

# CO-ORDINATED SCIENCES (US)

Paper 0442/13  
Multiple Choice

<i>Question Number</i>	<i>Key</i>	<i>Question Number</i>	<i>Key</i>
1	<b>C</b>	21	<b>C</b>
2	<b>B</b>	22	<b>A</b>
3	<b>C</b>	23	<b>C</b>
4	<b>A</b>	24	<b>D</b>
5	<b>D</b>	25	<b>B</b>
6	<b>A</b>	26	<b>D</b>
7	<b>D</b>	27	<b>B</b>
8	<b>A</b>	28	<b>A</b>
9	<b>B</b>	29	<b>A</b>
10	<b>A</b>	30	<b>D</b>
11	<b>B</b>	31	<b>A</b>
12	<b>D</b>	32	<b>D</b>
13	<b>D</b>	33	<b>A</b>
14	<b>C</b>	34	<b>C</b>
15	<b>B</b>	35	<b>C</b>
16	<b>C</b>	36	<b>C</b>
17	<b>A</b>	37	<b>D</b>
18	<b>C</b>	38	<b>B</b>
19	<b>D</b>	39	<b>A</b>
20	<b>B</b>	40	<b>B</b>

## General comments (Biology)

Only one question in the biology section was correctly answered by fewer than half the candidates. All other questions were competently handled.

## Comments on specific questions (Biology)

### Question 1

This question presented a scenario for candidates to read and understand. This was the easiest of the questions in this section.

### Question 3

Candidates often find it difficult to remember the relative positions of the xylem and phloem in the stem and in the root. There was evidence of this problem here, with all options being chosen by all but the most able candidates.

### Question 7

The key to this question was to realise that oxygen is taken up by the blood in the alveolus. A considerable number of candidates appeared to think the opposite. They may not have read the question properly before attempting to answer.

### Question 9

A significant minority of candidates believed that it is the entire pollen grain that travels to an ovule when fertilisation occurs. They also misunderstood the term *pollination*, not appreciating that this process terminates as soon as the pollen grain reaches the stigma.

### General comments (Chemistry)

Four of the questions in this section were answered correctly by the majority of candidates. None of the questions may be considered as being very difficult and there was no evidence of guesswork.

### Comments on specific questions (Chemistry)

#### Question 14

Although almost all of the candidates recognised that sand is insoluble, a few chose option **A**, indicating that they did not appreciate that barium chloride is soluble in water.

#### Question 16

Those candidates who chose option **A** not only misinterpreted the energy level diagram but also thought that the most reactive halogen, correctly identified as fluorine, would produce the least energy change.

#### Question 18

It was well known that the measurement of time is essential for determining reaction rate.

#### Question 19

This question was a straightforward recall and presented no problems.

#### Question 20

A significant minority chose option **A** rather than the correct answer, **B**. This indicates that many candidates thought, incorrectly, that catalysts are consumed in a chemical reaction.

#### Question 22

This question relating the properties of copper to its uses was answered correctly by almost all of the candidates.

### General comments (Physics)

Candidates found **Questions 28** and **40** the easiest, whereas **Questions 29** and **31** were more demanding.

### Comments on specific questions (Physics)

#### Question 28

Option **C** was the most popular choice, suggesting confusion with a speed/time graph.

**Question 29**

In this question about stretching a spring, the most popular choice was option **B**, with these candidates failing to notice that a graph of extension against load (not length against load) was required.

**Question 30**

A number of candidates believed that energy is measured in watts.

**Question 31**

The majority of candidates believed that evaporation of a liquid causes the temperature of the remaining liquid to increase. None of the candidates answered this correctly.

**Question 32**

The topic in this question was thermal expansion and contraction. The only incorrect answer chosen here was option **B**, where candidates believed that cooling a metal rod considerably would not alter its length.

**Question 33**

Most candidates appeared to have guessed the answer to this question on convection.

**Question 34**

This simple recall question about the nature of common types of wave caused many candidates to guess the answer.

