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CIVIL AERONAUTICS MANUAL 24

U. S. Department of Commerce Civil Aeronautics Administration

Civil Aeronautics Manuals and supplements thereto are issued by the Office of Aviation Safety, Civil Aeronautics Administration, for the guidance of the public and are published in the Federal Register and the Code of Federal Regulations.

Supplement No. 1 CAM #24 August 1, 1951

SUBJECT: 24.11 and 24.12
Aeronautical Knowledge

Commencing with the issuance of this supplement, a new procedure is being established for informing the public of CAA rules, policies, and interpretations. Pending such time as it will be possible for the CAA to issue a complete Civil Aeronautics Manual 24 including the appropriate Civil Air Regulation, there will be issued from time to time supplements such as this containing rules, policies, and interpretations in the form of pages to a manual. These pages should be retained by the recipient and combined with others that will be released periodically, thus permitting the compilation of all material on this particular regulation in one file. These supplements will be distributed by the CAA free of charge until such time as it is possible to release a complete Manual 24. Upon publication of the Manual which will include all supplements to date, it will be placed on sale at the Government Printing Office.

This procedure eliminates the use of the Aviation Safety Release for the publication of CAA material explaining or implementing Civil Air Regulations and as time permits, all prior Aviation Safety Releases of this type will be replaced either by a complete manual or a supplement such as this.

Instructions in this supplement regarding the insertion of new pages and the deletion of out-of-date material should be carefully followed. All supplements to Civil Aeronautics Manual 24 following this one will have this format.

The numbering system of this material follows exactly that of like material in Civil Air Regulations Part 24, dated September 1, 1949. CAA material is identified by appending a dash to the regulation number and then numbering as outlined in the attached pages.

To be used in conjunction with New Part 24

24.11-1 The Content and Scope of the Written Examination Required for an Aircraft Mechanic in Proof of Aeronautical Knowledge

24.12-1 The Content and Scope of the Written Examination Required for an Aircraft Engine Mechanic in Proof of Aeronautical Knowledge

Appendix A Study Guide for the Written Examination Required for Aircraft and Aircraft Engine Mechanic Certificates

The Office of Aviation Safety is issuing the attached supplement, together with Appendix A, to serve as a study guide for applicants preparing for the aircraft and aircraft engine mechanic written examinations. Appendix A includes a list of reference material and sample aircraft and aircraft engine mechanic written examination questions.

The attached new supplement with appendix should be retained with other statements and appendices which explain or implement Civil Air Regulation Part 24.

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Director, Office of
Aviation Safety

Attachments
Distribution: Air 9A, 11, 14, 40 all tabs, 40B, 40C, 40G
Air 40-F-1

"CAR 24.11 Aircraft mechanic rating. To be eligible for an aircraft mechanic rating, an applicant shall comply with the following requirements:

"(a) Aeronautical knowledge. Applicant shall have theoretical and practical knowledge of aircraft structure and rigging, including the control systems, and aircraft appliances, shall know how properly to inspect, maintain, and repair the same, and shall be generally familiar with the provisions of Parts 4a, 4b and 15, and thoroughly familiar with the provisions of Part 1 dealing with aircraft airworthiness and the provisions of Parts 18 and 24 of this subchapter.

"(b) Aeronautical experience. Applicant shall have had at least 1 year of practical experience, or what is deemed by the Administrator to be its equivalent, in the construction, inspection, maintenance, or repair of aircraft and aircraft appliances.

"(c) Aeronautical skill. Applicant shall satisfactorily demonstrate, by means of written, oral, and practical tests, his ability with respect to the subject matters prescribed in paragraph (a) of this section."

24.11-1 THE CONTENT AND SCOPE OF THE WRITTEN EXAMINATION REQUIRED FOR AN AIRCRAFT MECHANIC CERTIFICATE IN PROOF OF AERONAUTICAL KNOWLEDGE. (CAA policies which apply to Section 24.11 of the Civil Air Regulations.)

The written examination is designed for one specific purpose--to determine whether an aircraft mechanic applicant possesses the minimum basic knowledge required for maintaining a high standard of safety and workmanship.

(NOTE: The Administrator has compiled a study guide to aid applicants in preparing for the aircraft mechanic certificate examination. This guide is contained in Appendix A of Civil Aeronautics Manual 24.)

