Exemplar Early High School Science Test Questions

ACT® Aspire®

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Introduction

This booklet explains ACT Aspire® Early High School Science test questions by presenting, with their answer keys, sample questions aligned to each reporting category on the test. A key includes the question's depth-of-knowledge (DOK) level,[1] an explanation of the task posed by each question, a thorough explanation of correct responses, ideas for improvement, and more. The exemplar test questions included here are representative of the range of content and types of questions found on the ACT Aspire Early High School Science test. Educators can use this resource in several ways:

- Become familiar with ACT Aspire question types.
- See what typical questions in each ACT Aspire reporting category look like.
- Help reinforce or adjust teaching and learning objectives.
- Learn how ACT Aspire improvement idea statements can help students identify key skills they have not yet mastered.

The ACT Aspire Science tests focus on the assessment of science practices using real-world scientific scenarios. At the earlier grades, topics generally focus on everyday student discovery rather than formal science. The scenarios in the upper grade assessments include student investigations, formal scientific research, formal scientific data from references, and students or scientists providing competing explanations for real scientific phenomena.

The content of the tests includes material from biology (life sciences at the earlier grades), chemistry and physics (physical science at the earlier grades), and Earth/space sciences (such as geology, astronomy, and meteorology). Advanced knowledge in these areas is not required, but background knowledge acquired in general, introductory science courses may be needed to answer some of the questions in the upper grade assessments. The tests do not, however, sample specific content knowledge with enough regularity to make inferences about a student's attainment of any broad area, or specific part, of the science content domain. The ACT Aspire tests stress science practices over recall of scientific content, complex mathematics skills, and reading ability. To that end, the ACT Aspire Science tests assess science practices in three domains: Interpretation of Data; Scientific Investigation; and Evaluation of Models, Inferences, and Experimental Results.

[1] Norman L. Webb, "Depth-of-Knowledge Levels for Four Content Areas," last modified March 28, 2002, **http://facstaff.wcer.wisc.edu/normw/All%20content%20areas%20%20DOK%20levels%2032802.doc**.

The ACT Aspire tests currently include selected-response (multiple-choice) questions, technology-enhanced items (online only), and constructed-response tasks. In the technology-enhanced items, students must carry out actions such as moving objects, typing in their answers, and manipulating bar and line graphs to provide their responses. The constructed-response tasks require students to produce, rather than select, a response. Constructed-response tasks assess complex reasoning or thinking skills by providing opportunities for students to explain, justify, critique, create, propose, produce, design, or otherwise demonstrate their knowledge and understanding in ways that are not typically assessed through selected-response items. Constructed-response tasks are scored according to scoring criteria unique to each item. The scoring criteria identify the specific information a student needs to include for a valid and complete response. Depending on the item, a holistic rubric may also be used to score the item. The holistic rubric is used to assess the overall proficiency of the response, allowing for differentiation among multiple skill levels. Some constructed-response tasks, called composite tasks, blend technology-enhanced or selected-response elements with open response.

Improvement Ideas

ACT Aspire includes simple improvement ideas at the reporting category (skill) level on student and parent reports. These improvement ideas are provided for the lowest performing skill for each subject tested. The skills are always ordered from highest performing to lowest performing based on the percentage of points correct. If the percentages for two or more skills are tied, the skill with the lower number of total points is displayed first.

Keep in mind that the order of skills listed on reports may not always be exemplary of where to focus learning. For example, the skills in which a student performed within the ACT Readiness Range may not always be listed first, and the skills in which a student did not perform within the ACT Readiness Range may not always be listed last. Also, keep in mind the total number of points possible in each skill when interpreting the percentage correct.

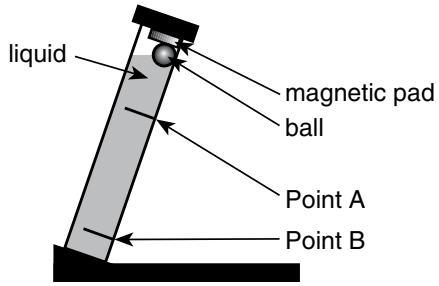
There are two levels of improvement idea statements (low and high) for ACT Aspire summative reporting. Low statements are given on the report if the student's lowest skill score is below the ACT Readiness Range for that particular skill. High statements are given on the report if the student's lowest skill score is at or above the ACT Readiness Range for that particular skill.

Answer Key

This section presents the grade, item type, DOK level, alignment to the ACT Aspire reporting categories, and correct response for each question. Each question is accompanied by an explanation of the question and the correct response as well as improvement idea statements for ACT Aspire Science.

