TEST NINJAS

ACT PRACTICE EXAM

STUDENT PRACTICE BOOKLET

# Test Ninjas ACT Science Practice Exam

## SCIENCE · INDIVIDUAL ACT SECTION

40
QUESTIONS

1
SECTION

STUDENT NAME

DATE

INSTRUCTOR

### PLAN YOUR SESSION

- Choose whether you will use the suggested section times or work without a timer.
- Keep your responses in the section you are currently completing.
- Record one answer per item and make any corrections unambiguous.
- Set the answer materials aside until your practice session is finished.

### BOOKLET INFORMATION

SUGGESTED TIMING
**40 minutes**

USEFUL MATERIALS
**Writing tool · scratch paper**

RESULTS
**Unofficial practice feedback**

**SESSION CUE** **Begin when your instructor or personal timer is ready.**

PUBLICATION NOTE
This booklet is an independently written practice resource. It is not an ACT test form, and results from it are not official scores.

STUDENT INITIALS

PRACTICE ASSESSMENT · 2026 EDITION

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# SCIENCE TEST

*40 MINUTES—40 QUESTIONS*

**DIRECTIONS:** Use the supplied studies, data displays, and competing explanations as your evidence. Compare variables, identify patterns, and evaluate what the results do—and do not—support.

*Record one response for each item; if more than one choice seems plausible, select the one best supported by the material provided.*

Osmosis is the movement of water across a selectively permeable membrane from an area of lower solute concentration to an area of higher solute concentration. Scientists studied the effects of different salt (NaCl) concentrations on red blood cells and plant cells.

Experiment 1 Red blood cells were placed in solutions with varying NaCl concentrations. After 30 minutes, the cells were observed under a microscope and their conditions were recorded.

Experiment 2 Elodea (aquatic plant) leaf cells were placed in the same NaCl solutions. After 30 minutes, the cells were observed for plasmolysis (separation of the cell membrane from the cell wall due to water loss).

Table 1 shows the NaCl concentration of each solution and its classification relative to the cells' internal concentration (0.9% for red blood cells, 0.5% for plant cells).

Figure 1 shows the percentage change in cell volume for both cell types after 30 minutes in each solution.

Table 2 shows the observed cell conditions after 30 minutes in each solution.

Table 3 shows the rate of water movement (in µL/min) across the cell membrane for each cell type in Solutions 1-5.

**Table 1: Solution Classifications**

Table 1: Solution Classifications

*Hypotonic = lower solute concentration than cell; Isotonic = equal concentration; Hypertonic = higher concentration*

| Solution | NaCl (%) | Classification for RBC | Classification for Plant Cells |
|---|---|---|---|
| 1 | 0.0 | Hypotonic | Hypotonic |
| 2 | 0.5 | Hypotonic | Isotonic |
| 3 | 0.9 | Isotonic | Hypertonic |
| 4 | 1.5 | Hypertonic | Hypertonic |
| 5 | 3.0 | Hypertonic | Hypertonic |

**Table 2: Cell Conditions After 30 Minutes**

Table 2: Cell Conditions After 30 Minutes

*Lysed = cell membrane burst; Crenated = shriveled; Turgid = swollen; Plasmolyzed = membrane separated from wall*

| Solution | Red Blood Cell Condition | Plant Cell Condition |
|---|---|---|
| 1 | Lysed | Turgid |
| 2 | Swollen | Normal |
| 3 | Normal | Slightly plasmolyzed |
| 4 | Crenated | Plasmolyzed |
| 5 | Severely crenated | Severely plasmolyzed |

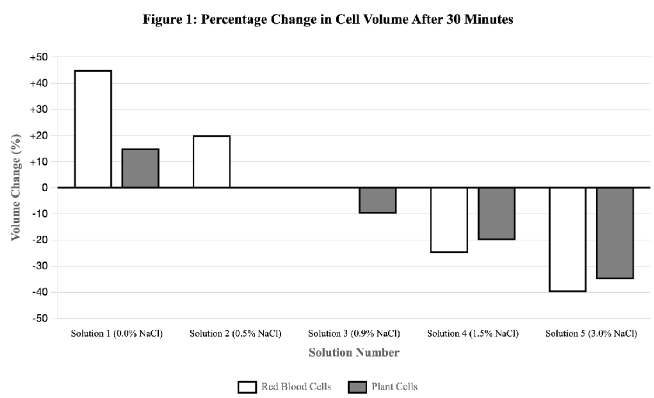
**Table 3: Rate of Water Movement Across Cell Membrane**

Table 3: Rate of Water Movement Across Cell Membrane

*Positive values = water entering cell; Negative values = water leaving cell*

| Solution | Red Blood Cells Water Rate (µL/min) | Plant Cells Water Rate (µL/min) |
|---|---|---|
| 1 | +2.8 | +1.2 |
| 2 | +1.5 | 0.0 |
| 3 | 0.0 | -0.8 |
| 4 | -1.8 | -1.5 |
| 5 | -3.2 | -2.4 |

**Figure 1: Percentage Change in Cell Volume After 30 Minutes**

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1. According to Table 2, in which solution did red blood cells maintain their normal shape and size?