"CAR 24.12 Aircraft engine mechanic rating. To be eligible for an aircraft engine mechanic rating, an applicant shall comply with the following requirements:

"(a) Aeronautical knowledge. Applicant shall have theoretical and practical knowledge of aircraft power plants, propellers, and their appliances, shall know how properly to inspect, maintain, and repair the same, and shall be generally familiar with the provisions of Parts 4a, 4b, 13, and 14, and thoroughly familiar with the provisions of Part 1 dealing with aircraft airworthiness and the provisions of Parts 18 and 24 of this subchapter.

"(b) Aeronautical experience. Applicant shall have had at least 1 year of practical experience, or what is deemed by the Administrator to be its equivalent, in the construction, inspection, maintenance, or repair of aircraft engines, propellers, and their appliances.

"(c) Aeronautical skill. Applicant shall satisfactorily demonstrate, by means of written, oral, and practical tests, his ability with respect to the subject matters prescribed in paragraph (a) of this section."

24.12-1 THE CONTENT AND SCOPE OF THE WRITTEN EXAMINATION REQUIRED FOR AN AIRCRAFT ENGINE MECHANIC CERTIFICATE IN PROOF OF AERONAUTICAL KNOWLEDGE. (CAA policies which apply to Section 24.12 of the Civil Air Regulations.)

The written examination is designed for one specific purpose--to determine whether an aircraft engine mechanic applicant possesses the minimum basic knowledge required for maintaining a high standard of safety and workmanship.

(NOTE: The Administrator has compiled a study guide to aid applicants in preparing for the aircraft engine mechanic certificate examination. This guide is contained in Appendix A of Civil Aeronautics Manual 24.)

STUDY GUIDE FOR THE WRITTEN EXAMINATION REQUIRED FOR AIRCRAFT AND AIRCRAFT ENGINE MECHANIC CERTIFICATES

(a) Taking the Examination. The applicant should always read the statement or question first to be sure that he understands what it means before looking at the answers listed below. An attempt should then be made to determine what the correct answer should be, or work out the problem to obtain the answer. The applicant should always bear in mind while taking the examination that the questions are not trick questions, but that each statement means exactly what it says. The statements do not concern exceptions to rules; they refer to general rules. Finally, the applicant should look through the list of alternate answers or phrases and find the one which says the same thing as his answer. The applicant should be sure that the one he selects answers the question completely. Only one of the alternate answers given is correct. The others may be answers that result from incorrect procedure (in a problem, for example) or from wrong interpretations of the question, or from misconceptions.

If considerable difficulty is encountered with a particular problem, the applicant should not spend too much time on it, but he should proceed to the next problem where the answer is known. When that section of the examination has been completed, he should go back to the unanswered questions. This procedure will enable him to use the total time available to maximum advantage in demonstrating his knowledge and understanding of the subject.

An applicant who is adequately prepared will have ample time to complete his work within the maximum time limit established for the examination. An applicant's inability to complete the examination within the time limit may indicate that he has not acquired adequate proficiency, that he lacks self-assurance, or that his reactions and thinking processes are not sufficiently rapid to assure reasonable skill in making decisions and taking appropriate action.

If the applicant remembers these facts, follows the instructions given, and knows the subject matter on which he is being tested, he will have no difficulty with the examination.

The applicant's answer sheet, together with any papers used during the examination for computation or notations, shall be surrendered before he leaves the examination room. Examination answer sheets are mailed immediately to the Washington office of the Civil Aeronautics Administration where a grade in each section is determined by an electric scoring machine; however, as a double check, all papers receiving grades below passing are given an additional hand check for verification before the results are mailed to the applicant. Applicants must receive a grade of at least 70 per cent in each section to be successful in the examination.

Complete records of examination results and other matters pertaining to the applicant's activity as a mechanic are maintained in the Washington office of the Civil Aeronautics Administration.

(b) Reference Material. The publications listed below which are marked "GPO" may be ordered from the Government Printing Office. Orders must be accompanied by money order or check made payable and addressed to the Superintendent of Documents, Government Printing Office, Washington 25, D.C. Publications marked "CAA" may be obtained from the Office of Aviation Information, Civil Aeronautics Administration, Washington 25, D.C.

