GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

JUNE 2025 **INTERMEDIATE LEVEL**

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

Duration: Two and a Half Hours

INSTRUCTIONS TO CANDIDATES

This Paper Has EIGHT (8) Questions. **Answer Any SIX (6).**

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 10 m/s^2 and π as $\frac{22}{7}$.

Calculators are allowed.

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

1. (a) The velocity-time graph for an object in motion is shown in **figure 1**.

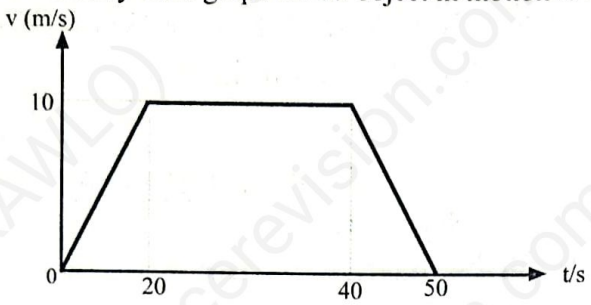


Figure 1

Determine:

(i) The total time taken for the journey. **(1 mark)**

(ii) The maximum velocity reached. **(1 mark)**

(iii) The acceleration during the first 20 seconds. **(2 marks)**

(iv) The total distance travelled. **(2 marks)**

(b) **Figure 2** shows a block and tackle pulley system.

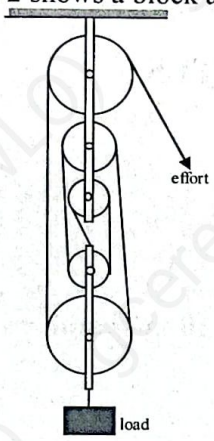


Figure 2

(i) What is the velocity ratio of the pulley system? **(1 mark)**

If a load of 60 N is raised through a vertical distance of 1 m by an effort of 20 N, calculate;

(ii) The mechanical advantage of the system. **(2 marks)**

(iii) The distance moved by the effort. **(2 marks)**

(iv) The efficiency of the machine. **(2 marks)**

(c) Give two reasons why the efficiency of the system is less than 100%. **(2 marks)**

---

2. (a) (i) State Ohm's law. **(2 marks)**

(ii) State two factors that affect the resistance of a conductor. **(2 marks)**

(b) Study the circuit in **figure 3** and answer the questions that follow.

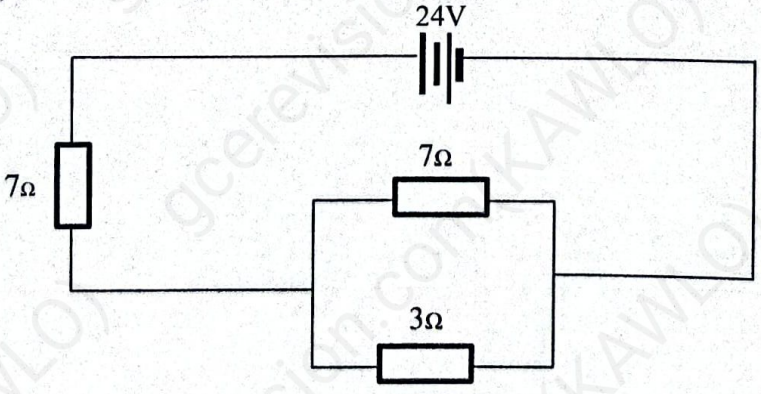


Figure 3

Go on to the next page

Calculate;

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

(ii) The potential difference across the 7 Ω resistor in the parallel section. **(3 marks)**

(iii) The current through the 3 Ω resistor. **(1 mark)**

(c) (i) Give one advantage of A.C over D.C **(1 mark)**

(ii) Name a device used to store electric charges and draw its circuit symbol **(2 marks)**

(iii) In pre-paid meters installed by ENEO, a household buys energy before consumption. How many units (KWh) will the house hold receive after buying energy worth 7500 frs. (1 unit costs 75 frs) **(2 marks)**

---

3. (a) (i) Give two properties of plastics which make them useful as engineering materials. **(2 marks)**

(ii) What is recycling of plastics? **(1 mark)**

(iii) What advantage does recycling of plastics have on the environment? **(1 mark)**

(b) Copy and complete the table by selecting a suitable metal from the box below, giving reason in each case.

Aluminium, Gold, Magnesium, Copper, Iron, Lithium

Uses	Metal	Property of material responsible for its use.
Earrings		
Axe		
Body work of aircraft		

(6 marks)

(c) (i) State Hooke's law. **(1 mark)**

(ii) Sketch a force –extension graph for a material that obeys Hooke's law for loads ranging up to the elastic limit. **(2 marks)**

(iii) The length of a wire that obeys Hooke's law increases from 80 mm to 83 mm when a mass of 0.03 kg is suspended on it. The length increases to 94 mm, when another mass is added to it. Find the additional mass on the wire. **(2 marks)**

---

4. (a) Butane (C_4H_{10}) is the main component of cooking gas used in our homes.

(i) Write the structural formula of butane. **(1 mark)**

(ii) Write a balanced equation to show the complete combustion of butane. **(3 marks)**

(iii) Calculate the molar mass of butane given that C=12 and H=1. **(2 marks)**

(iv) How many moles are present in 11.6 g of Butane? **(2 marks)**

(b) What is electrolysis? **(1mark)**

(c) A copper (II) sulphate solution was electrolyzed using inert electrodes.

