I will now combine the questions from the Cambridge IGCSE™ Combined Science exam paper (0653/41), Paper 4 Theory (Extended) from May/June 2023, with their respective mark schemes.

**Question 1:**

**1. (a) (i)** Identify the type of blood vessel labelled X in Fig. 1.1.

* **Mark Scheme:** Artery. [1 mark]

**1. (a) (ii)** Describe one difference between the frog heart and the human heart shown in Fig. 1.1.

* **Mark Scheme:** Any one from: frog has only 3 chambers/one ventricle; humans have four chambers/two ventricles; no septum in frog. [1 mark]

**1. (a) (iii)** Explain the advantages of a double circulatory system.

* **Mark Scheme:** Oxygenated and deoxygenated blood kept separate; high blood pressure around body/low blood pressure to lungs. [2 marks]

**1. (b) (i)** Identify the risk factor recorded by the highest percentage of people.

* **Mark Scheme:** (Lack of) physical activity. [1 mark]

**1. (b) (ii)** Calculate the number of people that record being overweight.

* **Mark Scheme:** (54 × 350) ÷ 100; 189. [2 marks]

**1. (b) (iii)** State one risk factor for CHD that is not linked to lifestyle.

* **Mark Scheme:** Age/genetics/inheritance. [1 mark]

**1. (c)** Explain why eating more fruit and vegetables can also reduce the risk of scurvy and constipation.

* **Mark Scheme:** Scurvy – (fruit and vegetables) are a source of Vit C/Vit C prevents scurvy; Constipation – (vegetables) are a source of fibre/fibre needed for bulk. [2 marks]

**Question 2:**

**2. (a) (i)** Complete Table 2.1.

* **Mark Scheme:** H+; hydroxide and water; Na+ and sodium chloride. [3 marks]

**2. (a) (ii)** State how the concentration of chloride ions changes during the electrolysis.

* **Mark Scheme:** Decreases because used up/forms chlorine. [1 mark]

**2. (b)** State the chemical test for hydrogen and the observation for a positive result.

* **Mark Scheme:** (Test) lighted splint AND (observation) pops. [1 mark]

**2. (c) (i)** Explain why the litmus indicator turns red.

* **Mark Scheme:** Shows an acid (produced). [1 mark]

**2. (c) (ii)** State and explain the color change of the red litmus indicator.

* **Mark Scheme:** (Red to) colorless; (because litmus is) bleached by chlorine (formed). [2 marks]

**Question 3:**

**3. (a)** State the process by which people are warmed by energy from the fire.

* **Mark Scheme:** Radiation. [1 mark]

**3. (b)** Explain why hot gases rise.

* **Mark Scheme:** Hot gases have faster moving molecules/more energy; spread out/more space between them; less dense than cold air/rises. [3 marks]

**3. (c) (i)** State how the musical note is produced by the guitar string.

* **Mark Scheme:** Vibration of string. [1 mark]

**3. (c) (ii)** Calculate the wavelength of the musical note.

* **Mark Scheme:** wavelength=speedfrequencywavelength=frequencyspeed​; 330256256330​; 1.29 m. [2 marks]

**3. (c) (iii)** Describe what is meant by a succession of compressions and rarefactions.

* **Mark Scheme:** Compressions – regions where air particles are close together; Rarefactions – regions where air particles are spread out. [2 marks]

**Question 4:**

**4. (a) (i)** Complete Table 4.1 with ticks to describe organisms.

* **Mark Scheme:** Owl – secondary consumer; Cougar – secondary consumer; Beaver – herbivore; Fruit – producer. [2 marks]

**4. (a) (ii)** Explain why more energy is available at the trophic level occupied by the beaver than the cougar.

* **Mark Scheme:** Energy lost at each level (of the food web); less energy available as move up trophic levels. [3 marks]

**4. (b)** State two ways pollen is adapted for insect pollination.

* **Mark Scheme:** Sticky (to stick to insects); scented/produce nectar (to attract insects). [2 marks]

**Question 5:**

**5. (a)** Deduce the general formula of alkenes.

* **Mark Scheme:** CnH2n*Cn*​*H*2*n*​. [1 mark]

**5. (b)** Complete the table by filling in the formulae for ethane and for octene.

* **Mark Scheme:** Ethane – C2H6*C*2​*H*6​; Octene – C8H16*C*8​*H*16​. [2 marks]