   **A.** Solution 1
   **B.** Solution 2
   **C.** Solution 3
   **D.** Solution 4

2. Based on Figure 1, which statement best describes the relationship between NaCl concentration and cell volume change?

   **F.** As NaCl concentration increases, both cell types show decreased volume.
   **G.** As NaCl concentration increases, both cell types show increased volume.
   **H.** Red blood cells are more resistant to volume changes than plant cells.
   **J.** Plant cells show greater volume changes than red blood cells in all solutions.

3. According to Table 3, in which solution was there no net water movement for plant cells?

   **A.** Solution 1
   **B.** Solution 2
   **C.** Solution 3
   **D.** Solution 4

4. Why did plant cells in Solution 1 become turgid while red blood cells lysed?

   **F.** Plant cells have a higher internal solute concentration than red blood cells.
   **G.** Plant cells are naturally resistant to hypotonic solutions.
   **H.** Red blood cells actively pump water out more efficiently.
   **J.** Plant cells have a cell wall that prevents excessive expansion.

5. Based on the data, what would most likely happen to a red blood cell placed in a 0.7% NaCl solution?

   **A.** The cell would swell but not burst.
   **B.** The cell would remain normal in size.
   **C.** The cell would lyse immediately.
   **D.** The cell would shrink slightly.

Coral reefs worldwide are experiencing mass bleaching events due to rising ocean temperatures. When stressed by heat, corals expel their symbiotic algae (zooxanthellae), losing their color and primary energy source. Scientists are exploring CRISPR-Cas9 gene editing to enhance coral heat tolerance. Four researchers discuss different approaches to using this technology.

Student 1: Based on our analysis of 47 coral species across the Great Barrier Reef, the most promising approach is to target the heat shock transcription factor 1 (HSF1) gene. When we compared HSF1 expression levels in bleaching-resistant versus bleaching-susceptible Acropora colonies, we found a 3.7-fold higher baseline expression in resistant corals. By using CRISPR to insert 2-3 additional copies of the HSF1 gene under a heat-inducible promoter, we can increase heat shock protein production by 450% during thermal stress events. Our preliminary experiments show that HSF1-enhanced coral fragments maintained 78% of their algal symbionts at 32°C, compared to only 23% retention in control fragments.

Student 2: My team's 5-year longitudinal study of 312 coral colonies reveals that symbiont diversity, not host genetics alone, determines bleaching resistance. We've identified the RAS2 and NPC2 genes that control symbiont recognition and uptake in coral larvae. Using CRISPR to modify these genes' binding domains increased uptake of heat-tolerant Durusdinium trenchii by 65% while reducing uptake of temperature-sensitive Cladocopium species. Our field trials in Palau showed that corals with edited symbiont-regulation genes maintained photosynthetic efficiency above 0.65 (Fv/Fm values) even at 31.5°C. This holobiont engineering approach addresses the root cause—the breakdown of the coral-algae partnership at elevated temperatures.

Student 3: Our systems biology model indicates that heat tolerance requires coordinated upregulation of 17 different stress response pathways. We've developed a CRISPR multiplexing approach targeting the master regulators NRF2 (oxidative stress), ATF6 (protein folding), and FOXO3 (cellular maintenance). Computer simulations predict that simultaneous 2x enhancement of these three transcription factors would increase coral survival probability from 12% to 89% during a 2°C warming event lasting 8 weeks. We're also targeting the carbonic anhydrase gene family to maintain calcification under stress. Single-gene approaches fail because heat stress causes cascading failures across multiple cellular systems—only a comprehensive multi-gene strategy can provide robust protection.

Student 4: The coral microbiome contains 3,000-6,000 bacterial species that collectively influence host physiology more than any single coral gene. We've isolated Endozoicomonas strains that naturally produce 15 different antioxidant compounds and 8 osmoprotectants. Using CRISPR, we've enhanced these metabolic pathways, creating engineered strains that produce 12x more catalase and 8x more mycosporine-like amino acids (natural sunscreens). When inoculated onto coral fragments, these engineered bacteria reduced oxidative damage markers by 67% during heat stress. Unlike germline editing of corals which takes years, we can deploy modified bacteria within weeks. Our approach also avoids regulatory concerns about genetically modified corals in the ocean.

CONTINUE →

6. According to the passage, which component of the coral holobiont is expelled during bleaching events?

**F.** Heat shock proteins
**G.** Endozoicomonas bacteria
**H.** Antioxidant compounds
**J.** Zooxanthellae (symbiotic algae)

7. According to Student 1, what percentages of algal symbionts did the HSF1-enhanced fragments and control fragments retain, respectively, at 32°C?

**A.** 78% vs 23%
**B.** 23% vs 78%
**C.** 45% vs 90%
**D.** 67% vs 12%

8. What specific measurement does Student 2 use to assess photosynthetic efficiency in heat-stressed corals?

**F.** Fv/Fm values
**G.** Durusdinium density
**H.** RAS2 expression levels
**J.** Temperature tolerance index

9. A reef-restoration manager needs a heat-protection intervention that can be deployed onto stressed corals within weeks rather than years and that also avoids the regulatory concerns associated with releasing genetically modified corals into the open ocean. Based on the four viewpoints, whose approach is best suited to meet BOTH of these requirements?