**Question 35**

This question also involved simple recall, in this case about the nature of the image in a plane mirror. The majority of candidates thought that the image was real.

**Question 36**

There were as many candidates who confused the relative frequencies and wavelengths of red and blue light as answered this question correctly.

**Question 37**

The range of frequency of human hearing was not well known.

**Question 38**

This Ohm's Law question was better answered than most others.

**Question 39**

This question on connecting lamps in a domestic lighting circuit was very poorly answered, with almost all choosing option **D**.

**Question 40**

Nuclide notation was not well understood.

# CO-ORDINATED SCIENCES (US)

Paper 0442/23  
Core Theory

## Key Message

Candidates should quote any formula used in a standard form and use recognisable symbols. Formulae consisting of only units or containing a mixture of words, symbols and units should be avoided. The idea of using the triangle consisting of three variables is a valuable tool to answering calculation questions but is not acceptable as a formula.

Candidates are reminded to use scientific language/words in their answers. Candidates should not answer questions using the word 'it', as it is often difficult to work out what the 'it' is referring to, and the Examiners' are unable to awarded credit.

## General Comments

Most candidates were able to attempt most questions, with parts of all questions accessible. There was a good range of marks on most questions. Although it appeared that candidates often knew the answers to the questions, their answers were sometimes vague. Performance depends not only on scientific knowledge but on the ability of the candidates to understand the question and express themselves clearly.

There was evidence of candidates running short of time to complete the examination, with the last few questions frequently rushed.

## Comments on specific questions

### Question 1

- (a) All three answers were well known.
- (b) Water was well known as one of the substances absorbed by root hair cells. Mineral salts was less well known.
- (c) (i) Few candidates were able to state what is transported in the phloem. Many candidates suggested 'nutrients', which was too vague to be creditworthy.
  - (ii) Many candidates gave answers referring to the nutrients and water not being able to move up the plant.

### Question 2

- (a) (i) Argon was well known, however a common incorrect answer was oxygen.
  - (ii) Most candidates selected a metal and non-metal. Most explanations given were in terms of electron gain and loss. What was required was that one of the elements needed to be a metal and the other a non-metal. Oxygen and sulfur was a common incorrectly suggested pair of elements, possibly because they are in the same group of the Periodic Table.
- (b) (i) The nucleus was well known, although a significant number of candidates thought that structure **A** was the whole phosphorus atom.
  - (ii) Most candidates worked out that the proton number was 15 and went on to explain that this was because the atom had 15 electrons.

- (c) (i) Very few candidates suggested magnesium sulfate as the original magnesium. Magnesium chloride was a common incorrect answer.
- (c) (ii) Most candidates gained some credit for their response. Filtration was usually seen, although a number of candidates simply suggested separating the precipitate from the solution. Very few candidates mentioned drying the solid. A number of candidates attempted to calculate the volume of the precipitate and then carry out a calculation to determine the mass using the density of the precipitate.

### Question 3

- (a) (i) The use of a variable resistor was not well known.
  - (ii) Approximately half the candidates chose meter **X** for reading the current, although very few could explain that meter **X** was the ammeter as it was in series in the circuit given.
  - (iii) This was quite well answered although many candidates were not awarded full credit because they used an incorrect symbol, in their formula, for current. The accepted symbol is **I** not **A**.
- (b) Most candidates gained partial credit for selecting two correct responses.
  - (c) Most candidates correctly identified the length of the wire and the cross sectional area of the wire as the two factors. A number of candidates repeated factors given in the question and were unable to be awarded credit.

### Question 4

- (a) The role of alcohol in the test was well known as was the milky appearance after adding the mixture to water. Only the most able candidates suggested that the beans would need to be chopped or crushed.
- (b) The role of protein for growth and repair was well known.
- (c) Most candidates explained that chewing would increase the surface area of the beans. Few candidates were able to describe clearly that the larger surface area made it easier for the enzymes to make contact with beans.
- (d) Only the most able candidates mentioned protein or amino acids. Many candidates stated that enzymes are denatured by heating, however, while being correct was not creditworthy in this context.
- (e) Most candidates gained partial credit with a number gaining full credit. The ideas of removal of habitats, less carbon dioxide being removed from the atmosphere and soil erosion were all well known.

