The Holy Family Catholic School

a voluntary academy

YEAR 11 Trial Examination Summer Term 2024

Student Name _____

Candidate Number _____

Subject Teacher _____

Form _____

Subject: Combined Science

Level: Higher

Title of Paper: Combined Science Higher

Duration of Paper: 55 minutes

Head of Subject/Lead: J Brewer

Head of Faculty: J Brewer

Biology Questions

1 Respiration occurs in cells.

(a) Why do cells respire?

(1)

- ☐ **A** to produce nitrogen
- ☐ **B** to release oxygen
- ☐ **C** to produce glucose
- ☐ **D** to release energy

(b) An athlete runs every day as part of their training.

(i) Explain why the breathing rate of the athlete increases when running.

(2)

(ii) When the athlete is running, their muscle cells use both aerobic respiration and anaerobic respiration.

State **two** differences between aerobic respiration and anaerobic respiration.

(2)

1 .....

2 .....

(c) Bromothymol blue (BTB) solution is an indicator of pH.

Figure 2 shows the colour of BTB at different pH levels.

pH	4	5	6	7 (neutral)	8
colour	yellow	yellowy green	light green	green	blue

Figure 2

When air is passed through green BTB, for one minute, the solution stays green.

When a person breathes out through a straw into BTB for one minute the solution turns yellow.

(i) Explain why the air breathed out turns the BTB solution yellow.

(2)

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(ii) A scientist placed pondweed into two sealed test tubes containing green BTB solution.

Test tube A was kept in the dark.
Test tube B was kept in the light.
All other conditions were kept the same.
Figure 3 shows these test tubes at the start of the investigation.

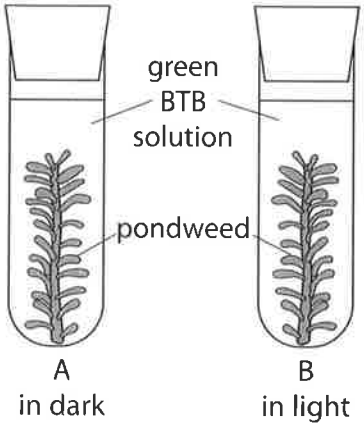

Figure 3

Figure 4 shows the colour of the BTB solution after 5 hours.

Tube A (in dark)	Tube B (in light)
yellowy green	green

Figure 4

Explain the results for tube A and tube B shown in Figure 4.

(2)

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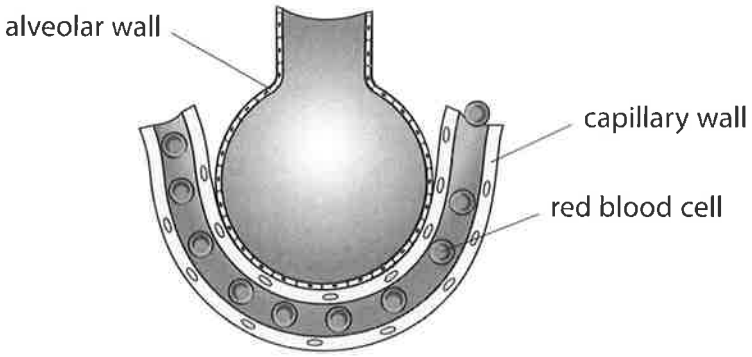
(Total for Question 2 = 9 marks)

2 Gas exchange happens in the alveoli in the lungs.

Figure 7 shows an alveolus and a capillary.



(adapted from : sciencepics/shutterstock)

Figure 7

(a) (i) Name the gas used in respiration that moves from the alveolus into the capillary.

(1)

.....

(ii) Name the gas produced by respiration that moves from the capillary into the alveolus.

(1)

.....

(iii) The capillary wall is only one cell thick.

Explain how gases move from the alveolus to the capillary.

(3)

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DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(iv) Explain the advantages of red blood cells passing one at a time through this narrow capillary.

(3)

(b) The average number of alveoli in each human lung is 280 million.

The surface area of 1 million alveoli is 0.25 m^2.

Calculate the total surface area of a human lung.

(2)

(Total for Question 4 = 10 marks)

Chemistry Questions

3 (a) Figure 5 shows the percentage of three gases, **X**, **Y** and **Z**, in the Earth's early atmosphere.