(i) State the different ions present in the solution. **(2 marks)**

Given that a steady current of 2 A was passed through the solution for 1 hour 40 minutes, calculate:

(ii) The quantity of charge passed. **(2 marks)**

(iii) The number of Faradays used. **(2 marks)**

---

5. (a) State the energy transformation carried out by each of the transducers in the following table: **(4 marks)**

Transducer	Energy transformation	
	Initial energy	Final useful energy
Example: House fan	Electrical	Kinetic
Electric boiler		
Battery		
Solar cell		
Car engine		

(b) An object of mass 200 kg is at the top of a cliff 45 m high.

(i) Calculate the potential energy of the object at that height. **(2 marks)**

(ii) What happens to the potential energy as the object falls? **(1 mark)**

Suppose the object falls to the bottom of the cliff;

(iii) What is the velocity with which it hits the ground? **(2 marks)**

(iv) State one form of energy to which the kinetic energy is transformed when the ball hits the ground? **(1 mark)**

(c) (i) What is renewable energy? **(2 marks)**

(ii) Give one example of renewable energy source. **(1 mark)**

(d) (i) Identify the safety symbols A and B in **figure 4** **(1 mark)**

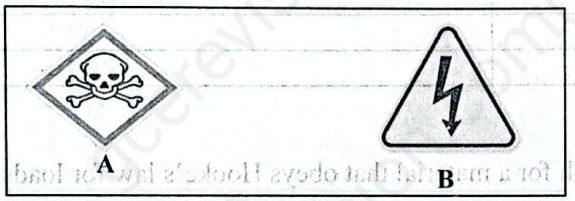


Figure 4

(ii) What security measure would you take when you see the safety symbol B? **(1 mark)**

---

6. (a) **Figure 5** shows the cooling curve of a 0.8 kg mass of gas at 115 °C loosing heat at a constant rate.

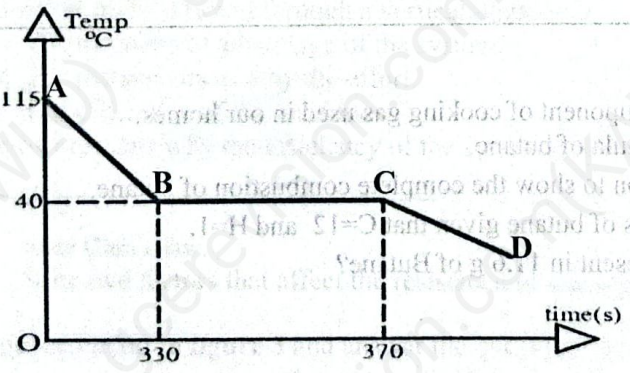


Figure 5

(i) What is the physical state represented by each of the regions AB and CD of the cooling curve? **(2 marks)**

(ii) What is the boiling point of the substance? **(1 mark)**

(iii) An electric heater rated 24 W was used in raising the temperature of a metallic block of mass **m** from 25 °C to 39 °C in 5 minutes. If the specific heat capacity of the metal is 571 J/kgk. Calculate the mass **m** of the block. **(3 marks)**

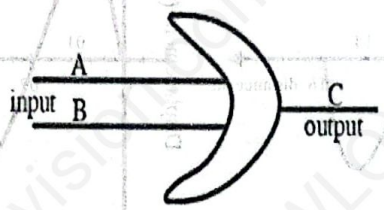
(iv) State one assumption made in your calculation. **(1 mark)**

(b) Mary, in a hurry to go to school, places a hot cup of coffee on a table for her breakfast.

(i) State two methods by which the cup loses heat. **(2 marks)**

(ii) State three ways Mary can use to make the hot cup of coffee lose heat faster . **(3 marks)**

(c) Name the logic gate in **figure 6** and draw its truth table.



(3 marks)

Figure 5

---

7. (a) A convex lens of focal length 30 cm is used to form a real image on a screen 90 cm from the lens. Calculate:

(i) The object distance from the lens. **(2 marks)**

(ii) The magnification of the lens. **(2 marks)**

(b) Draw a diagram to show how the image is formed in (a) above. **(3 marks)**

(c) A transformer is used to power a 6 V lamp from a 1.5 V supply.

(i) If there are 6 turns in the primary, how many turns are on the secondary coil? **(3 marks)**

(ii) State two ways by which power losses in a transformer can be minimized. **(2 marks)**

(d) (i) Draw the symbol of a diode and indicate its polarity. **(2 marks)**

(ii) State one use of the diode. **(1 mark)**

---

8. (a) **Figure 7** shows a solenoid wound on a cardboard tube. The ends of the solenoid are connected to a DC source through a rheostat and switch.

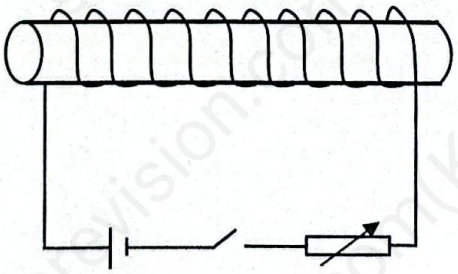


Figure 7

(i) Copy the figure and indicate the following:
-The direction of current,
- The polarity and
- The magnetic field lines. **(3 marks)**

(ii) State one method of making the field stronger. **(1 mark)**

(iii) Name one device which makes use of electromagnetism. **(1 mark)**