(1) The aircraft mechanic written examination is composed of four sections of 30 questions each, as follows: Rigging and Assembly; Wood, Fabric, Covering, and Doping; Sheet Metal and Welding; and Hydraulic Systems. An applicant can prepare himself for this examination by studying the following material:

Study Material	Where Obtained	Cost
Civil Air Regulations		
Part 1 - Certification, Identification, and Marking of Aircraft and Related Products	GPO	.05
Part 3 - Airplane Airworthiness--Normal, Utility, and Acrobatic Categories	GPO	.15
Part 4a- Airplane Airworthiness	GPO	.20
Part 4b- Airplane Airworthiness Transport Categories	GPO	.25
~~Part 15- Aircraft Equipment Airworthiness~~	~~GPO~~	.05
Part 18- Maintenance, Repair, and Alteration of Certificated Aircraft and of Aircraft Engines, Propellers, and Instruments	GPO	.05
Part 24- Mechanic Certificates	GPO	.05
Part 43- General Operation Rules	GPO	.05
~~Civil Aeronautics Manual 04~~	~~GPO~~	~~.45~~
Civil Aeronautics Manual 18	GPO	1.25
Civil Aeronautics Manual Supplements		
CAM 3 - Supplements 1, 4, 5, 6, 7, 8, 9, 10, "	CAA	no charge
CAM 4a- Supplement 1	CAA	no charge
CAM 4b- Supplements 3, 4, 5, 6, 7, 8, 1	CAA	no charge
CAM 43- Supplements 1, 4, 6, 1	CAA	no charge

(2) The aircraft engine mechanic written examination is composed of five sections of 30 questions each, as follows: Carburetors and Carburetion; Magnetos and Ignition System; Theory and Maintenance of Power Plants; Lubrication and Oiling Systems; and Propellers. An applicant can prepare himself for this examination by studying the following material:

Study Material	Where Obtained	Cost
Civil Aeronautics Technical Manual 101	GPO	.55
Civil Aeronautics Technical Manual 107	GPO	~~1.25~~
Civil Air Regulations		
Part 1 - Certification, Identification, and Marking of Aircraft and Related Products	GPO	.05

Study Material	Where Obtained	Cost
Civil Air Regulations		
Part 1 - Certification, Identification, and Marking of Aircraft and Related Products	GPO	.05
Part 4a- Airplane Airworthiness	GPO	.20
Part 4b- Airplane Airworthiness Transport Categories	GPO	.25
Part 13- Aircraft Engine Airworthiness	GPO	.05
Part 14- Aircraft Propeller Airworthiness	GPO	.05
Part 18- Maintenance, Repair, and Alteration of Certificated Aircraft and of Aircraft Engines, Propellers, and Instruments	GPO	.05
Part 24- Mechanic Certificates	GPO	.05
Civil Aeronautics Manual 14	GPO	~~.15~~ .20
Civil Aeronautics Manual 18	GPO	1.25
Civil Aeronautics Manual Supplements		
CAM 4a- Supplement (1)	CAA	no charge
CAM 4b- Supplements 3, 4, 5, 6, 7, 8, 9	CAA	no charge

(c) Sample Aircraft Examination Questions.

(1) Section One - Rigging and Assembly.

1. A pilot reports that the aircraft's left wing is heavy at all speeds. After ascertaining that the center section is rigged properly, the mechanic could correct this wing-heavy condition by
   1- reducing the dihedral in the left wing.
   2- washing-in the right wing and washing-out the left wing.
   3- rigging more dihedral in the right wing.
   4- washing-out the right wing and washing-in the left wing.

2. After trammeling all bays in a wing panel, the final alignment check to be made before covering is to
   1- make sure that all the drag wires in the bays are the same length.
   2- check the alignment of the spars.
   3- make sure that all drag and antidrag wires are tightened so that they are uniform in length.
   4- check the distances between the ribs.

3. A precaution to insure the maintenance of an adequate safety factor and of strength on all turnbuckles is to see that
   1- no more than three threads are exposed and that the turnbuckle is safetied against loosening by wire, the ends of which are securely fastened by at least four wraps.
   2- no threads are exposed to cause stripping and that the turnbuckle is cotter keyed at the hole in the barrel.
   3- no more than five threads are exposed and that the turnbuckle is safetied against the loosening rotation of the barrel.
   4- safety wire is installed through the barrel of the turnbuckle and that an adequate number of turns are used at each end to insure holding the wire.

4. Extra-flexible control cables are denoted by
   1- 7 x 9.
   2- 7 x 7.
   3- 7 x 12.
   4- 7 x 19.

5. When checking a wing for dihedral, the most commonly used reference line is the
   1- leading edge of the wing.
   2- center of the wing.
   3- front spar of the wing.
   4- wing fittings.

6. The installation or removal of additional optional equipment of appreciable weight, constituting a minor alteration on a certificated aircraft, requires
   1- only the appropriate entry in the Aircraft Operation Record.
   2- only inspection by an Aviation Safety Agent.
   3- proper entry in the aircraft logbook by the certificated mechanic in charge of the alteration.
   4- inspection and check of the weight and balance of the aircraft.