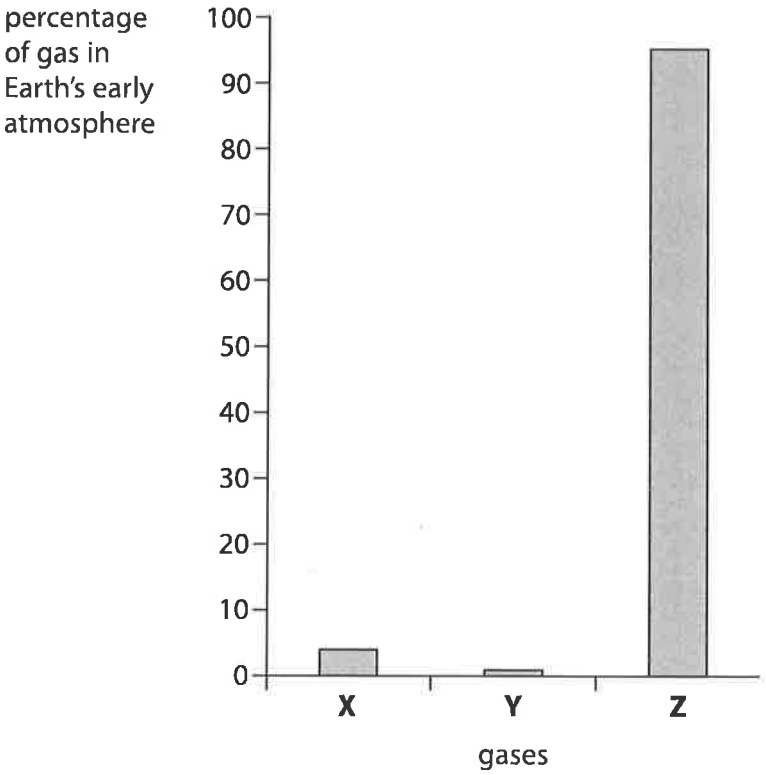

Figure 5

What is the name of gas **Z**?

(1)

- ☐ **A** argon
- ☐ **B** carbon dioxide
- ☐ **C** nitrogen
- ☐ **D** oxygen

(b) It is thought that small quantities of hydrogen sulfide, H_2S, were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.

(2)

(c) Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.

(3)

(d) A student investigates the effect of acid rain on cress plants.

The student uses this method.

step 1 grow 20 cress plants in each of two dishes, **A** and **B**

step 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

step 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

step 4 repeat steps 2 and 3 every day for one week

step 5 count how many plants are still alive after one week.

(i) State what piece of equipment the student could use to measure the pH of each liquid.

(1)

.....

(ii) Explain **one** improvement that the student could make to the method to make the results more valid.

(2)

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(Total for Question 3 = 9 marks)

4 Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

(a) Figure 10 shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

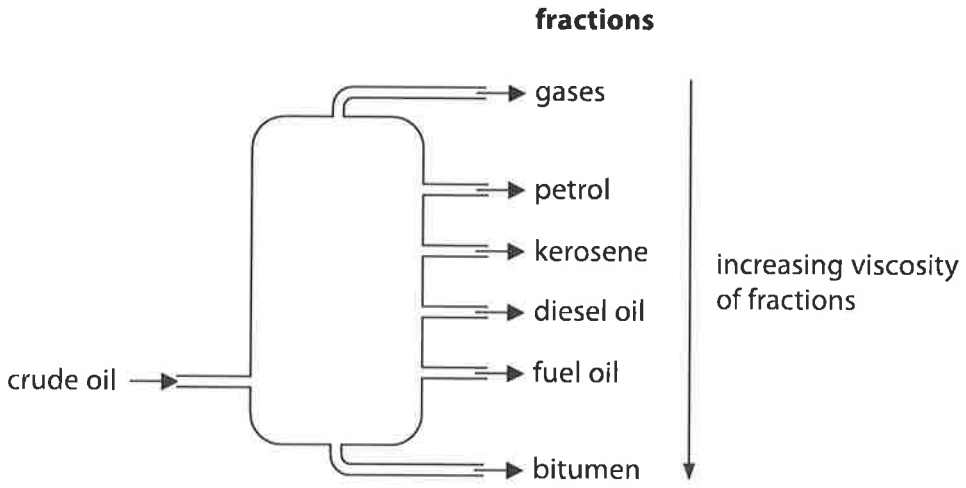

Figure 10

(i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?

