



Examination





November 2024

Part I - Theory Examination

The questions in the Theory Portion of the Examination are formatted as either true-false, multiple-choice, or problem-solving. General topic areas include:

- Principles of
 - Kinetic Energy
 - o Conservation of Linear Momentum
 - Principal Direction of Force (PDOF)
 - Occupant Kinematics
- Collision Evidence
 - Tire Marks
 - Roadway Marks
 - Vehicle Damage and Evidence
 - Lamp Examination
- Time Distance Analysis
- Change in Velocity (Δv)
- Critical Speed Analysis
- Airborne Analysis
- Newton's Laws

Part II - Practical Examination

During the Practical portion of the examination, the candidate will complete a crash reconstruction case based on a controlled crash test with objective data and definitive answers.

The candidate will be given a scale scene diagram capturing post-impact roadway evidence. The candidate must analyze case problem facts to **properly locate and draw vehicle positions** at specified locations on the diagram. Candidates will need to determine approach and departure angles from the diagram to complete a momentum analysis and answer a series of questions.

Potential analysis areas:

- Conservation of Linear Momentum
- Principal Direction of Force (PDOF)
- Time Distance
- Change in Velocity (Δv)
- Vehicle Speed
- Occupant Kinematics

Reference Materials

Candidates participating in the examination will be allowed a reasonable amount of reference material in the examination room during both portions of the examination. All reference materials must be in printed form; electronic (PDF) reference materials are not permitted.

Materials permitted to be kept at the candidate's work area at the examination site include:

- Examination booklet as provided by the proctor
- Examination workbook as provided by the proctor
- Approved calculator
- Formula sheets, provided they are laminated and bound within a 3-ring binder
- Momentum worksheets, provided the are laminated and bound in a 3-ring binder
- Plastic "sleeves" may be used for the formula or momentum worksheets, provided they are bound in a 3-ring binder. These sheets may not be removed or written upon by the candidate
- Bound textbook(s) and bound equation book(s) with reference tabs
- Small snacks and non-alcoholic refreshments
- Eyeglasses (without cases)
- Drawing tools, such as rulers, protractors, scales, triangles
- Pens, pencils and erasers
- Scissors
- Plastic transparency material, such as acetate and transparent tape
- Wristwatches without smart technology

Materials not permitted in the candidate's work area include:

- Loose papers, legal pads, steno pads
- Note-taking materials of any kind
- Post-it or other sticky notes
- Smart technology wristwatches
- Backpacks, briefcases, banker boxes, plastic totes, or similar storage compartments or containers at the candidate's work area during the examination

Candidates must demonstrate their ability to analyze a crash properly without using computer aids. Therefore, no computer equipment is permitted at the examination site. Only non-programmable hand-held calculators from the ACTAR Approved Calculator List are permissible. Approved calculators are listed at the end of this document.

Additional recommended tools for the Practical portion of the examination include:

- Traffic Template and/or Engineering Scale
- Protractor
- Colored Pencils
- Drafting Supplies
- All items a candidate may need to complete scale diagramming

Candidates may utilize drawing aids for the Practical portion of the examination (i.e. foam boards, cardboard, etc.). Such aids shall be surrendered to the proctor at the conclusion of the exam.

Electronic Devices

The following electronic items are prohibited from the examination site:

- Computers
- Cellular phones (may be secured with the proctor at the site)
- Tablets and iPads
- Scanning devices, photography equipment, or video recording devices
- Programmable calculators
- Electronic watches (i.e. Apple Watch)
- Headphone devices (i.e. Earbuds)

Attempting to photograph, copy, or otherwise enter any question(s) or examination data onto paper or into an electronic storage device for later retrieval will immediately disqualify the candidate from the accreditation program.

Only those calculators listed within the Approved ACTAR Calculator List will be permitted in the examination room. Approved calculators are listed at the end of this document.

Grading and Scoring Procedures

Answers will be graded as correct or incorrect, and partial credit will not be given for any question. A question that requires a numerical value must also include proper units, if applicable (i.e. speed, velocity, time, distance, etc.). Answers that do not include proper units will be marked incorrect even if the numerical value alone is correct. Answers given as ranges (i.e., 45-50 mph or 10-12 meters, etc.) will be marked incorrect.