7. As incorporated in a fabric-covered wing panel, the principal function of drag and antidrag wires is to
   1- resist the forces acting forward and rearward in the plane of the chord.
   2- relieve excess strain on the wing root fittings.
   3- distribute throughout the spars the loads acting on the strut fittings.
   4- distribute equally throughout the panel all flying and landing loads.

8. An airplane should be rigged to fly hands-off at
   1- low speed.
   2- maximum speed.
   3- all speeds.
   4- cruising speed.

9. With reference to the cables used in primary flight control, the smallest one on which the standard Army and Navy tuck splice, or Roebling roll, is required is the one whose diameter is
   1- 1/4".
   2- 5/32".
   3- 1/8".
   4- 3/32".

10. If the stablizer brace wires vibrate excessively in flight, the probable cause is
   1- excessive tension on the rigging wires.
   2- excessive play in the stablizer adjusting mechanism.
   3- that the streamlined wires are not streamlined in line of flight.
   4- excessive wear of the hinge pins or bolts.

11. On airplanes having tail surfaces not equipped with an adjustable vertical fin, correction of directional stability generally is provided for by
    1- installing trim or balance tabs on the ailerons.
    2- rigging the rudder off center.
    3- installing trim or balance tabs on the trailing edge of the rudder.
    4- a wash-in of the wing to maintain directional stability.

12. On large control surfaces, static balance is obtained by
    1- placing counterweight arms or lead weights in the lead edges.
    2- equipping the control surfaces with trim tabs.
    3- putting hinges on the control surfaces at the center line of the surface.
    4- balancing the control arms.

13. To check a fuselage for proper alignment after a section of one longeron has been replaced, a mechanic should
    1- tram the replaced section.
    2- check from a center line all stations in the replaced section.
    3- check for squareness all stations in the damaged area.
    4- attach plumb bobs to the replaced members and check with the original members.

14. When the fuselage is leveled in a flying position, the center section is checked first for
    1- contour, dihedral, and alignment with fuselage.
    2- symmetry, correct stagger, and incidence.
    3- squareness with the fuselage longerons.
    4- the acute angle between the wing chord and the center section.

15. A wing having drag and antidrag wire bracing should be checked to determine whether
    1- all bays are properly trammeled.
    2- all compression ribs are tight.
    3- all spar fittings are in line.
    4- the same number of turns has been taken on each wire.

(2) Section Two - Wood, Fabric, Covering, and Doping.

1. In order not to overstress the rib stitching, it is necessary to space the stitches a definite distance apart, depending on the
    1- contour of the airfoil.
    2- strength and weight of the fabric.
    3- speed of the airplane.
    4- distance between the ribs.

2. Wood parts are treated for preservation by
    1- applying dope-proof paint.
    2- applying two coats of boiled linseed oil.
    3- applying spar varnish or lionoil.
    4- applying two coats of clear lacquer.

3. In the event the fabric must be repaired under adverse weather conditions and the mechanic wishes to prevent blushing of the doped surface, he should
   1- add thinner to the dope.
   2- apply a fabric rejuvenator.
   3- add retarder to the dope.
   4- apply the dope more rapidly.

4. On a lacquer or pigmented dope surface, orange peel or pebble finish is the result of
   1- insufficiently reduced lacquer or pigmented dope.
   2- applying too heavy or too wet a coat of dope.
   3- using too much thinner in the lacquer or dope.
   4- holding the spray gun too close to the surface.

5. In order to make tight fabric patches, it is a good practice to
   1- brush on more dope at the center.
   2- prestretch the fabric.
   3- leave the center undoped on the first coat.
   4- brush on the dope evenly over the patch.

6. A wing is refinished by applying dope. If the dope scales after drying, the scaling usually is caused by
   1- the improper removal of oil, grease, wax, or soap from the old surface.
   2- an improper application of the original coat of dope.
   3- too much thinner in the dope.
   4- the undercoat not having been sanded.

7. Just before the covering is applied, the most important check or inspection to be made of the wing panel is
   1- to locate the position of all inspection openings.
   2- to remove all small imperfections.
   3- to ascertain if all the bays are the same size.
   4- for defects and for the proper safetying of turnbuckles and nuts.

8. When recovering a wing, all patches, reinforcements, finishing tape, etc., should be put on
   1- after the fourth coat of dope.
   2- with the first coat of dope.
   3- with the last coat of dope.
   4- after the first coat of dope has dried.

