

Science Entry Assessment

Name Date Score

Time: about 55 minutes. GCSE Higher-tier (Year 11) combined-science screener. Answer ALL questions. Show full working and give units for every calculation. 'Explain' means give reasons; 'evaluate' means weigh both sides and reach a judgement. Calculators allowed. Marks in brackets. This is a demanding paper sat near the end of the GCSE course; attempt every part, including the final stretch questions. Show your working where you can. Marks for each question are shown in brackets, like [2]. Total marks: **71**.

- 1 Define homeostasis. Then explain why maintaining a constant core body temperature is important for the enzymes that control metabolic reactions. [3]

WORKING

Answer

BIOLOGY: HOMEOSTASIS

- 2 In a cross, brown coat (B) is dominant to white coat (b). Two heterozygous brown mice are crossed. (a) Draw the Punnett square (write out the four offspring genotypes). (b) State the expected ratio of brown to white offspring. (c) If 60 offspring are produced, how many would you expect to be white, and explain why the actual number might differ. [4]

WORKING

Answer

BIOLOGY: GENETICS / INHERITANCE

- 3 25.0 cm³ of sodium hydroxide solution is neutralised by 20.0 cm³ of 0.100 mol/dm³ hydrochloric acid. The equation is: NaOH + HCl → NaCl + H₂O. Calculate the concentration of the sodium hydroxide solution in mol/dm³. [4]

WORKING

Answer

CHEMISTRY: TITRATION CALCULATION / REQUIRED PRACTICAL

- 4 A 0.045 kg ball is dropped from a height of 1.8 m. (a) Calculate its gravitational potential energy at the start ($g = 9.8 \text{ N/kg}$). (b) Ignoring air resistance, calculate its speed just before it hits the ground. (c) In reality the measured speed is lower than your answer to (b). Explain why. [4]

WORKING

Answer

PHYSICS: ENERGY CONSERVATION

- 5 Explain how the body responds to a rise in blood glucose concentration after a meal. Name the organ, the hormone, the target organ and the effect, and state how this is an example of negative feedback. [4]

WORKING

Answer

BIOLOGY: HORMONAL CONTROL / NEGATIVE FEEDBACK

- 6 The reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ is exothermic in the forward direction and reaches a dynamic equilibrium. (a) Explain what 'dynamic equilibrium' means. (b) Using Le Chatelier's principle, predict and explain the effect on the yield of ammonia of (i) increasing the pressure and (ii) increasing the temperature. [4]

WORKING

Answer

CHEMISTRY: EQUILIBRIUM / LE CHATELIER (HABER)

- 7 A transformer has 2000 turns on the primary coil and 50 turns on the secondary coil. The primary potential difference is 230 V. (a) Calculate the secondary potential difference and state whether this is a step-up or step-down transformer. (b) The transformer is 100% efficient and the secondary current is 4.0 A. Calculate the primary current. [4]

WORKING

Answer

PHYSICS: TRANSFORMERS

- 8 Describe how you would carry out a chromatography experiment to find out whether a food colouring is a single dye or a mixture of dyes. Explain how you would calculate the R_f value and what an R_f value tells you. [4]

WORKING

Answer

CHEMISTRY: CHROMATOGRAPHY / REQUIRED PRACTICAL

- 9 Explain why a person with damaged kidneys may need dialysis. In your answer state TWO substances that the dialysis must remove or control, and explain why the dialysis fluid contains a normal blood-level concentration of glucose. [4]

WORKING

Answer

BIOLOGY: KIDNEYS / DIALYSIS

- 10 A student investigates the extension of a spring. Loads and extensions: 1.0 N → 2.0 cm; 2.0 N → 4.0 cm; 3.0 N → 6.0 cm; 4.0 N → 8.5 cm; 5.0 N → 11.5 cm. (a) Calculate the spring constant in N/m using the linear region. (b) Identify the load at which the spring stops obeying Hooke's law and justify your answer with the data. [4]

WORKING

Answer

PHYSICS: HOOKE'S LAW / REQUIRED PRACTICAL

- 11 Antibiotic resistance in bacteria is increasing. Explain, using ideas about natural selection, how a population of bacteria can become resistant to an antibiotic. [4]

WORKING

Answer

BIOLOGY: NATURAL SELECTION / EVOLUTION

- 12 Iron(III) oxide is reduced in the blast furnace: $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$. (a) Define reduction in terms of oxygen and in terms of electrons. (b) Calculate the maximum mass of iron that can be obtained from 320 tonnes of Fe_2O_3 . (Relative atomic masses: Fe = 56, O = 16.) [4]

WORKING

Answer

CHEMISTRY: REDOX / REACTING MASSES

- 13 A car travels along a motorway. The driver has a reaction time, then the brakes are applied. (a) State what is meant by 'thinking distance' and 'braking distance'. (b) Explain, using energy ideas, why doubling the car's speed increases the braking distance by a factor of FOUR (assuming the same braking force). [4]

WORKING

Answer

PHYSICS: STOPPING DISTANCES

- 14 Describe the carbon cycle. In your answer, name the processes that REMOVE carbon dioxide from the atmosphere and the processes that RETURN it, and explain how deforestation can increase atmospheric CO₂ in TWO different ways. [4]

WORKING

Answer

BIOLOGY: CARBON CYCLE / HUMAN IMPACT

- 15 STRETCH. Two resistors are connected in PARALLEL across a 12 V battery: R₁ = 4.0 ohm and R₂ = 12 ohm. (a) Calculate the total resistance of the parallel combination. (b) Calculate the total current drawn from the battery. (c) Explain why adding a third resistor in parallel DECREASES the total resistance, even though you are 'adding' a resistor. [4]

WORKING

Answer

PHYSICS: PARALLEL CIRCUITS (STRETCH)

- 16 STRETCH. A student adds excess zinc to 50.0 cm³ of 0.200 mol/dm³ copper(II) sulfate: $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$. (a) Explain why this is a displacement reaction and which metal is oxidised. (b) Calculate the maximum mass of copper that could be produced. (Ar: Cu = 64.) [4]

WORKING

Answer

CHEMISTRY: DISPLACEMENT / MOLES (STRETCH)

- 17 STRETCH. The 'thinking distance' for stopping a car is sometimes modelled as $d = v \times t$, where t is reaction time. A driver has reaction time 0.70 s. (a) Calculate the thinking distance at 30 m/s. (b) The braking distance at 30 m/s is 75 m. The same car's KE is removed by an average braking force of 7200 N. Use this to estimate the mass of the car, then comment on whether your value is realistic. [4]

WORKING

Answer

PHYSICS: STOPPING DISTANCE / ENERGY (STRETCH)

- 18 STRETCH. Evaluate the use of stem cells from human embryos in medicine. Give one clear benefit and one ethical objection, and reach a justified judgement about whether their use should be allowed. [4]

WORKING

Answer

BIOLOGY: STEM CELLS / ETHICS (STRETCH)

End of assessment. Hand your paper back when you are finished. Well done!