**A.** Student 1's, because inserting extra HSF1 gene copies boosts heat shock protein production by 450%
**B.** Student 2's, because editing the RAS2 and NPC2 genes shifts corals toward heat-tolerant symbionts
**C.** Student 4's, because engineered Endozoicomonas bacteria can be deployed within weeks and avoid GM-coral regulatory concerns
**D.** Student 3's, because its multi-gene CRISPR strategy raises simulated survival from 12% to 89%

10. Student 3 argues that 'single-gene approaches fail because heat stress causes cascading failures across multiple cellular systems.' Of the other three viewpoints, which student's strategy is the most direct target of this specific criticism?

**F.** Student 2's, because it edits the two genes RAS2 and NPC2 to control symbiont uptake
**G.** Student 4's, because it relies on a single Endozoicomonas bacterial strain
**H.** Student 1's, because it relies on enhancing the single HSF1 transcription factor gene
**J.** Student 3's own carbonic anhydrase targeting, because it focuses on calcification alone

11. Which students provide specific numerical data from actual experiments or field trials?

**A.** Students 1 and 3 only
**B.** All four students
**C.** Students 2 and 3 only
**D.** Students 1, 2, and 4 only

A simple pendulum consists of a mass (bob) suspended from a fixed point by a string. Students investigated how various factors affect the period of a pendulum (the time for one complete swing back and forth). Two experiments were conducted to determine how pendulum length and bob mass affect the period.

Experiment 1: In this experiment, students used pendulums with different lengths but kept the bob mass constant at 50 g. They measured the period by timing 10 complete swings and dividing by 10. Each measurement was repeated three times and averaged. The amplitude (initial displacement angle) was kept small at 10 degrees for all trials. Results are shown in Table 1 and Figure 1.

Experiment 2: In this experiment, students kept the pendulum length constant at 80 cm and varied the mass of the bob. The same timing procedure was used, with the amplitude maintained at 10 degrees. Results are shown in Table 2 and Figure 2.

Theory: The period T of a simple pendulum for small angles is given by $T = 2\pi\sqrt{(L/g)}$, where L is the length and g is the acceleration due to gravity (9.8 $m/s^2$). This formula shows that period depends only on length and gravity, not on mass.

**Table 1: Effect of Pendulum Length on Period**

**Table 1: Effect of Pendulum Length on Period**

| Length (cm) | Average Period (s) |
|---|---|
| 20 | 0.90 |
| 40 | 1.27 |
| 60 | 1.56 |
| 80 | 1.80 |
| 100 | 2.01 |
| 120 | 2.20 |

*Experiment 1: Pendulum length varied while mass held constant at 50 g*

**Figure 1: Relationship between pendulum length and period showing square root dependence**

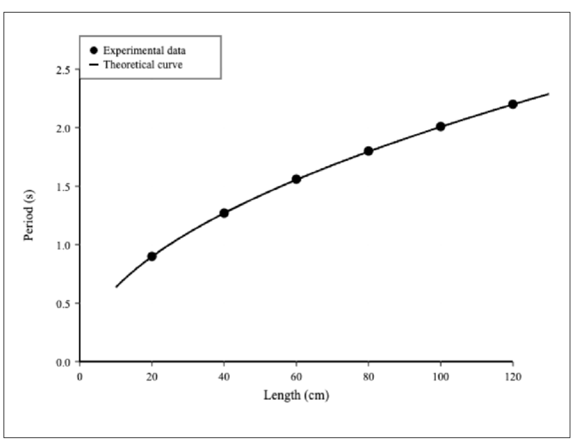



*Figure 1: Relationship between pendulum length and period showing square root dependence*

**Table 2: Effect of Bob Mass on Period**

**Table 2: Effect of Bob Mass on Period**

| Bob Mass (g) | Average Period (s) |
|---|---|
| 25 | 1.79 |
| 50 | 1.80 |
| 75 | 1.80 |
| 100 | 1.81 |
| 125 | 1.80 |
| 150 | 1.79 |

*Experiment 2: Bob mass varied while length held constant at 80 cm*

**Figure 2: Period remains constant regardless of bob mass**

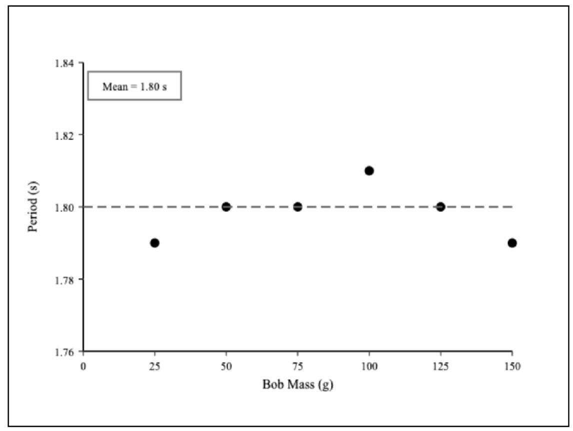



*Figure 2: Period remains constant regardless of bob mass*

CONTINUE →

12. Based on the results of Experiment 1, which of the following best describes the relationship between pendulum length and period?