Students used a *viscometer* (a device that measures the viscosity of a substance) to study several liquids. The viscometer consisted of a tube to hold a liquid, a metal ball, and a magnetic pad that can hold or release the ball (see Figure 1).

Figure 1



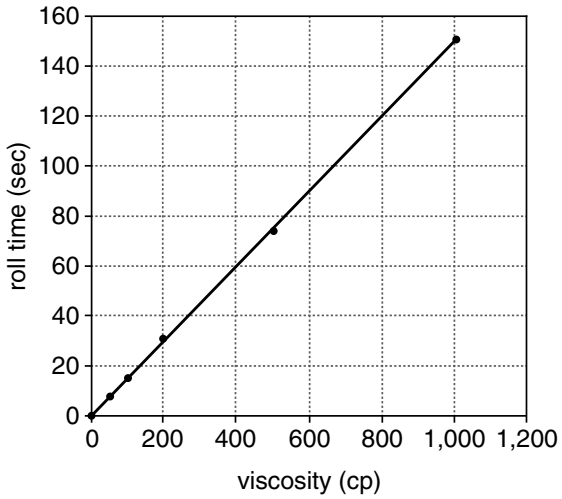
The liquid is added to the tube and allowed to become still. The cap, to which the magnetic pad and ball are attached, is fitted on the tube. The ball is then released from the pad by remote control, and the time it takes for the ball to roll from Point A to Point B (the *roll time*) is measured. Six liquids (Liquids A–F) of known viscosity (in centipoise, cp) at 25°C were supplied with the viscometer for use as standards (see Table 1).

Table 1	
Liquid	Viscosity (cp)
A	1
B	50
C	100
D	200
E	500
F	1,000

Experiment 1

The roll time for each of Liquids A–F was measured at 25°C in the viscometer. The students prepared Figure 2 based on their results.

Figure 2



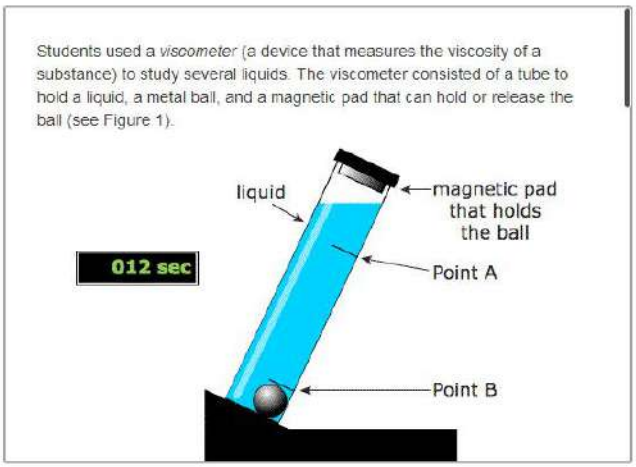
Experiment 2

The roll time of several common liquids was measured at 25°C in the viscometer (see Table 2).

(Note: SAE numbers refer to viscosity ratings set by the Society of Automotive Engineers.)

Table 2	
Liquid	Roll time (sec)
Corn syrup	12
Kerosene	2
H_2O	1
SAE 10 motor oil	8
SAE 20 motor oil	30
SAE 30 motor oil	60
SAE 50 motor oil	180

Question 1



Based on Experiments 1 and 2, the viscosity of SAE 30 motor oil at 25°C is closest to which of the following?

A. 30 cp
B. 60 cp
C. 200 cp
D. 400 cp

Sequence	Grade	Item type	DOK level	Reporting category	Correct response
1	EHS	Selected Response	2	Interpretation of Data	D

This item requires the examinee to combine data from Table 2 with data from Figure 2.

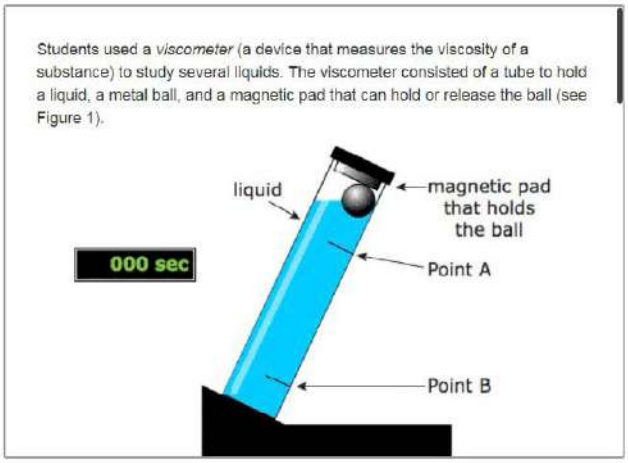
Correct Response

The roll time listed in Table 2 for SAE 30 motor oil is 60 sec. In Figure 2, a roll time of 60 sec is expected for a liquid that has a viscosity of about 400 cp. Answer option D is the correct response.

Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Interpretation of Data	EHS	Generate and interpret a greater number and variety of data presentations (scientific tables, line graphs, diagrams). Use trends to extend data in data presentations (interpolation, extrapolation).	Carefully consider the intended audience to determine the most accurate and useful way to present data. Use mathematical concepts (interpolation, extrapolation, slope) to interpret and extend from graphs.

Question 2



Upon completion of both experiments, how many times had the remote control released the ball from the magnetic pad in the viscometer?

- A. 6
- B. 7
- C. 13
- D. 19

Sequence	Grade	Item type	DOK level	Reporting category	Correct response
2	EHS	Selected Response	2	Scientific Investigation	C

This item requires the examinee to understand a simple experimental design.

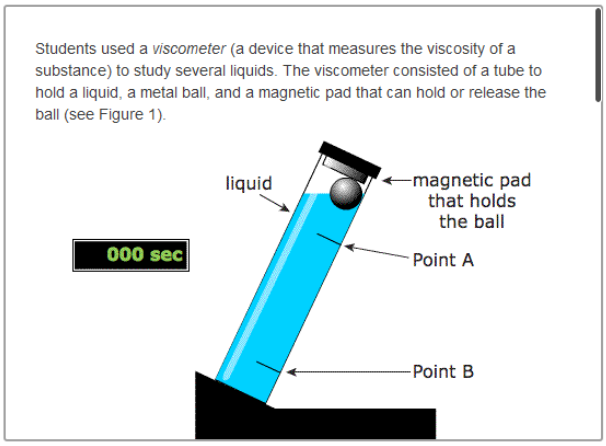
Correct Response

In Experiment 1, the ball was released 6 times, and in Experiment 2, the ball was released 7 times, for a total of 13 times. Answer option C is the correct response.

Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Scientific Investigation	EHS	Generate questions that can be investigated and then design and perform controlled experiments to validly test the questions. Examine complex scientific experiments involving multiple variables.	Generate hypotheses and then design and perform controlled experiments involving multiple variables to validly test the hypotheses. Evaluate experiments for possible sources of measurement error.

Question 3



A student claimed that at 25°C, SAE 20 motor oil has a lower viscosity than does Liquid C. Based on the results of Experiments 1 and 2, explain why the student's claim was **INCORRECT**. As part of your explanation, give the viscosities of these liquids at 25°C.

720

Sequence	Grade	Item type	DOK level	Reporting category	Correct response
3	EHS	Constructed Response	3	Evaluation of Models, Inferences, and Experimental Results	See scoring guide.

This item requires the examinee to determine which data and results from Table 1, Table 2, and Figure 2 are needed to explain why the student's claim was not correct.

Scoring Guide

2 points; analytic

Rubric

Score	Description
2	The response explains why the student's claim was incorrect and includes the viscosities of Liquid C and SAE 20 motor oil at 25°C.
1	The response states that the viscosity of Liquid C is 100 cp **OR** states that the viscosity of SAE 20 motor oil is 200 cp.
0	The response demonstrates little understanding of data interpretation.

Sample Student Responses

Score	Response
2	Table 1 shows that the viscosity of Liquid C (at 25°C) is 100 cp. Using Figure 2 and Table 2, the viscosity of SAE 20 motor oil (at 25°C) is 200 cp, so the claim that SAE 20 motor oil has a lower viscosity than Liquid C is not correct.
1	Table 1 shows that the viscosity of Liquid C (at 25°C) is 100 cp, so the response is not correct.
0	Table 1 shows that the viscosity of Liquid C (at 25°C) is 50 cp.

Improvement Idea Statements

Reporting category	Grade	Low statement (scored below ACT Readiness Range)	High statement (scored at or above ACT Readiness Range)
Evaluation of Models, Inferences, and Experimental Results	EHS	Compare and evaluate the results of scientific experiments and compare and evaluate competing scientific explanations. Examine ways to improve on scientific experiments and explanations.	Evaluate competing scientific explanations by generating predictions based on each explanation. Explain why the results of scientific experiments support or do not support a scientific explanation.