CITY OF LONDON
FREEMEN'S SCHOOL

SAMPLE ENTRANCE EXAMINATION PAPER

For pupils currently in Year 8

SCIENCE

(BIOLOGY, CHEMISTRY, PHYSICS)

Time: 1 hour

You should spend no more than 20 minutes on each section.

Answer all questions in the spaces provided.

S0613	✓	SCI

Science Department

13+ Entrance Examination Requirements

Candidates may be required to plot graphs and measure lengths and angles, so should bring a pen, pencil, ruler, rubber and protractor to the exam. As well as the specific topics listed below, candidates may be asked to answer questions on a comprehension passage or use their knowledge of graphs and practical skills.

Biology

- Cells
- Plant and Animal Reproduction
- Variation and Adaptation
- Senses
- Planning experiments and analysing and evaluating evidence

Chemistry

- Physical Separations and Changes: filtering, evaporation, distillation, fractional distillation, chromatography, states of matter, changes of state, effect of impurities, diffusion
- Chemical changes: simple reversible reactions, thermal decomposition, burning and oxidation, rusting, precipitates and effervescence
- Elements, Compounds and Mixtures: atoms and symbols for elements, compounds and mixtures, interpretation of formulae, properties of materials
- Data handling and graphical skills

Physics

- Light and sound, including reflection and refraction
- Satellites and the Solar System
- Forces and springs
- Speed
- Electric circuits
- Electromagnets
- Energy changes

B I O L O G Y

1) In January 2002, thousands of pupils recorded the numbers of different birds seen in their gardens in one hour. They sent their results to the Royal Society for the Protection of Birds who has kept data for many years.

(a) Why are the results from this survey more reliable than one person's observation?

……

……

1 mark

(b) Pupils observed birds in their gardens for one hour during the last week in January.

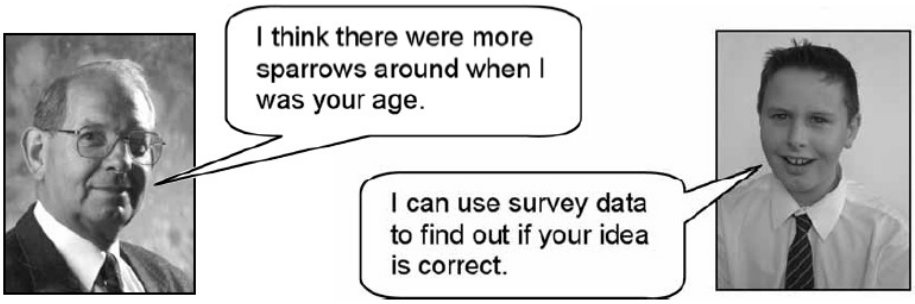
Give **two** factors which are being controlled in this survey.

1. ……

2. ……

1 mark

Jack's grandad says: Jack says:



Jack thinks that the results collected in 2002 **cannot** test his grandad's idea that sparrows are less common than they used to be.

(i) What additional survey data would Jack need to test his grandad's idea?

……

……

1 mark

(ii) What pattern in the survey results would give Jack the evidence that his grandad was correct?

……

……

1 mark
(Total = 5 marks)

2. (a) When fertilisation takes place, the nucleus of a sperm joins with the nucleus of an ovum (egg).
In which part of the reproductive system does fertilisation normally take place in humans?

Tick the correct box.

1 mark

cervix	☐	ovary	☐
oviduct	☐	uterus	☐

(b) The table below gives information about fertilisation in three animals.

animal	Does fertilisation take place inside or outside the body?	number of eggs released at a time
human	inside	1
bird	inside	4
frog	outside	3000

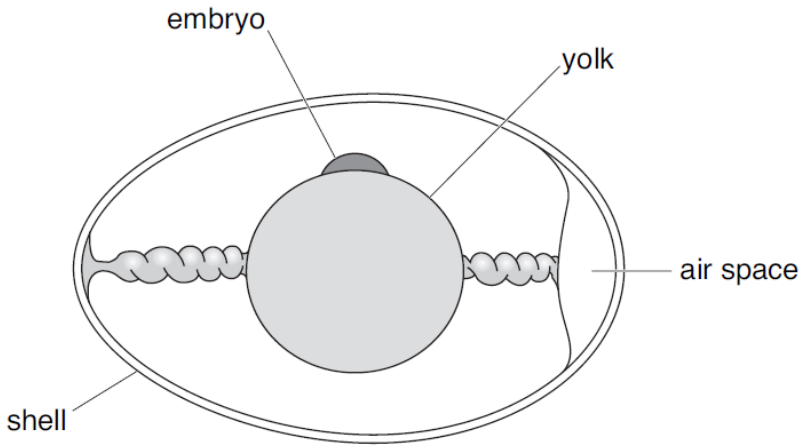
Frogs release their eggs and sperm into water.
The eggs are fertilised in the water.
Why is it an advantage for frogs to release large numbers of eggs and sperm?