- **F.** As length increases, period decreases proportionally
- **G.** As length increases, period increases proportionally to the square root of length
- **H.** As length increases, period remains constant
- **J.** As length increases, period increases proportionally to the square of length

13. According to Experiment 2, which statement about the effect of bob mass on pendulum period is correct?

- **A.** Increasing the bob mass significantly increases the period
- **B.** Increasing the bob mass significantly decreases the period
- **C.** The bob mass affects the period only at extreme values
- **D.** The bob mass has essentially no effect on the period

14. If a pendulum with a length of 50 cm were tested in Experiment 1, its period would most likely be:

- **F.** 1.10 s
- **G.** 1.42 s
- **H.** 1.68 s
- **J.** 2.10 s

15. What was the primary purpose of keeping the amplitude constant at 10 degrees in both experiments?

- **A.** To ensure the pendulum would complete exactly 10 swings
- **B.** To minimize air resistance effects
- **C.** To control a variable that might affect the period
- **D.** To make timing easier for the students

16. Based on both experiments, which factor is the primary determinant of a pendulum's period?

- **F.** The mass of the bob
- **G.** The initial velocity of the bob
- **H.** The material of the string
- **J.** The length of the pendulum

17. If the experiments were repeated on the Moon, where gravity is approximately 1/6 that of Earth, how would the periods compare to those measured on Earth?

- **A.** The periods would be about 2.4 times as long
- **B.** The periods would be about 6 times longer
- **C.** The periods would be about 1/6 as long
- **D.** The periods would be unchanged

Scientists hypothesized that simultaneously measuring multiple molecular features (DNA methylation, RNA expression, and protein abundance) from individual cells could reveal how cells regulate gene expression. They conducted an experiment using single-cell multi-omics technology to analyze immune cells.

Experiment 1: Blood samples were collected from 5 healthy volunteers. Immune cells were isolated and separated into individual cells using microfluidic devices. Each cell was labeled with a unique molecular barcode to track its identity. The cells were divided into 4 groups for different analyses: Group A: Single-cell RNA sequencing only; Group B: Single-cell DNA methylation analysis only; Group C: Single-cell protein analysis only; Group D: Integrated multi-omics analysis (all three measurements from same cell). All groups contained approximately 5,000 cells each. Cells were processed using specialized protocols that preserved nucleic acids and proteins. Data was collected using next-generation sequencing and mass spectrometry. Figure 1 shows the number of molecular features detected in each analysis group.

Experiment 2: Using the multi-omics data from Group D, researchers examined the relationship between DNA methylation and gene expression. They focused on 100 genes known to be important for immune function. For each gene, they calculated the correlation between methylation level and RNA expression across all cells. Cells were classified into 3 immune cell types based on their molecular profiles: T cells (1,850 cells, 37%, Primary function: Adaptive immunity), B cells (1,200 cells, 24%, Primary function: Antibody production), and Monocytes (1,950 cells, 39%, Primary function: Innate immunity). The cell type distribution is shown in Table 1, and the correlation analysis results are presented in Figure 2.

**Figure 1: Number of Features Detected per Cell**

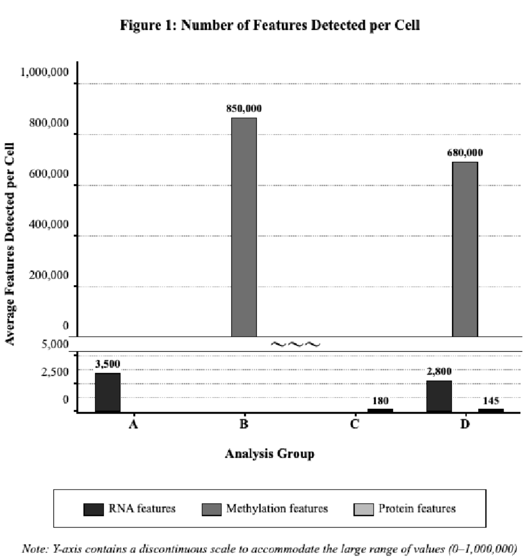
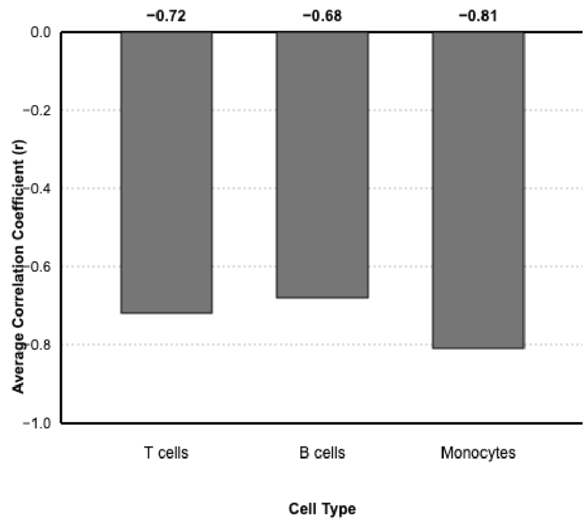



**Table 1 and Figure 2**

**Table 1: Cell Type Distribution in Group D**

| Cell Type | Number | Percentage | Primary Function |
|---|---|---|---|
| T cells | 1,850 | 37% | Adaptive immunity |
| B cells | 1,200 | 24% | Antibody production |
| Monocytes | 1,950 | 39% | Innate immunity |

**Figure 2: Methylation vs Expression Correlation by Cell Type**




*Negative values indicate an inverse methylation–expression association.*

CONTINUE →

18. According to Figure 1, which measurement type lost the most features in absolute numbers when performed as part of multi-omics analysis (Group D) compared to single-modality analysis?