### Question 5

- (a) (i) Test-tube **Q** was correctly identified as the one containing iron, although few candidates could explain why. Only the most able candidates referred to the orange layer being 'rust'.
  - (ii) Calcium, magnesium and zinc were the only metals that gained credit, hydrogen (gas) was well known.
  - (iii) Either zinc or iron were awarded credit.
- (b) This was quite well answered. Candidates were able to connect the key and copper electrode to the power supply using wires. Many showed the key and the copper electrode dipping into the solution and some gave the correct polarity for the key and copper electrode.

### Question 6

- (a) Many candidates gained some credit.

- (b) Most candidates drew a suitable wave. The amplitude was usually correctly shown. However, when labelling the wavelength candidates were unable to be awarded credit as they had not clearly shown the distance between identical points on two successive waves.

#### Question 7

- (a) Most candidates gave 'normal' (for colour) and 'aa' (for genotype) gaining full credit.
- (b) The term *phenotype* was well known.
- (c) (i) Many candidates showed a good understanding of what they needed to do on this question. Even when an error was made part way through, the candidates invariably managed to complete the diagram to show the genotypes of the offspring.
- (ii) Many candidates determined the correct ratio based on their answer to part (i).
- (d) This was not well known. Very few candidates suggested crossing the snake with an albino snake. Most candidates suggested that you would have to investigate the parents and grandparents of the snake.

#### Question 8

- (a) (i) Carbon dioxide was well known.
- (ii) Using limewater to test for carbon dioxide was also well known.
- (iii) Few candidates knew this. No common incorrect answer was seen.
- (iv) Most candidates correctly determined that there were three different elements in calcium nitrate, but were unable to work out the total number of atoms present.
- (b) (i) Most candidates confused higher pH with greater acidity and consequently gave an incorrect explanation.
- (ii) Two variables were usually correctly identified gaining full credit.

#### Question 9

- (a) (i) Most candidates were able to interpret the distance/time graph and determine the total distance covered.
- (ii) 5 m/s was the most popular response.
- (iii) While 'not moving' was the most popular correct response, a number of candidates confused the distance/time graph with a speed/time graph and suggested that the cart was moving at a constant speed.
- (iv) Many candidates knew that the forces were unbalanced but only the most able explained that as the cart was accelerating the speed must be changing.
- (b) Almost all the candidates correctly answered this question.
- (c) (i) 'Kinetic' was the most popular answer, but a common incorrect answer was 'gravitational potential energy'.
- (ii) 'Gravitational potential energy' was the most popular answer but a common incorrect answer was 'kinetic'.
- (d) Most candidates were able to do this. The commonest error was to choose an incorrect formula.
- (e) (i) Most candidates were able to show that the particle arrangement in a gas was random.

- (ii) Candidates needed to describe two ideas to gain credit. Not only did they need to describe that particles would move faster, if the temperature increased, but also that this increased speed meant more collisions with the tyre wall.
- (iii) Many candidates did not describe sweating and cooling in terms of particles and were unable to gain awarded credit.

#### Question 10

- (a) The trachea and lung were well known.
- (b)(i) Many candidates correctly defined diffusion as the movement of molecules from a region of high concentration to a region of low concentration gaining full credit.
  - (ii) Plasma was not well known. Haemoglobin and red blood cells were commonly seen incorrect responses.
  - (iii) Many candidates gained full credit, however, a significant number of candidates referred to anaerobic respiration.
  - (iv) Many candidates were able to explain that the rate of diffusion of carbon dioxide would increase but few could explain why.