……

……

1 mark

(c) The diagram shows a section through a fertilised egg of a bird.



(i) The shell of a bird's egg is porous. This means it has microscopic holes in it.
Why does it need to be porous?

……

……

1 mark

(ii) Give **one** other function of the egg shell.

……

……

1 mark

(d) A bird's egg contains yolk which is a food store for the developing chick.
A human egg does **not** contain yolk.
Why does a human egg **not** need to contain a food store for the embryo?

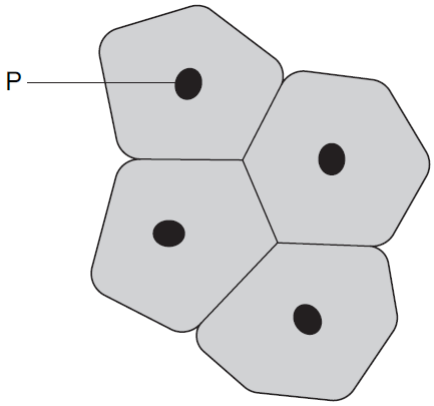
……

……

1 mark

(Total = 5 marks)

3. The diagram shows a group of cells from the lining of the mouth.



(i) Give the name and function of part P.

Name of part P

……

1 mark

Function of part P

……

……

1 mark

(ii) Which word describes this group of cells?
Tick the correct box.

compound	organism	organ	tissue
☐	☐	☐	☐

1 mark
(Total = 3 marks)

4. Read the extract below and then answer the questions which follow it.

Adaptations shown by predators
A predator like the sparrowhawk displays obvious adaptations which make it an efficient predator:
• sharp, grasping claws or talons
• a curved, sharp beak
• large forward facing eyes

But what sort of adaptations are shown by other predators, such as insects?

A predatory beetle, called *Rhizophagus grandis* feeds on the spruce bark beetle, *Dendroctonus micans*, which is a well-established pest that was accidentally introduced from continental Europe in imported timber. The larvae of the bark beetle cluster together in a large group in spruce trees, eating the resinous bark and producing large amounts of faeces.

The predatory beetle is found within the pest's natural range and preys only on the pest. This is an example of **biological control**.

This particular biological control programme has been highly successful because of the extraordinary ability of the predator to locate its prey even when there may be only a few infested trees in the forest.

a) Why is it important that there is variation amongst organisms?

……

……

1 mark

b) Explain how each of the adaptations of the sparrowhawk make it an efficient predator

sharp, grasping claws or talons

……

……

a curved, sharp beak

……

……

large forward facing eyes

……

……

3 marks

c) Explain what is meant by the term “biological control”.

……

……

1 mark

d) Suggest how the predatory beetle, *Rhizophagus grandis,* is able to locate its prey successfully even when there may be only a few infested trees in the forest.

……

……

……

……
…

2 marks
(Total = 7 marks)

Turn-over

CHEMISTRY

C1. These boxes show some methods of separating mixtures.

1 filtration	2 distillation	3 evaporation
4 fractional distillation	5 chromatography	6 using a separating funnel

Give the numbers of the boxes for your answers.

a] Which method can be used to separate solid salt from salt solution?

_____

b] Which method can be used to obtain a solid from a mixture of solid and solution?

_____

c] Which method can be used to separate a solvent from a solution?

_____

d] Which method can be used to separate a mixture of two miscible liquids with different boiling points?

_____

e] Which method can be used to make pure water from sea water?

_____

f] Which method can be used to separate coloured dyes in a solution?

_____ [5]

C2. This table gives data for some elements.