**F.** DNA methylation features (lost 170,000)
**G.** RNA features (lost 700)
**H.** Protein features (lost 35)
**J.** All lost the same number of features

19. Based on the experimental design, what is the most likely reason for including Groups A, B, and C in addition to Group D?

**A.** To increase the total number of cells analyzed
**B.** To analyze different cell types separately
**C.** To reduce experimental costs
**D.** To serve as controls for comparing detection efficiency

20. According to Figure 2, which statement best describes the relationship between DNA methylation and gene expression?

**F.** Higher methylation is associated with higher expression
**G.** Higher methylation is associated with lower expression
**H.** Methylation and expression are not correlated
**J.** The relationship varies randomly by cell type

21. If a rare cell type comprises 0.1% of immune cells, approximately how many cells would researchers need to analyze in Group D for the expected number of cells of this type to be 5?

**A.** 500
**B.** 1,000
**C.** 5,000
**D.** 50,000

22. Which immune cell type showed the strongest relationship between DNA methylation and gene expression according to Figure 2?

**F.** T cells
**G.** B cells
**H.** All showed equal correlation
**J.** Monocytes

23. What is a potential limitation of the multi-omics approach (Group D) compared to single-modality analyses?

**A.** It shows reduced detection sensitivity for each individual measurement
**B.** It cannot distinguish between cell types
**C.** It requires more cells per analysis
**D.** It only works with blood cells

Robotic arms used in manufacturing must balance speed, precision, and energy efficiency. Engineers tested different control algorithms and motor configurations to optimize performance for various industrial tasks. The precision of a robotic arm is measured by its repeatability (ability to return to the same position) and accuracy (closeness to the intended target). Control systems use feedback loops with position sensors to minimize errors. The data show a speed-precision tradeoff: faster movements generally result in larger positioning errors.

Table 1 shows specifications for different robotic arm configurations, including motor type, degrees of freedom, maximum speed, repeatability, power consumption, and payload capacity. Five configurations are compared: Precision Assembly, High-Speed Pick, Heavy Lifting, Collaborative, and Welding, each optimized for specific industrial applications.

Figure 1 displays the relationship between arm movement speed and positioning error for three different control algorithms: PID (Proportional-Integral-Derivative), Adaptive, and Predictive Model Control. The data was collected from 1000 movement trials per algorithm at each speed setting, showing how positioning error increases with movement speed for all three algorithms, though at different rates.

**Table 1: Robotic Arm Configuration Specifications and Performance Metrics**

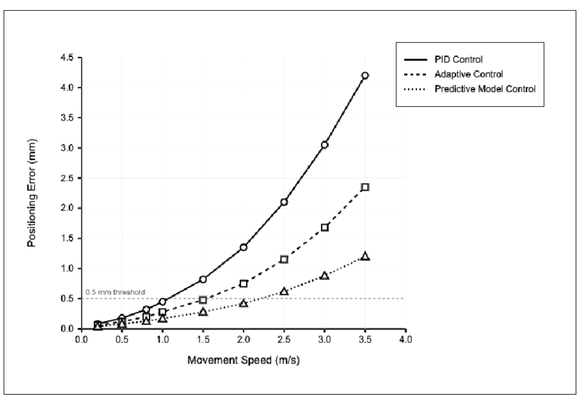
Table 1: Robotic Arm Configuration Specifications and Performance Metrics

| Configuration | Motor Type | Degrees of Freedom | Max Speed (m/s) | Repeatability (mm) | Power Consumption (W) | Payload Capacity (kg) |
|---|---|---|---|---|---|---|
| Precision Assembly | Servo | 6 | 0.5 | 0.02 | 150 | 5 |
| High-Speed Pick | Servo | 4 | 3.5 | 0.15 | 480 | 2 |
| Heavy Lifting | Hydraulic | 5 | 0.8 | 0.50 | 850 | 50 |
| Collaborative | Servo | 7 | 1.2 | 0.05 | 250 | 10 |
| Welding | Servo | 6 | 1.5 | 0.10 | 380 | 15 |

**Figure 1: Positioning Error vs Movement Speed for Control Algorithms**

Figure 1: Positioning Error vs Movement Speed for Control Algorithms

Relationship between robotic arm tip velocity and positioning error for three control algorithms: PID (Proportional-Integral-Derivative), Adaptive, and Predictive Model Control. Data collected from 1000 movement trials per algorithm at each speed setting.

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**24.** According to Table 1, which statement best describes the relationship between degrees of freedom and repeatability in servo motor configurations?