9. On aircraft, balsa wood is used in the construction and the repair of
   1- wing panel bows.
   2- patterns for the construction of parts.
   3- fairings and streamlined strips.
   4- wing ribs.

10. For reinforcement of a splice on a solid wood spar, the wood generally used in making the side plates is
    1- birch.
    2- spruce.
    3- ash.
    4- mahogany.

11. The rib stitching inside the slipstream of an airplane which has a maximum speed of 150 mph has a maximum spacing of
    1- one inch.
    2- two and one-half inches.
    3- three and three-fourth inches.
    4- four inches.

12. When mixed with dope, aluminum powder is used primarily to
    1- protect the dope and fabric from deterioration due to the rays of the sun.
    2- form a neutral base for the color pigment.
    3- facilitate sanding.
    4- provide a lightweight filler.

13. In hand sewing, there should be
    1- seven to nine stitches every two inches.
    2- one to three stitches every inch, locking them once in every foot.
    3- stitches at least every three-eighths of an inch, locking them once in every eight inches.
    4- four to six stitches every inch, locking them once in every six inches.

14. In order to remove the creases in the fabric cover before applying dope to the wing, a mechanic should
    1- soak the fabric in a baking soda and water solution for one hour, applying the fabric to the wing when it is damp.
    2- dampen the fabric and sprinkle it with table salt when it is dry.
    3- use naphtha and water on the fabric.
    4- sponge the fabric lightly with water.

15. In a wood spar, a longitudinal crack not near a fitting
    1- can be repaired only after obtaining a written authorization from both the Civil Aeronautics Administration and the aircraft manufacturer.
    2- can be repaired only by splicing in a new spar section.
    3- can be repaired by gluing on reinforcement plates.
    4- necessitates replacement of the entire spar, according to Civil Aeronautics Manual 18.

(3) Section Three - Sheet Metal and Welding.

1. When welding aluminum, flux is used to
   1- permit the use of a slight reducing corrosion.
   2- prevent corrosion.
   3- reduce the carbon content.
   4- remove slag.

2. The proper length of the shank of a rivet is the sum of the thickness of the metals being riveted plus
   1- three times the diameter of the rivet shank.
   2- one times the diameter of the rivet shank.
   3- two times the diameter of the rivet shank.
   4- one and one-half times the diameter of the rivet shank.

3. Rivets made from 17S material are identified by a
   1- brazier head.
   2- plain head.
   3- dimple on the head.
   4- raised tit on the head.

4. When applied to aluminum alloy sheet, the term "Alclad" indicates that the surface of the sheet has been treated for corrosion by
   1- the chrome-phosphate process.
   2- an electro-chemical process.
   3- cadminum plating.
   4- coating with pure aluminum.

5. If a weld tends to pull loose, one of the most probable explanations is that the weld was made
   1- with a slight carbonizing flame.
   2- with too hot a flame.
   3- with insufficient heat at the weld.
   4- too light; that is, not building up the weld sufficiently.

6. In a weld, undercutting is indicated by the
   1- lack of build-up of the weld itself.
   2- number of blow holes, or projecting globules.
   3- hollow appearance of the weld at the edge.
   4- loose appearance of the weld along the edges.

7. Where 24S-O is employed in the construction of metal aircraft, the supplementary suffix "O" indicates that the metal is
   1- heat treated.
   2- heat treated and then rolled.
   3- annealed.
   4- full-hard.

8. In riveting a steel fitting to an aluminum alloy structure, a mechanic should
   1- brace the surrounding structure to dampen vibration from the steel fitting.
   2- separate the fitting from the structure by use of protective material.
   3- use a rivet of larger diameter than would be used if both fittings were aluminum alloy.
   4- use a coat of grease between the fitting and the structure.

9. If a torch "pops" repeatedly and goes out while making a cluster weld at an acute angle and the torch and pressures are O.K. the most probable cause of the trouble is that the
   1- tip is overheating.
   2- oxides in the weld are absorbing too much acetylene.
   3- acetylene supply is failing.
   4- tip size is too small.

10. In the SAE numbering system for steel, the last two digits usually indicate the
   1- strength weight ratio.
   2- average carbon content.
   3- type to which the steel belongs.
   4- approximate percentage of the predominant alloying element.

11. After completion of an aluminum weld, all flux should be removed immediately in order to
   1- permit normalizing of the weld.
   2- prevent corrosion.
   3- avoid heat strains.
   4- prevent formation of scale.

12. After completion of all fabrication operations on welded steel tubular structures, the inside of the tubing should be flushed with
   1- hot, raw linseed oil or lionoil.
   2- zinc chromate.
   3- a hot mixture of beeswax and grease.
   4- hot engine oil.