Scoring will be based on adhering to the ACTAR Guide to Report Numerical Answers. For instance, a candidate's answer to a question written as 25.6 mph will be graded as 25 mph.

To be awarded Accreditation, candidates must score 75% or better on both the Theory and Practical portions of the examination. To attain accreditation, both portions of the examination must be successfully completed before the candidate's current eligibility period expires.

Scores will be recorded as either pass or fail. ACTAR does not retain nor disclose numeric scores. Grading will not be done at the examination site. The examinations will be sent to the grading committee and graded later. Expect that it may take up to 60 days before you hear back on your examination score.

Candidate Qualification and Eligibility

After a candidate's application for accreditation has been approved, the candidate is granted a two-year eligibility period to take the examination. Candidates who fail to successfully complete both portions of the examination during their initial eligibility period may request to be granted an additional two-year eligibility period. Payment of the equivalent application fee will be required for a subsequent period. When a new eligibility period is granted, both portions of the examination must be successfully completed during the new two-year eligibility period regardless of the success on one part during the previous two-year period. Candidates will have

three attempts to pass the exam during the second eligibility period. Any candidate who has not successfully passed the exam at the end of that second two-year period will not be allowed to sit for any future ACTAR examination.

Candidates qualified to sit for the exam before January 1, 2022, will be subject to this policy after their current eligibility period expires. Those candidates will be limited to a maximum of two additional two-year eligibility periods. Any additional eligibility period(s) need not be consecutive.

Examination Review

Candidates who fail an examination will receive a limited written review of their attempt. The review will indicate which sections of the examination the candidate answered incorrectly. The review is not intended to be a mentoring session but to provide the candidate with an understanding of concepts that may warrant additional study. Candidates will be provided with no further feedback from the Grading Committee.

Additional Information

Candidates should know the differences between the coefficient of friction and drag factor (a coefficient that has been adjusted for braking and/or grade). They should also be familiar with the difference between acceleration rates and factors.

Some questions are compounding, such as where a current problem depends upon a previously answered solution. If the previously answered solution is incorrect, this may cause the current problem solution to be incorrect, even if proper methodology has been followed.

Sample Examination Questions

These sample questions are not an indication of the level of difficulty or simplicity of the examination and do not reflect the full variety of questions the candidate might be faced with but are representative of some of the questions which might be found on the examination.

- 1. The departure angle of a vehicle involved in a collision is measured from its impact point to its final rest position.
 - a. True
 - b. False
- 2. In a 90° collision where the center of mass of one vehicle is aligned with that of the other vehicle, both vehicles will always achieve the same departure angle.
 - a. True
 - b. False

- 3. If the velocity of a vehicle is doubled, the amount of kinetic energy it has _____.
 - a. remains the same
 - b. quadruples
 - c. is halved
 - d. doubles
- 4. The amount of overlap can best be determined by contact damage.
 - a. True
 - b. False
- 5. Tearing, breaking, and punctures are examples of
 - a. eccentric damage
 - b. directed damage
 - c. induced damage
 - d. contact damage
- 6. Parallel fracture lines in laminated safety glass usually result from an occupant or some other object striking the windshield.
 - a. True
 - b. False

A car starts to skid from 80 mph (129 km/h). Assume a drag factor of 0.72 on the roadway surface.

- 7. What will the car's speed be after it has slid 150 ft (46 m)?
- 8. How long, in seconds, will the speed reduction take?
- 9. How far did the vehicle travel during braking?
- 10. In the vehicle's first second of braking, how far did it travel?

Sample Examination Question Answers

- 1. B
- 2. B
- 3. B
- 4. A
- 5. D
- 6. B
- 7. 56 mph (90 km/h)
- 8. 1.50 seconds
- 9. 153 feet (46.6 meters)
- 10. 106 feet (32.2 meters)

There will be four (4) scenario-based problems, in which a series of up to ten related questions will be asked for each scenario. Below are two examples of the scenario problems.