Name	Symbol	Melting point (°C)	Boiling point (°C)	Electrical conductivity
Aluminium	Al	660	2450	good
Bromine	Br	−7	58	poor
Calcium	Ca	850	1490	good
Chlorine	Cl	−101	−35	poor
Copper	Cu	1083	2600	good
Helium	He	−270	−269	poor
Iron	Fe	1540	2900	good
Lead	Pb	327	1750	good
Magnesium	Mg	650	1110	good
Mercury	Hg	−39	357	good
Nitrogen	N	−210	−196	poor
Oxygen	O	−219	−183	poor
Phosphorus	P	44	280	poor
Potassium	K	64	760	good
Sodium	Na	98	890	good
Sulphur	S	119	445	poor
Tin	Sn	230	2600	good
Zinc	Zn	419	906	good

Use the table to answer these questions.

a] What is the melting point of iron? _____

b] Which element melts at -7°C? _____

c] Which element boils at 280°C? _____

d] Which element has a boiling point only 1°C higher than its melting point? _____

e] What is the physical state of oxygen at -200°C? _____

f] Which element has:

[i] the highest melting point? _____

[ii] the lowest melting point? _____

g] Which two metals are liquid at 70°C? _____ _____

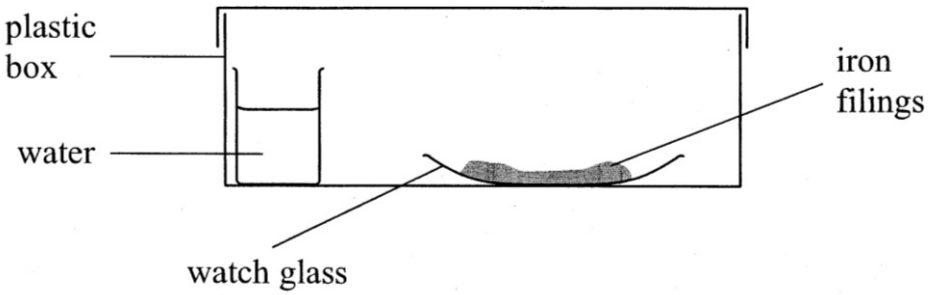
h] Which non metal is a liquid at room temperature? _____ [8]

Turn-over

C3. This question is about an experiment concerning rusting of iron. It is designed to test your data handling skills **not** your knowledge of rusting.

Some students followed these instructions to investigate how changing the temperature alters the rate of rusting.

- weigh an empty watch glass
- place some iron filings on the watch glass
- reweigh the watch glass with iron filings
- set up the apparatus as shown in the diagram



- leave the apparatus at a known temperature
- after three weeks reweigh the watch glass with its contents
- repeat each step at different temperatures.

i. Three of the students described their results as follows:

Temperature in fridge was 5°C, in this run the empty watch glass weighed19.23 g. it weighed 28.34 g with the iron filings and at the end it weighed28.42g.

The one that I left in a warm room weighed 29.76 g at the end, the empty watch glass was 20.12 g and with the iron it weighed 29.52 g. The temperature of the warm room was 26°C.

I used an oven to heat the last one. The watch glass with iron went up from27.34 g to 27.84 g. The temperature of the oven was 60°C and the empty watch glass weighed 16.24 g.

Complete the following table by adding a suitable column heading and then entering the data obtained by the students.

	Mass of empty watch-glass (g)	**Mass of watch-glass with iron filings at start of experiment (g)**	**Mass after 3 weeks (g)**	**Change in mass (g)**

[3]

ii. Suggest why the students' experiments may not have been a fair test.