- **F.** More degrees of freedom always result in better repeatability
- **G.** Fewer degrees of freedom always result in worse repeatability
- **H.** The collaborative configuration with 7 DOF has worse repeatability than the high-speed configuration with 4 DOF
- **J.** Degrees of freedom and repeatability show no clear correlation

**25.** Based on Figure 1, if a manufacturing process requires positioning error below 0.5 mm, what is the maximum speed at which the Adaptive Control algorithm can operate?

- **A.** 1.0 m/s
- **B.** 1.5 m/s
- **C.** 2.0 m/s
- **D.** 2.5 m/s

**26.** An engineer must select a robotic arm that achieves a repeatability of 0.05 mm or better (that is, 0.05 mm or smaller) while handling an 8 kg payload. Based on Table 1, which configuration meets BOTH requirements?

- **F.** Precision Assembly
- **G.** High-Speed Pick
- **H.** Collaborative
- **J.** Welding

**27.** According to Figure 1, by approximately what factor does the positioning error of the PID Control algorithm increase as the movement speed rises from 1.5 m/s to 2.5 m/s?

- **A.** 1.5 times
- **B.** 2.0 times
- **C.** 2.5 times
- **D.** 3.0 times

**28.** A factory operates 50 High-Speed Pick robots continuously. If each robot is replaced with a Collaborative configuration, what would be the change in total power consumption?

- **F.** Decrease of 11,500 W
- **G.** Decrease of 23,000 W
- **H.** Increase of 11,500 W
- **J.** Increase of 23,000 W

When materials are subjected to external forces, they experience stress (force per unit area) and respond with strain (deformation). The relationship between stress and strain reveals fundamental material properties including elastic modulus, yield strength, and ultimate tensile strength. Materials exhibit elastic behavior (reversible deformation) at low stresses and plastic behavior (permanent deformation) beyond the yield point.

Key definitions:

- Stress: $\sigma = F/A$, measured in Pascals (Pa) or MPa
- Strain: $\varepsilon = \Delta L/L_0$, dimensionless ratio
- Elastic Modulus: $E = \sigma/\varepsilon$ in the elastic region
- Yield Strength: Stress at which permanent deformation begins
- Ultimate Tensile Strength (UTS): Maximum stress before failure

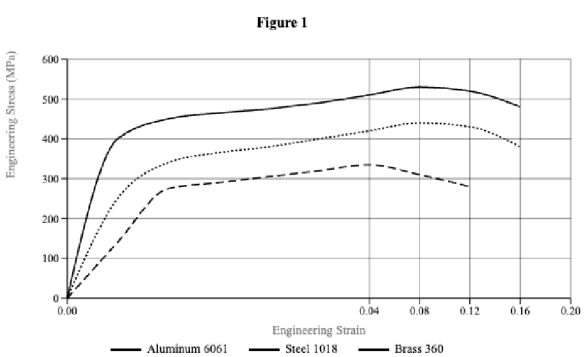
Experimental Setup: Universal Testing Machine with 100 kN capacity, crosshead speed 0.01-500 mm/min, extensometer gauge length 50 mm. Test specimens prepared according to ASTM standards with 12.5 mm diameter gauge section. Tests conducted at 20°C (±2°C) with strain rate 0.001 $s^{-1}$.

Study 1: Stress-strain behavior of aluminum alloy 6061, mild steel 1018, and brass 360 was investigated through tensile testing until fracture. Figure 1 shows the engineering stress-strain curves.

Study 2: The effect of strain rate on polycarbonate behavior was studied at rates from 0.0001 to 0.1 $s^{-1}$. Figure 2 shows yield stress and elastic modulus versus strain rate.

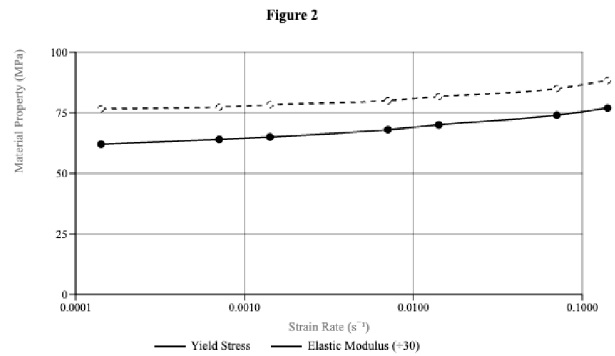
Study 3: Temperature effects on steel 1018 mechanical properties were investigated from -40°C to 300°C. Figure 3 shows temperature dependence of yield strength, ultimate strength, and elongation.