13. Welds tend to crack immediately outside the welded area when the welding joint
   1- is built up to provide extra thickness at the seam.
   2- is cooled too rapidly.
   3- has insufficient heat when fused.
   4- has too much heat when fused.

14. In normalizing X4130 steel, the steel is heated to its critical temperature and
   1- tempered.
   2- quenched in water.
   3- cooled slowly in still air.
   4- quenched in oil.

15. Welded structures are normalized in order to
    1- normalize the strength of all welds.
    2- prevent the burning of the base metal during the welding operation.
    3- relieve internal stresses.
    4- temper the structure.

(4) Section Four - Hydraulic Systems.

1. In a hydraulic system, the sediment trap usually is located in the
    1- fluid reservoir.
    2- pressure cylinder housing.
    3- pressure pump housing.
    4- inlet line at the pressure cylinder.

2. When a hydraulic four-way valve leaks at the core it
    1- spills oil on the aircraft.
    2- prevents the accumulator from filling.
    3- may cause an actuating cylinder to operate.
    4- may cause the brakes to lose pressure.

3. Following brake pedal movement, a flow of hydraulic fluid in the reserve tank indicates that there is
    1- too much fluid in the lines.
    2- insufficient brake shoe clearance.
    3- a leak in the master cylinder.
    4- excessive spring tension on the check valve.

4. If the flaps fail to lower when the control is moved to flap-down position, the trouble may be due to
    1- the hydraulic fluid being too cold.
    2- the pressure relief valve spring being set too high.
    3- the relief valve by-passing.
    4- the hydraulic fluid being too thin.

5. If an aircraft equipped with hydraulically operated flaps cannot maintain flap position when making an approach for a landing, the trouble may be due to
    1- too high a fluid viscosity.
    2- improper functioning of the relief valve.
    3- the pilot's accidentally placing the flap control handle in the wrong position when operating the emergency hydraulic hand pump.
    4- improper functioning of the engine pump.

6. In flight, if hydraulically operated flaps are unusually slow in closing, it may be due to
   1- a worn actuating piston.
   2- an excessively high hydraulic pressure.
   3- too great a tension on the pressure relief valve spring.
   4- worn flap hinge brackets.

7. On a hydraulically operated brake system, if the brake reaction is firm but the pedal creeps under applied pressure, it is usually an indication that the
   1- fluid line is kinked.
   2- vent in the tank is partially clogged.
   3- pressure tank has an air leak.
   4- master cylinder has an internal leak.

8. In a hydraulic line, an orifice is used to
   1- maintain constant pressures in the hydraulic system.
   2- restrain backward flow of the fluid.
   3- restrain the rate of flow of the fluid in the lines.
   4- allow a fast unrestrained flow of the fluid.

9. Brakes are bled to
   1- drain the excess hydraulic fluid.
   2- equalize the pressure system.
   3- relieve the brakes from dragging.
   4- remove air from the system.

10. If brakes that are soft and weak become O.K. after pumping the pedal a few times, one probable cause is that
   1- there is an obstruction in the line.
   2- there is a weak spring in the master cylinder.
   3- the rubbers are breaking down.
   4- the fluid supply is too low.

11. When inflating an aerol type strut
   1- the airplane should be raised on jacks.
   2- the airplane should have its normal load and should be in a taxiing position.
   3- if excessive leakage is noted, the packing-gland nut should be screwed extremely tight.
   4- a plus or minus tolerance of 3/4 inch is permitted in the specified piston extension.

12. Fluid is added to the shock struts on landing gears when the
   1- airplane is in the unloaded condition.
   2- strut is fully collapsed and supporting the weight of the airplane.
   3- airplane is on wing jacks and has its struts extended.
   4- weight of the airplane is not on the wheels.

13. In aircraft hydraulic systems pressure accumulators are used
   1- to compensate for fluid expansion in the tank.
   2- as storage space for reserve fluid.
   3- to store fluid under pressure.
   4- to provide for proper flow to all parts of the system.

14. "Soft" or weak hydraulic disc-type brakes may be corrected by
    1- grinding and replating the disc.
    2- bleeding the brake pressure lines.
    3- adjusting the brake tension springs.
    4- lengthening the brake pedal travel.

15. When a certified aircraft has undergone a major repair or alteration, it shall, prior to carrying passengers, be
    1- inspected and certified as airworthy by a certificated mechanic only.
    2- test flown in the presence of a CAA Aviation Safety Agent.
    3- test flown by a pilot who has an appropriate rating for the aircraft.
    4- test flown for at least 5 hours by an appropriately rated pilot.