#### Question 11

- (a) Coal was the most common correct answer given, but a number of candidates chose either a liquid or gaseous fossil fuel.
- (b)(i) Fractional distillation was well known. Very few responses of just 'distillation' were seen.
  - (ii) Most candidates knew that gasoline was used as a vehicle **fuel**. A response such as 'for cars' were not creditworthy as this is too vague.
- (c)(i) Many candidates gained full credit for their structure of ethane, a significant number drew the structure of methane.
  - (ii) This was poorly answered. A few candidates completed the left hand side of the equation with oxygen, and very few knew both carbon dioxide and water to complete the right hand side of the equation.
- (d)(i) Cracking was well known.
  - (ii) This was not well answered. Few candidates were able to explain that air contained oxygen and fewer were able to suggest that oxygen would probably cause the reactant to burn rather than crack.

#### Question 12

- (a) Most candidates were able to describe reflection and many were able to describe total internal reflection. Many candidates did this by continuing the light ray in the optical fibre on the diagram.
- (b)(i) Red and violet were not well known. Green and yellow were common incorrect colours responses.
  - (ii) A number of candidates managed to work this out and suggest raindrops.
- (c)(i) Most candidates knew that the image would be at the same horizontal level as the nose. Few realised that the image would be the same distance behind the mirror that the nose was in front. A number of candidates located the image either in front of the mirror or on the surface of the mirror.
  - (ii) Many candidates gained credit. A number of candidates wrote down contradictory descriptions, for example real and virtual.

# CO-ORDINATED SCIENCES (US)

Paper 0442/33  
Extended Theory

## Key Message

Candidates should quote any formula used in a standard form and use recognisable symbols. Formulae consisting of only units or containing a mixture of words, symbols and units should be avoided. Candidates are expected to give correct units with their answers and give an appropriate number of significant figures. Working should be shown, as some credit can be awarded even if errors have been made in the arithmetic.

When drawing diagrams or graphs, candidates should be reminded to take care to draw clearly and to use the correct labels and labelling lines.

## General Comments

The majority of candidates showed a wide range of knowledge and understanding across the syllabus. Almost all candidates attempted to answer all the questions, and the majority communicated their responses clearly. Extended answers were well structured and ideas generally clearly expressed.

Candidates should check that they have answered the question that has been asked. The most successful candidates differentiated between instructions like state, describe and explain. They also checked their work to ensure that they were not simply rearranging or repeating information given in the question.

Candidates are reminded to use correct scientific terminology, and to know their definitions. Calculations were usually carried out systematically but a number of candidates had difficulty converting units.

## Comments on Specific Questions

### Question 1

- (a) Most candidates labelled the root hair cell correctly, however many were unable to locate structure A 'a partially permeable membrane'.
- (b) The relationship between the structure of the cell and its function was appreciated by most. The uptake of water and the large surface area were often quoted. The effect of surface area on rate of uptake and the role of the partially permeable membrane in osmosis were less well known.
- (c) Those candidates who gained full credit in this question appreciated that it was the removal of the phloem, rather than the xylem or outer layer, which prevented movement of material to the roots. They stated that the phloem transported sucrose from the leaves to the root, rather than in the reverse direction.

### Question 2

- (a) Many candidates selected two non-metals as having atoms which formed covalent bonds. Others demonstrated a misconception by selecting a non-metal and a metal. A few were given credit for going beyond the requirements of the syllabus, explaining in terms of the difference in electronegativity.
- (b)  $\text{PH}_3$  was usually given as the formula of phosphine. Credit was awarded for a well drawn 'dot and cross' diagram of the electronic structure. A few candidates attempted to describe ionic bonding.



- (c) (i) Only the most able candidates appreciated that the use of excess barium chloride would precipitate all sulfate ions from the solution. Names or (symbols with the correct charge) gained credit. Most candidates had to use the term *chloride*.
- (ii) Most candidates knew how to calculate a mass from concentration and volume, but a significant number had difficulty in converting units.
- (iii) The equation was used by many to establish the relationship between numbers of moles of reactant and of product.
- (iv) Many candidates found the relative formula mass from data in the Periodic Table, but only the most able correctly calculated a mass in grams from the number of moles.