(1)

		bitumen	diesel oil	fuel oil
☐	**A**	fuel for large ships	surfacing roads	fuel for trains
☐	**B**	fuel for large ships	fuel for trains	surfacing roads
☐	**C**	surfacing roads	fuel for trains	fuel for large ships
☐	**D**	surfacing roads	fuel for large ships	fuel for trains

(ii) Explain the trend in the viscosity of the fractions.

(2)

(b) Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14}, and one molecule of alkene **Y**.

$$\mathbf{X} \rightarrow C_6H_{14} + \mathbf{Y}$$

The relative formula mass of **Y** is 56.
The empirical formula of **Y** is CH_2.

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: H = 1.0, C = 12)

(4)

molecular formula of **X** = ...

*(c) Large quantities of methane are used as a fuel.

Figure 11 shows a Bunsen burner.

Methane can be used as fuel for the Bunsen burner.

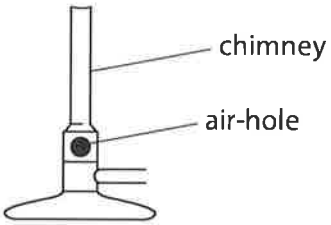

Figure 11

The air-hole on the chimney of the Bunsen burner can be opened and closed.

Explain the effect of opening and closing the air-hole of the Bunsen burner on the products of combustion of methane and the harm that using large quantities of methane as a fuel can cause.

(6)

Physics Questions

5 (a) Which of these means changing state from solid directly to gas?

(1)

☐ **A** condensing

☐ **B** freezing

☐ **C** melting

☐ **D** sublimating

(b) An object has a mass of 7.22×10^{-2} kg and a volume of 2.69×10^{-5} m^3.

Calculate the density, ρ, of the object.

Use an equation selected from the list of equations given at the end of the question paper.

(3)

State the unit.

density = ... unit .....

(c) Aluminium has a melting point of 660 °C.

The absolute zero of temperature is –273 °C.

(i) Calculate the melting point of aluminium in kelvin.

(1)

melting point of aluminium = ... K

(ii) Describe the motion of particles in liquid aluminium (above 660 °C).

(2)

.....

.....

.....

(d) A student determines the volume of a piece of metal by measuring the volume of water that it displaces.

The student wrote the following in his notebook.

> I put some water into a measuring cylinder.
> I put the piece of metal into the water in the measuring cylinder.
> I took the reading of the new water level in the measuring cylinder.
> This was the volume of the piece of metal.

The student's description is incomplete.

Suggest **two** sentences that the student could have included to provide a more complete description of the correct procedure.

(2)

1 .....

.....

2 .....

.....

(Total for Question 2 = 9 marks)

6 (a) Figure 6 shows part of the inside of a pen.

The pen contains a spring that can be compressed.

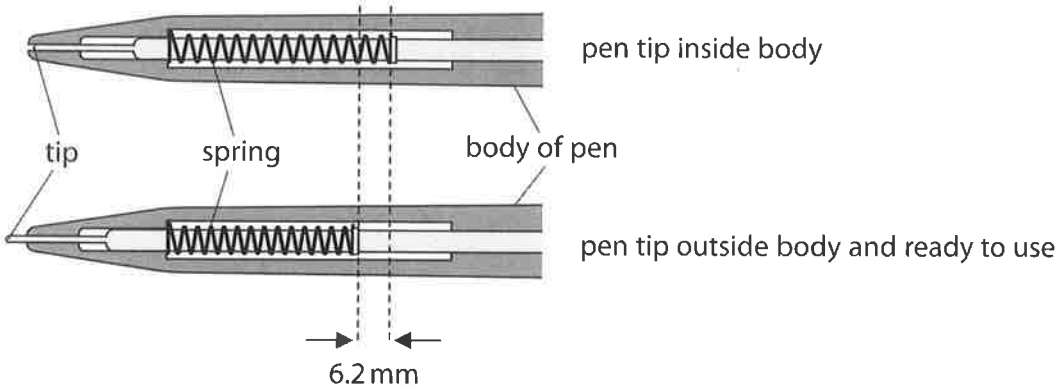

Figure 6

The spring constant of the spring is 260 N/m.

