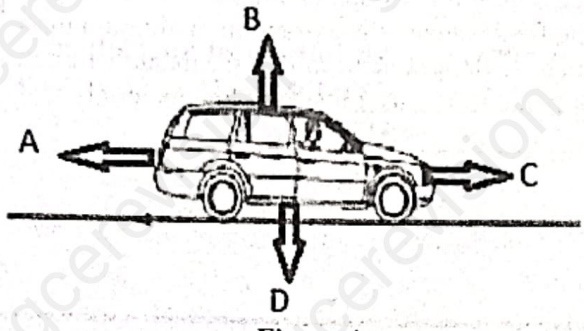

Figure 1

(i) Name the forces acting on the car. **(4 marks)**

(ii) Which of the forces increases when the brakes are applied? **(1 mark)**

(iii) Which force increases when the accelerator pedal is pressed down? **(1 mark)**

(iv) Given that the forces have values; A= 600 N, B= 8000 N, C= 1000 N and D= 8000 N. Calculate the mass of thecar. **(2 marks)**

(v) What is the resultant force on the car? **(2 marks)**

2.Consider the circuit diagram in figure 1 below.

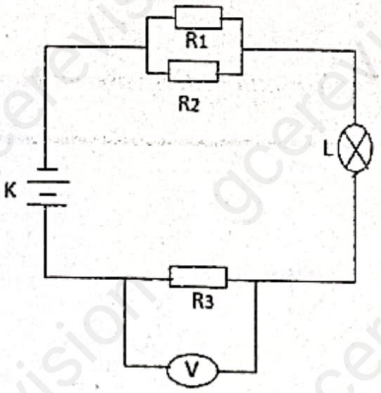

Figure 1

(a) Identify the components K, L and V. **(3 marks)**

(b) Given that R_1=6 Ω, R_2=6 Ω, R_3=1 Ω and the e.m.f of K=8 V. Determine:

(i) The total resistance in the circuit. **(2 marks)**

(ii) The current flowing through R_3. **(2 marks)**

(iii) The reading of the component V in the circuit. **(1 mark)**

(c) Using the same components, draw a circuit that will make the current flowing through R_3 to reduce. **(3 marks)**

(d) What would be observed in the circuit that would confirm that the current has reduced? **(1 mark)**

(e) Calculate the cost of using a 60 W bulb continuously for 29 days if one unit of electricity costs 60FCFA. **(3 marks)**

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3. (a) State with a reason, which of the following metal: aluminium, gold, and iron is used for making
   (i) axe **(2 marks)**
   (ii) cooking pots **(2 marks)**
   (iii) jewelleries. **(2 marks)**

(b) Metals are extracted from earthly impurities called ores by different industrial processes.
   (i) Name the ore from which aluminium is extracted. **(1 mark)**
   (ii) Name the industrial process used for extracting aluminium. **(1 mark)**
   (iii)Write the equation for the final stage in the extraction of aluminium. **(2 marks)**

(c) Give two reasons why plastics are preferable to iron in the manufacture of water pipes **(2 marks)**

(d) State three properties which make stones useful as building materials. **(3 marks)**

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4. (a) Copy and complete the table below concerning the element X.(X is not the usual symbol of the element)

Isotope	Number of protons	Number of neutrons
$^{79}_{35}X$		
$^{81}_{35}X$		

(4 marks)

(b) What do you understand by redox reaction? **(1 mark)**

(c) Classify the following chemical equations as **oxidation reaction** or **reduction reaction.**
   (i) $N_2 + 3H_2 \longrightarrow NH_3$ **(1 mark)**
   (ii) $2Ca + O_2 \longrightarrow 2CaO$ **(1 mark)**

(d) Whichtype of bonding exists in each of the following compounds?
   (i) Carbon dioxide (CO_2). **(1 mark)**
   (ii) Sodium chloride (NaCl) **(1 mark)**

(e) Rusting is an oxidation process that causes a lot of damage on structures made of iron.
   (i) State two substances that must be present for iron to get rusted. **(2 marks)**
   (ii) What is the best way to prevent an iron door from rusting? **(1 mark)**

(f) (i) State the fundamental law of magnetism. **(2 marks)**
   (ii) Give one use of magnets **(1 mark)**

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5. (a) Select appropriate words from the list in the bracket that corresponds to the letters K, L, M, N and P in the paragraph below.(non-renewable, kinetic, chemical, electrical, heat)

Most power stations use ____K_____ sources of energy,such as coal or oil. These fossil fuels are initially burnt in a boiler. This converts the _____L_____ energy in the fuel to ____M_____ energy. A turbine then converts this energy into _____N_____ energy, which in turn is converted to _____P_____ energy by a generator. **(5 marks)**

(b) A 4.7 Ω resistor manufactured from a tungsten wire has a power rating of 10 W, cross-sectional area of 2.0×10^{-7} m^2 and resistivity of 5.0×10^{-7} Ωm. Calculate:
   (i) The maximum current that should pass through the resistor. **(2 marks)**
   (ii) The maximum p.d across the resistor. **(1 mark)**
   (iii) The length of the wire used to make the resistor. **(2 marks)**

(c) What is the importance of the following components in a circuit?
   (i) Earth wire. **(1 mark)**
   (ii) Fuse **(1 mark)**

(d) In hospitals, taps with long control handles are used in order to avoid contamination as shown in figure 2 below.