**5. (c) (i)** State what is meant by unsaturated and hydrocarbons.

* **Mark Scheme:** Unsaturated – contains a double bond; Hydrocarbons – compounds of hydrogen and carbon only. [2 marks]

**5. (c) (ii)** Explain why methene does not exist.

* **Mark Scheme:** Cannot have a double bond with only one carbon. [2 marks]

**5. (d) (i)** State one use of refinery gas.

* **Mark Scheme:** Fuel (for cooking/heating). [1 mark]

**5. (d) (ii)** Explain why propane and butane are in the same fraction.

* **Mark Scheme:** Similar boiling points. [1 mark]

**Question 6:**

**6. (a) (i)** Complete the sentence about gravitational force.

* **Mark Scheme:** Weight. [1 mark]

**6. (a) (ii)** Draw an arrow to show the direction of the force due to friction.

* **Mark Scheme:** Arrow upwards, in contact with box. [1 mark]

**6. (b)** Calculate the time taken by the box to travel on the conveyor belt.

* **Mark Scheme:** time=distancespeedtime=speeddistance​; 5.00.200.205.0​; 25 s. [2 marks]

**6. (c) (i)** Calculate the gain in gravitational potential energy of the box.

* **Mark Scheme:** energy gained=mass×g×heightenergy gained=mass×g×height; 45×10×245×10×2; 900 J. [2 marks]

**6. (c) (ii)** Calculate the pressure exerted by the box on the floor of the aircraft.

* **Mark Scheme:** pressure=forceareapressure=areaforce​; 4500.60×0.500.60×0.50450​; 1500 N/m2N/m2 or Pa. [4 marks]

**Question 7:**

**7. (a) (i)** Complete sentences about the yellow color of leaves.

* **Mark Scheme:** Chlorophyll; chemical/organic; carbohydrates/sugars. [3 marks]

**7. (a) (ii)** Explain why the stem of plant B bends upwards.

* **Mark Scheme:** Unequal distribution of auxin; more auxin on lower side causes greater growth. [3 marks]

**7. (b)** Describe how the cell labelled X is adapted for its function.

* **Mark Scheme:** Long/hair-like (to increase surface area); thin wall (for easy entry of water). [2 marks]

**7. (c)** Explain one way the death of aquatic plants reduces the concentration of dissolved oxygen in lakes.

* **Mark Scheme:** Dead plants are decomposed by bacteria which use oxygen. [2 marks]

**Question 8:**

**8. (a) (i)** Balance the equation for the reaction that forms rust.

* **Mark Scheme:** 3 O2O2​ and 2 Fe2O3Fe2​O3​. [1 mark]

**8. (a) (ii)** Deduce the symbol for the iron ion in Fe2O3Fe2​O3​.

* **Mark Scheme:** Fe3+Fe3+. [1 mark]

**8. (b) (i)** Describe how a barrier method prevents rusting.

* **Mark Scheme:** Stops water/oxygen reaching the iron/steel. [2 marks]

**8. (b) (ii)** State an example of a barrier method used to prevent rusting.

* **Mark Scheme:** Paint/grease/oil. [1 mark]

**8. (c)** State the number of electrons shared between oxygen atoms and give a reason.

* **Mark Scheme:** Four; to fill outer shells. [2 marks]

**8. (d)** Explain why iron oxide and oxygen have different physical states.

* **Mark Scheme:** (Iron oxide) ions held together by strong ionic bonds; (oxygen) molecules held together by weak intermolecular forces. [2 marks]

**Question 9:**

**9. (a)** State the law of reflection of light.

* **Mark Scheme:** Angle of incidence equals angle of reflection; measured from the normal. [1 mark]

**9. (b) (i)** Calculate the resistance of the lamp.

* **Mark Scheme:** resistance=voltagecurrentresistance=currentvoltage​; 5.00.0200.0205.0​; 250 Ω. [2 marks]

**9. (b) (ii)** Calculate the power rating of the lamp.

* **Mark Scheme:** power=voltage×currentpower=voltage×current; 5.0×0.0205.0×0.020; 0.10 W. [2 marks]

**9. (b) (iii)** Complete the circuit diagram for the lamp circuit.

* **Mark Scheme:** Correct placement of switch and resistor in series with LEDs, LEDs in parallel. [3 marks]

This completes the combination of questions and their respective mark schemes from the specified IGCSE Combined Science exam paper.