(i) Calculate the force needed to compress the spring by the amount shown in Figure 6.

Give your answer to an appropriate number of significant figures.

Use an equation selected from the list of equations given at the end of the question paper.

(3)

force = ... N

(ii) A student removes the spring from the pen and investigates the compression of the spring.

Figure 7 shows the equipment and the procedure that the student uses.

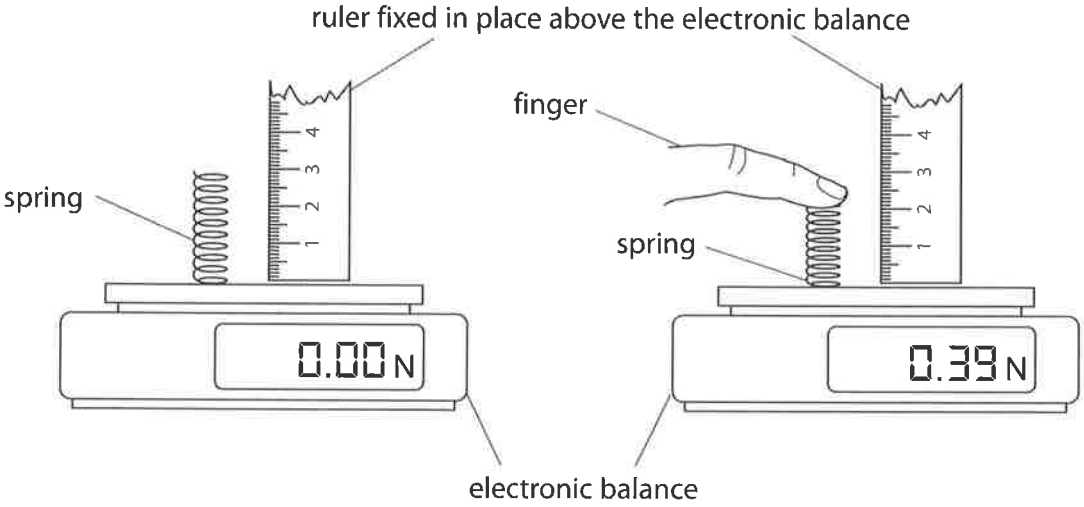

Figure 7

The student presses down on the spring to change its length.

The electronic balance measures the force applied to the spring.

Describe how the student can determine the change in length of the spring.
You may add to Figure 7 to help your answer.

(3)

(iii) The student finds it difficult to make an accurate measurement of the change in length of the spring using the equipment as shown.

Describe **one** way that the student could improve the procedure.

(2)

(b) Figure 8 shows a different spring hanging from a hook fixed to the ceiling.

A block hangs from the other end of the spring.

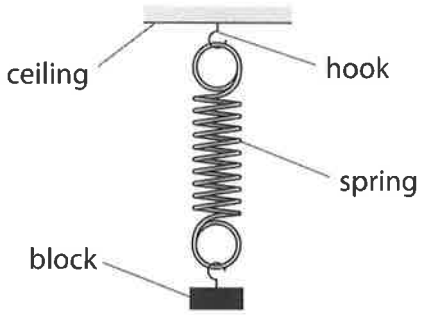

Figure 8

The weight of the spring is 1 N.
The weight of the block is 5 N.

The force exerted on the top of the spring by the hook is

(1)

☐ **A** 4 N down

☐ **B** 4 N up

☐ **C** 6 N down

☐ **D** 6 N up

(c) Figure 9 shows two forces, P and Q, acting at point X.