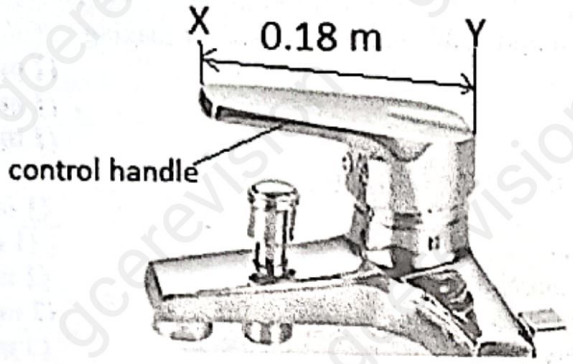

Figure 2

(i) Apart from avoiding contamination, give one other advantage of using taps with long control handles. **(1 mark)**

(ii) If a nurse applies a force of 3.5 N at the point X, 0.18 m from the Yin order to turn open the tap, calculate the maximum moment produced. **(2 marks)**

6.(a) The curve in figure 3 below shows the processes involved in converting a given mass of ice to steam by continuous heating.

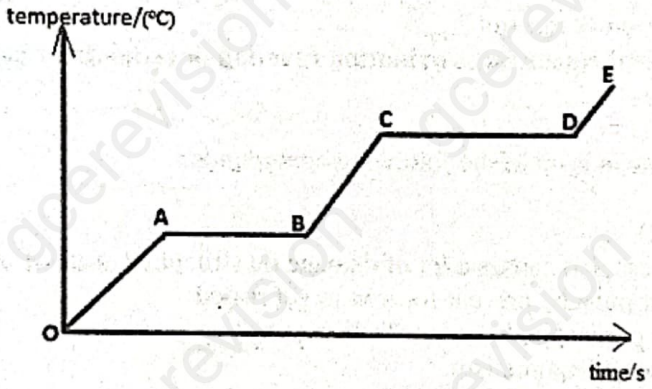

Figure 3

(i) Name the processes represented by OA, AB, BC, CD and DE. **(5 marks)**

(ii) Explain why there is no rise in temperature at AB and CD though heating is continuing. **(2 marks)**

(b) An electric heater working for 15 minutes changes the temperature of 10 kg of water from 20 °C to 40 °C. (Specific heat capacity of water is 4200 J/kgK), Calculate:

(i) the energy absorbed by water to heat up. **(3 marks)**

(ii) the power of the heater. **(2 marks)**

(c) What are the majority charge carriers in

(i) n-type semi-conductors? **(1 mark)**

(ii) p-type semi-conductors? **(1 mark)**

(d) Name a device used in the generation of electrical energy which is made using semi-conductors. **(1 mark)**

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7. (a) What is electromagnetic induction? **(2 marks)**

(b) A transformer in a mobile phone charger converts 100 V mains voltage into 5 V. Given that the phone needs a current of 3 A when charging.

(i) What type of transformer is found in the mobile phone charger? **(1 mark)**

(ii) Calculate the current coming from the mains supply. **(2 marks)**

(iii) If there are 300 turns of wire in the primary coil of the transformer, calculate the number of turns in the secondary coil. **(2 marks)**

(c) What would you use to protect the following parts of the body at a construction site?

(i) The head. **(1 mark)**

(ii) The eyes. **(1 mark)**

(iii) The fingers. **(1 mark)**

(iv) Thefeet. **(1 mark)**

(d) State one harmful effect of the presence of an excess of each of the following gases in the atmosphere.
(i) Carbon dioxide (CO_2) **(1 mark)**
(ii) Sulphur dioxide (SO_2) **(1 mark)**
(iii) Chlorofluorocarbons (CFCs) **(1 mark)**
(iv) Carbon monoxide (CO) **(1 mark)**

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8. (a) Consider a ray of light falling on a prism as shown in figure 4 below.

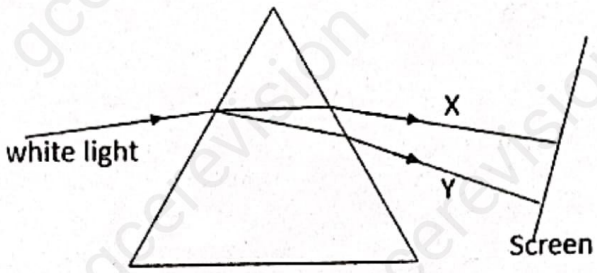

Figure 4

(i) What is the phenomenon demonstrated as the ray goes through the prism? **(1 mark)**
(ii) Name the colours X and Y. **(2 marks)**
(iii) Give two reasons why the incident rays splits into different colours on the screen. **(2 marks)**

(b) A convex lens of focal length 8 cm is used to capture the image of an object placed in front of it. Given that the object is 4 times magnified, determine the object distance. **(3 marks)**

(c)

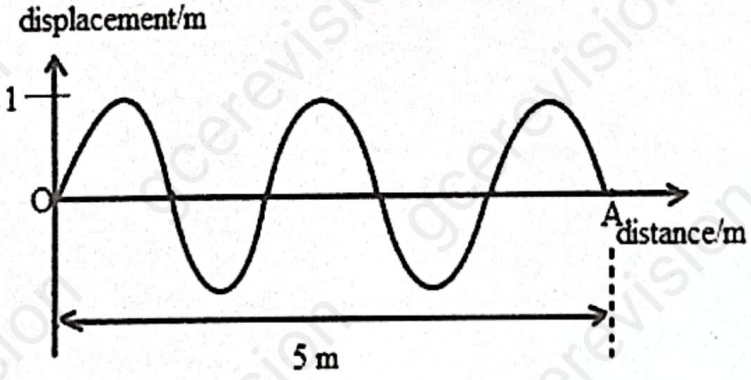

Figure 5

From figure 5, determine the:
(i) amplitude. **(1 mark)**
(ii) wavelength. **(1 mark)**
(iii) period if the wave profile take 3s to move from O to A. **(2 marks)**

(d) State the main function each of the following electronic components.
(i) Capacitor **(1 mark)**
(ii) Diode **(1 mark)**
(iii) Transistor **(1 mark)**