(d) Sample Aircraft Engine Examination Questions.

(1) Section One - Carburetors and Carburetion.

1. If an engine runs O.K. at low altitudes but loads up at high altitudes, the probable cause is that the
    1- mixture is too rich.
    2- pressure is too high.
    3- economizer is not closing.
    4- air intake is partially clogged.

2. On some engines, detonation within the cylinders may be detected by
    1- intermittent missing of the engine.
    2- early firing of the charge in the cylinders.
    3- rising head temperatures.
    4- backfiring through the carburetor.

3. In a fuel pressure system using a diaphragm-type relief valve, if the fuel pressure is normal on the ground but increases with altitude, the trouble may be that the
    1- carburetor float valve is not working properly.
    2- gas line is partially clogged.
    3- air vent on the fuel pump is clogged.
    4- relief valve on the fuel pump is not adjusted properly.

4. The purpose of an economizer is to
    1- furnish, at any speed, the correct amount of fuel to the main discharge nozzle.
    2- regulate, at all speeds, the flow of fuel through the main metering jet.
    3- increase, at full throttle, the flow of air around the main discharge jet.
    4- supply and regulate the additional fuel required for speeds above the cruising range.

5. The fuel supply and fuel lines being O.K., an engine starts and runs normally for a short time, then stops. After standing a few minutes the engine performs in the same manner, repeating the performance each time it is started. The cause of this trouble may be that
   1- air is leaking into the intake system.
   2- the float level is set too low.
   3- the air vent to the fuel tank is clogged.
   4- the throttle valve is loose on the shaft.

6. The float level in a multiple-jet carburetor is measured from the level of the fuel in the float chamber to the
   1- bottom of the float chamber.
   2- main nozzle.
   3- parting surface.
   4- carburetor float.

7. When operating, the back suction type mixture control
   1- limits the flow of the fuel into the float chamber.
   2- increases the pressure above normal in the float chamber.
   3- reduces the suction in the venturi.
   4- reduces the effective suction on the metering system.

8. Shims are placed under the carburetor needle valve seat to
   1- compensate for the difference in expansion of the carburetor body and the needle seat.
   2- adjust the float level.
   3- insure a gas tight joint.
   4- provide a replaceable surface that can be ground without damaging the bowl.

9. The main air bleed jet in a carburetor
   1- assists in atomizing the fuel.
   2- regulates the pressure in the metering system.
   3- regulates the velocity of fuel through the venturi.
   4- maintains atmospheric pressure in the carburetor.

10. If the idling mixture is too rich and the adjustment has no effect, the probable cause is that the
   1- float level is too high.
   2- main metering jet is too large.
   3- idling speed air bleed is clogged.
   4- economizer is not operating.

11. If a supercharged engine functions at high speed but neither idles nor runs properly at low speed, the trouble may be caused by
   1- an excessively worn throttle shaft and bushings.
   2- water in the carburetor.
   3- an incorrect grade of fuel.
   4- the screen in the carburetor air scoop being partially clogged.

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12. Excess pressure from the fuel pump to the carburetor is controlled by
    1- a combination bypass and relief valve.
    2- regulating the speed of the fuel pump.
    3- the size of the fuel inlet at the carburetor.
    4- the throttle.

13. On a supercharged engine, a small leak in the line between the manifold pressure gauge and the induction system may cause the gauge to
    1- register high at high power.
    2- register low at high power.
    3- register atmospheric pressure.
    4- fluctuate.

14. The use of a fuel of too low an octane rating results in
    1- a loss of power from too lean a mixture.
    2- detonation.
    3- the engine missing at high speed.
    4- excessive carbon deposits on the cylinders.

15. If the operation limits of a supercharged engine are exceeded at low altitude, the most probable, immediate result would be
    1- an excessively rich mixture.
    2- excessive heat and cylinder pressures.
    3- a loss of power.
    4- a decrease in the manifold pressure.

(2) Section Two - Magnetos and Ignition System.

1. In most magnetos, if a spark plug wire becomes disconnected from the magneto, the
    1- condenser will overload.
    2- primary winding will heat up.
    3- spark will be conducted away by a ground wire.
    4- spark will jump the safety gap.

2. A magneto functions properly at take-off, but misses and becomes inoperative after forty-five minutes in the air. Upon landing and allowing the engine to cool, the magneto tests O.K. The breaker points and distributor blocks also are O.K. The most probable trouble was that
    1- the coil developed an internal short.
    2- the condenser shorted out.
    3- the magneto magnets were weak and were discharging gradually.
    4- condensation formed in the harness, shorting the spark plug leads.