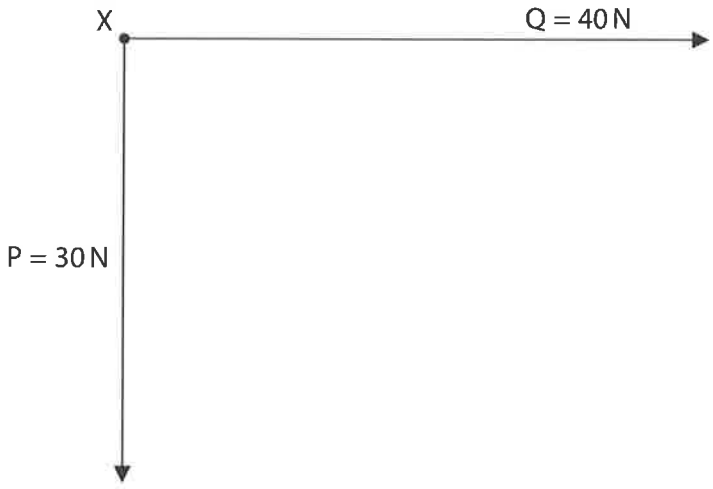

diagram is drawn to scale

Figure 9

Complete the diagram in Figure 9 to show the size and direction of the resultant force, R, on point X.

(2)

(Total for Question 4 = 11 marks)

The periodic table of the elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

** The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

If you're taking **GCSE (9–1) Combined Science** or **GCSE (9–1) Physics**, you will need these equations:

HT = higher tier

	distance travelled = average speed × time	
	acceleration = change in velocity ÷ time taken	$a = \frac{(v-u)}{t}$
	force = mass × acceleration	$F = m \times a$
	weight = mass × gravitational field strength	$W = m \times g$
HT	**momentum = mass × velocity**	$p = m \times v$
	change in gravitational potential energy = mass × gravitational field strength × change in vertical height	$\Delta GPE = m \times g \times \Delta h$
	kinetic energy = 1/2 × mass × (speed)^2	$KE = \frac{1}{2} \times m \times v^2$
	efficiency = $\frac{\text{(useful energy transferred by the device)}}{\text{(total energy supplied to the device)}}$	
	wave speed = frequency × wavelength	$v = f \times \lambda$
	wave speed = distance ÷ time	$v = \frac{x}{t}$
	work done = force × distance moved in the direction of the force	$E = F \times d$
	power = work done ÷ time taken	$P = \frac{E}{t}$
	energy transferred = charge moved × potential difference	$E = Q \times V$
	charge = current × time	$Q = I \times t$
	potential difference = current × resistance	$V = I \times R$
	power = energy transferred ÷ time taken	$P = \frac{E}{t}$
	electrical power = current × potential difference	$P = I \times V$
	electrical power = (current)^2 × resistance	$P = I^2 \times R$
	density = mass ÷ volume	$\rho = \frac{m}{V}$

	force exerted on a spring = spring constant × extension	$F = k \times x$
	(final velocity)^2 − (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2 \times a \times x$
HT	**force = change in momentum ÷ time**	$F = \frac{(mv - mu)}{t}$
	energy transferred = current × potential difference × time	$E = I \times V \times t$
HT	**force on a conductor at right angles to a magnetic field carrying a current = magnetic flux density × current × length**	$F = B \times I \times l$
	For transformers with 100% efficiency, potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil	$V_p \times I_p = V_s \times I_s$
	change in thermal energy = mass × specific heat capacity × change in temperature	$\Delta Q = m \times c \times \Delta\theta$
	thermal energy for a change of state = mass × specific latent heat	$Q = m \times L$
	energy transferred in stretching = 0.5 × spring constant × (extension)^2	$E = \frac{1}{2} \times k \times x^2$

If you're taking **GCSE (9–1) Physics**, you also need these extra equations:

	moment of a force = force × distance normal to the direction of the force	
	pressure = force normal to surface ÷ area of surface	$P = \frac{F}{A}$
HT	$\frac{\text{potential difference across primary coil}}{\text{potential difference across secondary coil}} = \frac{\text{number of turns in primary coil}}{\text{number of turns in secondary coil}}$	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$
	to calculate pressure or volume for gases of fixed mass at constant temperature	$P_1 \times V_1 = P_2 \times V_2$
HT	**pressure due to a column of liquid = height of column × density of liquid × gravitational field strength**	$P = h \times \rho \times g$

END OF EQUATION LIST