**Figure 1: Engineering stress-strain curves for three metals showing elastic and plastic regions**



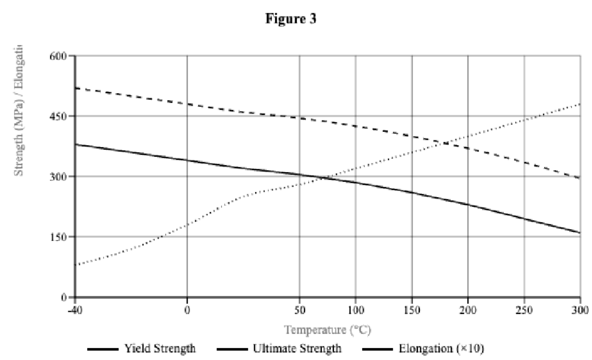

*Engineering stress-strain curves for three metals showing elastic and plastic regions.*

**Figure 2: Yield stress (solid line) and elastic modulus (dashed line) versus strain rate for polycarbo…**




*Yield stress (solid line) and elastic modulus (dashed line) versus strain rate for polycarbonate.*

**Figure 3: Temperature dependence of yield strength (solid line), ultimate strength (dashed line), and…**




*Temperature dependence of yield strength (solid), ultimate strength (dashed), and elongation (dotted).*

CONTINUE →

**29.** Based on Figure 1, which material has the highest elastic modulus?

- **A.** Aluminum 6061
- **B.** Steel 1018
- **C.** Brass 360
- **D.** All have the same modulus

**30.** According to Study 2, how does increasing strain rate affect polycarbonate's mechanical properties?

- **F.** Both yield stress and modulus increase
- **G.** Yield stress increases, modulus decreases
- **H.** Both yield stress and modulus decrease
- **J.** Yield stress decreases, modulus increases

**31.** Based on Figure 3, at which listed temperature does steel 1018 have both a yield strength of at least 300 MPa and an elongation of at least 20%?

- **A.** -40°C
- **B.** 20°C
- **C.** 150°C
- **D.** 300°C

**32.** Using Figure 1 and the passage information, which statement about material behavior is correct?

- **F.** The material with highest density has the highest strength
- **G.** Elastic modulus correlates directly with elongation
- **H.** Aluminum shows the most gradual transition from elastic to plastic behavior
- **J.** Steel maintains strength better than aluminum after yielding

**33.** When the polycarbonate strain rate increases from 0.001 $s^{-1}$ to 0.1 $s^{-1}$, by approximately what percentage does its yield stress change?

- **A.** It decreases by 18%
- **B.** It increases by 18%
- **C.** It decreases by 13%
- **D.** It does not change

**34.** Based on Figure 1, which material fractures at the lowest engineering strain?

- **F.** Aluminum 6061
- **G.** Steel 1018
- **H.** Brass 360
- **J.** All three fracture at approximately the same strain

Absorption spectroscopy is used to study gases in Earth's atmosphere. When light passes through a gas, the transmitted intensity I is described by Beer's Law: $I = I_0 \times 10^{(-\alpha cL)}$, where $\alpha$ is the molar absorption coefficient, c is concentration, and L is path length. Percent transmission is $(I/I_0) \times 100\%$.

For a standardized 10 cm cell at 1.0 atm and 25°C, the students reported each gas's optical density, $A = \alpha cL = -\log_{10}(I/I_0)$. Optical density is dimensionless, and percent transmission can therefore be calculated as $100 \times 10^{(-A)}$. At constant temperature and path length, gas concentration is proportional to pressure, so for a gas with optical density $A_1$ at 1.0 atm, the ideal model predicts $A_p = A_1 p$ when pressure p is measured in atmospheres.

Students conducted 2 experiments to model how atmospheric gases absorb 550 nm light. The setup included a white-light source, a sealed gas cell, a pressure gauge, a wavelength selector, and a detector.

Figure 1 shows the 10 cm gas cell at 25°C. The wavelength selector is set to 550 nm, the pressure gauge reads 1.0 atm, and the data system displays $I/I_0 = 96.6\%$.

Experiment 1: Different gases were tested at 1.0 atm. Table 1 gives the standardized optical density A and percent transmission for each gas.

Experiment 2: Nitrogen dioxide ($NO_2$), whose optical density at 1.0 atm is 0.850, was tested at several pressures. Concentrations were calculated for 25°C, and transmissions were calculated from the ideal pressure model. Table 2 shows the results.

**Figure 1: A white-light source directs light through a 10 cm gas cell**

**Figure 1**

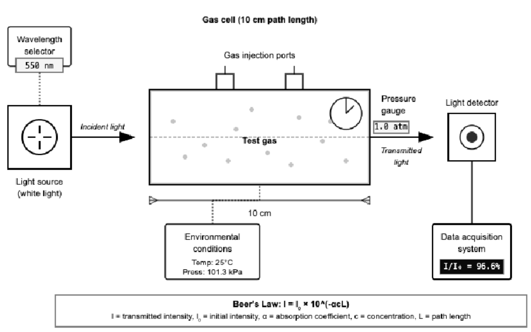



**Table 1: Standardized optical density and percent transmission at 1.0 atm, 25°C, and 550 nm**

**Table 1**

| Gas | Molecular Formula | Standardized Optical Density A (dimensionless) | Percent Transmission (%) |
|---|---|---|---|
| Nitrogen | $N_2$ | 0.001 | 99.8 |
| Oxygen | $O_2$ | 0.003 | 99.3 |
| Carbon dioxide | $CO_2$ | 0.015 | 96.6 |
| Nitrogen dioxide | $NO_2$ | 0.850 | 14.1 |
| Chlorine | $Cl_2$ | 0.120 | 75.9 |