### Question 3

- (a) A minority of candidates knew the relationships between variables in the circuit.
- (b) The majority of candidates knew the factors affecting resistance and gained full credit.
- (c) (i) The power input was usually calculated correctly, with the working shown.
  - (ii) Candidates were most likely to succeed in obtaining the power output when they carried out the process in two stages. Those most successful stated both of the formulae required and used the correct units.
  - (iii) The reason for the difference between power input and output was not always appreciated, with the question often being repeated in a different form, rather than describing the loss of useful energy from the system.
  - (iv) Those that understood the meaning of efficiency could usually show how they calculated its value. A few candidates obtained an answer in excess of 100% without attempting to correct an earlier error.
- (d) (i) Most candidates named the sign of the charge on an electron gaining credit.
  - (ii) The behaviour of  $\alpha$ - and  $\beta$ -radiation in an electric field could often be explained in terms of differing charges. The lack of charged particles in  $\gamma$ -radiation was not always included in the answer.

### Question 4

- (a) (i) Bacteria or an appropriate named bacterium was required for the type of microorganism added to milk to make yoghurt. Yeast was a popular incorrect response.
  - (ii) Some candidates appreciated that the milk was kept warm to speed the process because the bacteria worked better above normal room temperature or at the optimum temperature for the enzyme. Others misunderstood *warm* and suggested that a high temperature would kill unwanted bacteria.
- (b) (i) Most could describe the change in lactic acid concentration shown on the graph and used data as evidence gaining credit.
  - (ii) Most noticed that added sugar caused an increase in lactic acid concentration or an increase in rate of production. Only a few explained this in terms of sugar being converted to lactic acid to gaining credit. A common misconception was that 'sugar helped' or 'catalysed the bacterial process'.
- (c) There were many creditworthy suggestions for harmful effects on the environment caused by deforestation. To gain full credit candidates needed to give an explanation for the effect, e.g. erosion caused by the lack of tree roots holding the soil.

### Question 5

- (a) This question proved to be a good discriminator for those with a sound understanding of redox processes. Some candidates explained the displacement process in terms of the relative reactivities of metals, which was not required. Others made correct general statements of the relationships between oxidation and reduction and electron transfer, gaining partial credit. Very few were able to apply this principle to the specific atoms and ions involved in this reaction.
- (b) Some candidates understood that the metal was combining with oxygen whereas others suggested the name of a metal. Most candidates realised that hydrogen was displaced and could write the correct order of reactivity. Very few candidates explained the order in terms of relative ability to combine with oxygen, most simply stating that **Q** reacted and **P** did not.
- (c) Some candidates were awarded credit stating that zinc acted as a barrier between the steel and the air, but only the most able went on to gain any further credit. A common misconception was that zinc was less reactive than iron so formed this protective oxide coating more slowly than the iron would rust.

### Question 6

- (a) (i) The majority of candidates correctly linked the types of electromagnetic radiation with their uses and effects gaining full credit.
- (ii) The property most often given was speed.
- (b) (i) Many candidates used the graph to give a reason for identifying the flask that cooled most rapidly, by comparing the final temperatures. Some repeated the question and were unable to be awarded credit.
- (ii) Few candidates demonstrated an understanding of heat transfer by comparing the emission of heat radiation by the different surfaces. Many gave incorrect explanations in terms of the absorption or attraction of radiation.
- (iii) Most candidates gave at least one of the two variables required to be kept constant. The use of the same measuring instrument or constant temperature of the water was not creditworthy.

### Question 7

- (a) Most candidates showed understanding of dominant and recessive alleles, gaining credit.
- (b) Most knew that *phenotype* was the term used for the visible appearance produced by a genotype gaining credit.
- (c) There were many genetic diagrams drawn that gained full credit. A number of candidates were not awarded full credit due to the omission of the parents' genotypes.
- (d) Many candidates showed good understanding of the subject by being able to apply their knowledge to this genetic problem and explained their solution very clearly gaining credit.