The scenario-based questions may ask for answers including, but not limited to:

- Impact Speeds
- Post Impact Speeds
- Speed Across Surfaces
- Change in Velocity
- Kinetic Energy of the Vehicle
- Principal Direction of Force
- Time Distance Analysis
- Drag Factor Analysis

Example Scenario #1

A Nissan, which weighs 3,850 pounds (1,746 kilograms), is traveling 15 degrees north of east when it strikes a Buick, which weighs 4,230 pounds (1,919 kilograms) and is traveling 10 degrees west of north. After the collision, the Nissan is redirected 25 degrees towards the north while the Buick is redirected 55 degrees towards the east.

After the collision, the Nissan slid across two surfaces before stopping. It expends 16,603 ft-lbs. (22,511 J) of energy on the first surface, which has a downhill grade of -4% and 21,843 ft-lbs. (29,615 J) on the second surface, which has an uphill grade of 2%. Both surfaces have a coefficient of friction of 0.75.

The Buick's post-impact speed was 20 mph (32.2 km/h), and it traveled 40 feet (8.94 meters) on a surface with an uphill grade of 3% and a coefficient of friction of 0.78.

Before the impact, Nissan attempted to avoid the collision by locking up the brakes for 52 feet (15.85 meters) and skidding with a drag factor of 0.8.

Prior to the impact, the Buick was accelerating for 52 feet (15.85 meters) with an acceleration factor of 0.246.

Example Scenario #2

The driver of a vehicle locks up the brakes (100% braking) in an effort to avoid a vehicle crossing over into their lane of travel. Due to the curve in the roadway, it skids off the road and strikes a tree head-on. In the process, it skids across three surfaces, the first concrete, the second asphalt, and the third grass. After the impact with the tree, the 4250-pound (1928 kg) vehicle rebounds backward with a speed of 5.1 mph (8.2 km/h). When it stuck the tree, it had 194,524 ft-lb (263,740 J) of kinetic energy and 387,124 ft-lb (524,870 J) of kinetic energy at the start of the second (asphalt) surface.

It traveled 55 feet (16.76 meters) on the first surface and 42 feet (12.8 meters) on the third surface with a drag factor of 0.38.

Testing established that the coefficient of friction for the concrete surface was 0.82, 0.68 for the asphalt surface, and 0.48 for the grass surface.

The asphalt surface had an uphill grade of 2%, and the concrete surface had a downhill grade of 3%.



Guide for Reporting Numerical Answers ACTAR Accreditation Examinations

For both the **THEORY** and **PRACTICAL** Examinations, the significant digits for all answers must be expressed as shown in the examples below.

Imperial answer should be shown:	Units	Metric answer should be shown:
0.75	Acceleration / Deceleration (drag factor)	0.75
25.7 fps ²	Acceleration Rate / Deceleration Rate	7.85 m/s²
305°	Degrees	305°
10 in 10.2 ft	Distance	10 cm 10.00 m
87,338 ft lb	Energy	87,338 J
85,500 lb*mph	Momentum	85,500 kg*kph
5.10 %	Percent of grade / slope	5.10 %
25 mph	Speed	25 kph
25.5 fps	Velocity	15.5 m/s
2.35 sec	Time	2.35 sec

The grading committee will not round your answers for you or check your answers beyond the values stated above.

Answers given as a range (i.e.: "45-55 deg" or "10-12 inches", etc.) are prohibited and will be marked wrong.

All numeric answers must include the proper units (mph, degrees, feet, etc.).

Unless otherwise stated in a particular question or with given information, a 60/40 front/rear weight distribution will be assumed for the vehicles described in the exam.



Approved Calculator List ACTAR Accreditation Examinations

Effective November 1, 2024

To protect the integrity of the accreditation exam, ACTAR limits the types of calculators candidates may use during the exam.

Only those electronic devices (calculators) listed below are approved for use by candidates taking the accreditation examination.

No exceptions or substitutions are allowed.

Casio:

Approved Models Only Include (including plus models):

- fx-55
- fx-82AU
- fx-115
- fx-260
- fx-300
- fx-991

Hewlett Packard:

Approved Models Only Include:

- HP33s
- HP35s

Texas Instruments:

Approved Models Only Include:

- TI-30X
- TI-36

Sharp:

Approved Models Only Include:

• EL0531WB (including BL or BK)