*All measurements use a 10 cm cell at 1.0 atm, 25°C, and 550 nm.*

**Table 2: Ideal-model $NO_2$ transmission at 25°C and 550 nm**

**Table 2**

| Pressure (atm) | Concentration (mol/L) | Percent Transmission (%) | Absorbed Light Percentage (%) |
|---|---|---|---|
| 0.25 | 0.010 | 61.3 | 38.7 |
| 0.50 | 0.020 | 37.6 | 62.4 |
| 1.00 | 0.041 | 14.1 | 85.9 |
| 2.00 | 0.082 | 2.0 | 98.0 |

*$NO_2$ at 25°C and 550 nm; values follow $A_p = 0.850p$ and $T = 100 \times 10^{-A}$.*

CONTINUE →

**35.** According to the results of **Experiment 1**, which gas absorbed the least amount of light at 550 nm?

**A.** Nitrogen
**B.** Oxygen
**C.** Carbon dioxide
**D.** Chlorine

**36.** In **Experiment 2**, what was the relationship between gas concentration and percent transmission?

**F.** As concentration increased, percent transmission increased
**G.** As concentration increased, percent transmission decreased
**H.** As concentration increased, percent transmission remained constant
**J.** As concentration increased, percent transmission first increased then decreased

**37.** Based on **Figure 1**, if the gas cell were made longer (increasing the path length), what would happen to the percent transmission for a given gas at constant concentration?

**A.** It would increase
**B.** It would depend on the type of gas
**C.** It would remain the same
**D.** It would decrease

**38.** If water vapor had a percent transmission of 89.1% in the standardized 1.0 atm cell, what would its approximate optical density A be?

**F.** 0.005
**G.** 0.050
**H.** 0.100
**J.** 0.500

**39.** According to Table 2, when $NO_2$ pressure doubles from 0.50 atm to 1.00 atm, the absorbed-light percentage:

**A.** decreases by approximately 24 percentage points
**B.** remains approximately the same
**C.** increases by approximately 24 percentage points
**D.** more than doubles

**40.** Based on Beer's Law and the results of both experiments, which change would result in the greatest decrease in percent transmission?

**F.** Replacing $N_2$ with $O_2$ at the same pressure
**G.** Doubling the concentration of $CO_2$
**H.** Halving the path length for any gas
**J.** Replacing $Cl_2$ with $NO_2$ at the same pressure

**SECTION COMPLETE · 4**

**Pause here and wait for the cue to begin the next section.**
**During timed practice, do not revisit a section after leaving it.**

QUICK REFERENCE

# Answer Key

Correct responses by section

## SCIENCE · SCIENCE SECTION

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 C | 2 F | 3 B | 4 J | 5 A | 6 J | 7 A | 8 F | 9 C |
| 10 H | 11 D | 12 G | 13 D | 14 G | 15 C | 16 J | 17 A | 18 F |
| 19 D | 20 G | 21 C | 22 J | 23 A | 24 J | 25 B | 26 H | 27 C |
| 28 F | 29 B | 30 F | 31 B | 32 J | 33 B | 34 F | 35 A | 36 G |
| 37 D | 38 G | 39 C | 40 J | | | | | |

TEST NINJAS ACT PRACTICE

# Science: Number Correct to Scale Score

Find your total number correct in this 40-question Test Ninjas section, then read across to the estimated 1–36 scale score. Wrong answers do not subtract points.

## Science Practice Conversion

40 questions · 34 operational-question curve

| NUMBER CORRECT OF 40 | ESTIMATED SCALE SCORE | NUMBER CORRECT OF 40 | ESTIMATED SCALE SCORE |
|---|---|---|---|
| 40 | 36 | 19 | 20 |
| 39 | 35 | 18 | 19 |
| 38 | 34 | 17 | 18 |
| 37 | 33 | 16 | 18 |
| 36 | 33 | 15 | 18 |
| 35 | 32 | 14 | 17 |
| 34 | 31 | 13 | 16 |
| 33 | 30 | 12 | 15 |
| 32 | 29 | 11 | 14 |
| 31 | 28 | 10 | 14 |
| 30 | 28 | 9 | 12 |
| 29 | 27 | 8 | 12 |
| 28 | 26 | 7 | 11 |
| 27 | 25 | 6 | 10 |
| 26 | 25 | 5 | 9 |
| 25 | 24 | 4 | 7 |
| 24 | 23 | 3 | 7 |
| 23 | 23 | 2 | 6 |
| 22 | 23 | 1 | 3 |
| 21 | 22 | 0 | 1 |
| 20 | 21 | | |

**How this estimate is calculated:** ACT's enhanced Science practice curve scores 34 operational questions, while this booklet presents 40 questions and does not identify field-test items. Each total correct is therefore projected proportionally to 34 scored questions, rounded to the nearest raw point, and converted with ACT's published practice curve. The result is useful for practice planning but is not an official ACT score.

TEST NINJAS PRACTICE ASSESSMENT

# End of Practice Assessment

Your practice booklet is complete. Check your work only after the timing conditions you selected have ended.

## Test Ninjas ACT Science Practice Exam

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