### Question 8

- (a) Many candidates correctly deduced the answer knowing that the symbol for a calcium ion was  $\text{Ca}^{2+}$ . To gain full credit candidates had to use an argument or show working based on the need for charge balance.
- (b) (i) Most candidates gained credit for stating that the rate of reaction increased with concentration, only the most able referred to direct proportionality to gain full credit.
- (ii) The most able candidates described the increased probability or rate of collision, but many gave explanations that were too vague to be creditworthy.
- (iii) Many candidates stated that temperature would have an effect on the rate of reaction so needs to be kept constant, to make it a fair test gained credit.

### Question 9

- (a) (i) Candidates had to indicate how data from the distance/time graph was used to be awarded credit.
- (ii) Candidates who gave the correct formula for kinetic energy usually calculated the correct answer, however, some candidates did not use the correct unit.
- (iii) Most candidates interpreted the graph correctly and stated that the cart was stationary over that period gaining credit.
- (iv) Candidates who gave the formula for acceleration usually calculated the correct answer. A minority made a mistake with the unit using m/s or  $m/s^{-2}$ . Credit was only given for formulae that made it clear that the **change in** speed was used.
- (b) (i) Candidates who described the increased rate of collision (or more forceful collisions) with the tyre wall gained credit. There were a number of imprecise attempts to apply the gas laws or to describe a tendency towards expansion.
- (ii) Only the most able candidates were able to apply kinetic theory to give an explanation of evaporation.
- (iii) Care should be taken when drawing particle diagrams. Most candidates gained credit for their drawing of the gas, but few gained credit for their drawing of the liquid. Correct particle diagrams of a gas showed particles drawn in a random arrangement, of a similar size and not touching. Correct particle diagrams of a liquid showed particles drawn in an irregular arrangement, of a similar size and with most of the particles touching.

### Question 10

- (a) Most candidates gained some credit showing knowledge of the mechanism of accommodation by the eye.
- (b) Many candidates correctly located the image on the retina of the eye, but some placed it on the lens.
- (c) (i) Only the most able candidates gave a definition that gained credit, many just gave an example which was not sufficiently detailed to be creditworthy.
- (ii) The role of the structures should have been applied to the specific reflex action described in the stem of the question. Candidates needed to use the term *nerve impulse* rather than vague terms such as *information*, and describe the specific transmission between retina to brain and brain to muscle to be awarded credit.
- (d) (i) The best explanations for the lack of blood capillaries in the cornea and lens were based on their absorption of light. Imprecise reasons such as 'loss of vision' were not sufficient to be awarded credit.
- (ii) The requirement for oxygen for respiration by cells was understood by a few candidates. The best answers described the release of energy rather than its production.

### Question 11

- (a) (i) The correct formula for the alkane in Fig. 11.1 was usually given gaining credit.
- (ii) The explanation for the structure being that of an alkane molecule usually included the observation that the C-C bonds are single bonds. The fact that the compound was a hydrocarbon was often omitted. Several candidates showed knowledge beyond the syllabus by referring to the general formula for alkanes.

- (b)(i) The most able candidates stated that gasoline had smaller molecules and hence weaker intermolecular forces leading to lower boiling point, gaining credit.
- (ii) Only a small number of candidates could explain why gasoline boiled over a range of temperatures.
- (c)(i) Some knew the bromine test for unsaturated hydrocarbons, but many candidates described the resulting mixture as *clear* rather than **colourless**.
- (ii) The best candidates deduced the balanced equation for the combustion of ethene.

#### Question 12

- (a) Most candidates relied on completion of the diagram to show total internal reflection. Some diagrams were accurate and drawn with care. Only the most able candidates appreciated that total internal reflection only occurs when the angle of incidence exceeds the critical angle.
- (b) Most diagrams showed rays reflected from the mirror into the eye at reasonable angles. The best responses anticipated what was required in part (ii) by locating the image and drawing construction lines back to rays drawn accurately to the eye.