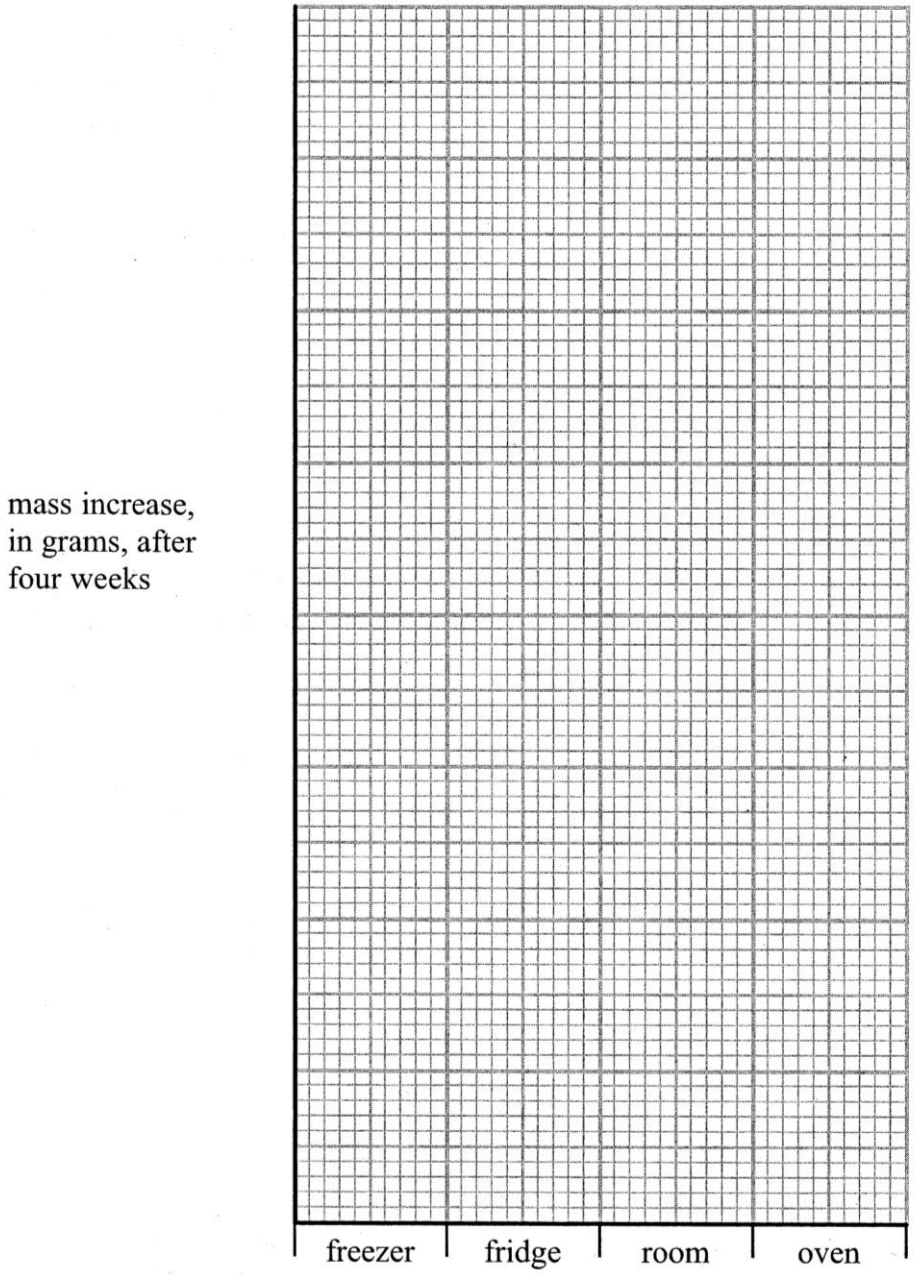
_____

_____ [1]

iii. Another group of students repeated the experiment so that it was a fair test. The apparatus was left in different places. They recorded the masses every week for 6 weeks.
Their results are shown in the table.

Place left	Temperature range (°C)	Mass increase (g) after					
		1 week	2 weeks	3 weeks	4 weeks	5 weeks	6 weeks
freezer	–18 to –16	0.00	0.00	0.00	0.00	0.00	0.00
fridge	3 to 6	0.02	0.05	0.08	0.11	0.13	0.16
room	14 to 25	0.04	0.11	0.14	0.20	0.25	0.31
oven	47 to 48	0.08	0.15	0.24	0.32	0.41	0.41

Draw a bar chart to show the mass increase after 4 weeks in each place.



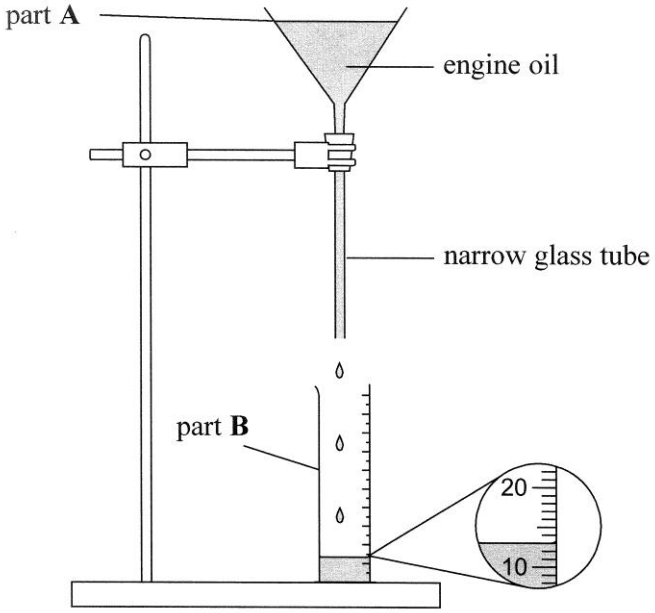
[3]

(Total 7 marks)

Turn-over

PHYSICS

1. A student uses the apparatus in the diagram to investigate the flow of engine oil through a narrow glass tube.



(a) Name part **A**.

.....

(1)

(b) (i) How can the student connect part **A** to the narrow glass tube?

.....

.....

(1)

(ii) Explain why she must take care when doing this.

.....

.....

(1)

(c) (i) Name part **B**.

.....

(1)

(ii) What is the volume in cm^3 of engine oil in part **B**?

Volume = ... cm^3

(1)

(d) The student measures the time taken for engine oil to flow through the narrow glass tube. What can she use to measure the time in seconds?

.....

(1)

(e) The student made a note of the time taken in seconds for different volumes of engine oil to flow through the tube.

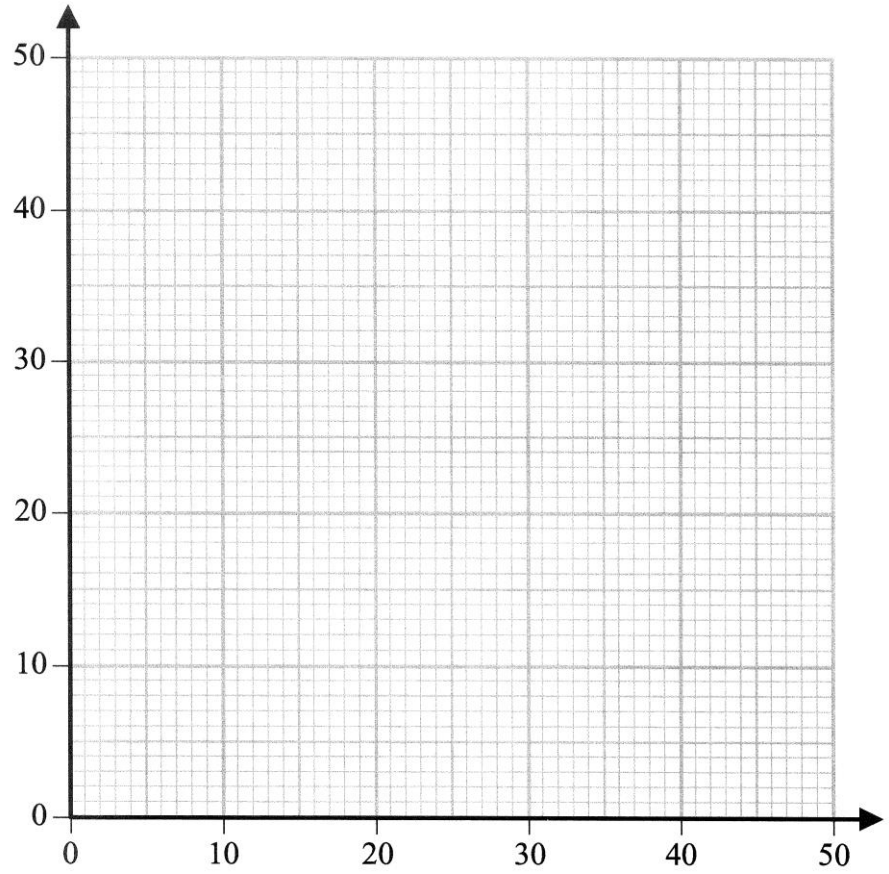
25 / 41s	10 / 16s	15 / 24s
5 / 8s	30 / 49s	20 / 28s

(i) Put her results into a suitable table with column headings and units.

(3)

(ii) Use the grid to plot a graph of time (*y*-axis) against volume (*x*-axis).
Label the axes and circle any point which is anomalous or unexpected.
Draw a line of best fit on your graph.

Turn-over



(7)

(f) Another student carried out a similar experiment but he used cooking oil.

Write a conclusion for this experiment.

.....

.....

.....

(2)

(f) Another student carried out a similar experiment but he used cooking oil.

(g) Suggest and explain why both students carried out their experiments at the same temperature.

.....

.....

.....

(2)

(Total 20 marks)

END OF SAMPLE PAPER

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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
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

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

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