3. If the ground wire becomes disconnected from the magneto, the
   1- engine will not start.
   2- switch will not stop the engine.
   3- engine will stop.
   4- magneto will overheat.

4. Hot running spark plugs are designed for use in
   1- extremely cold weather.
   2- air-cooled engines having high compression ratios.
   3- all unsupercharged engines.
   4- low pressure engines that operate at a low temperature.

5. The magneto breaker points are timed so that they will break or begin to open before the piston reaches the top dead center
   1- to allow for time between the opening of the points and the firing at the plug.
   2- to allow for the required time between ignition and complete combustion.
   3- to take advantage of the low cylinder pressures which permit a more rapid combustion of the fuel.
   4- so that the points will be fully opened when the piston reaches top dead center.

6. When the magnets are removed from a magneto they should
   1- be placed anywhere, as they cannot be damaged.
   2- be placed on glass or fiber.
   3- have a steel or iron connector placed across the poles.
   4- have the poles bridged with copper or aluminum.

7. The ignition timing of a magneto is advanced by
   1- moving the breaker assembly opposite to the direction of cam rotation.
   2- moving the breaker assembly in the direction of cam rotation.
   3- changing the clearance between the breaker points.
   4- rotating the distributor.

8. With reference to the numbers on the distributor blocks, the spark plug wires on all aircraft engines are connected
   1- in the order in which the cylinders are numbered.
   2- to the adjacent cylinders, starting in a clockwise direction from No. 1.
   3- to the adjacent cylinders starting in a counterclockwise direction from No. 1.
   4- in the order in which the cylinders fire.

9. In all magnetos, the purpose of the safety gap is to
   1- protect the primary winding from being short circuited.
   2- prevent the condenser from becoming overloaded.
   3- protect the distributor from excessive voltage.
   4- protect the high tension insulation in the magneto.

10. If the movable breaker point in a magneto sticks or freezes, it may cause the
    1- condenser to burn out.
    2- points to be burned.
    3- engine to stop running.
    4- engine to miss at high speed.

11. If the magneto functions properly at low and medium speeds but misfires at high speed, the probable trouble is
    1- burnt and pitted breaker points.
    2- a weak breaker spring.
    3- a weak rotating magnet.
    4- an advanced spark.

12. Spark plug wires have heavy insulation
    1- to cut down radio interference.
    2- to prevent leakage of high tension current.
    3- to protect them from moisture.
    4- because they carry a high amperage current.

13. If the breaker-point clearance on a four lobe magneto is found, on checking, to vary from .008" on one lobe to .014" on the lobe diametrically opposite, the most probable cause is
    1- a worn rotating magneto shaft and bearing.
    2- dirt on the shaft at the cam seat.
    3- a slightly worn cam lobe.
    4- a bent magneto cam shaft.

14. In high tension magneto, the function of the condenser is to
    1- act as a bypass for excess current in the primary winding when the points are closed.
    2- act as a safety gap for the secondary current.
    3- regulate the flow of current between the primary and secondary windings in the coil.
    4- assist in the instantaneous collapse of the magnetic field of the primary circuit.

15. When giving an engine a routine check, if the breaker points are found to be pitted, it indicates that the
    1- coil is getting weak.
    2- points are adjusted too wide.
    3- safety gap is adjusted too wide.
    4- condenser is not functioning properly.

(3) Section Three - Theory and Maintenance of Power Plants

1. Excessive valve clearance results in the valves opening
    1- late and closing early.
    2- late and closing late.
    3- early and closing late.
    4- early and closing early.

2. The "critical altitude" of an engine is the
   1- highest altitude at which the engine will operate safely.
   2- highest altitude at which the engine will maintain its rating power output.
   3- altitude at which the maximum horsepower is obtained.
   4- altitude at which it becomes necessary to use the mixture control.

3. Valves should be adjusted only when the piston is
   1- on top center of the exhaust stroke.
   2- on top center of the firing stroke.
   3- on bottom center of the power stroke.
   4- starting on the compression stroke.

4. When replacing valve guides in cylinders, the proper procedure is to
   1- obtain from the manufacturer a guide with approximately a .002" larger outside diameter than the one removed, then heat the cylinder and press in guide cold.
   2- heat cylinder and guide and press in guide.
   3- chill cylinder and guide and press in guide.
   4- install a guide whose outside diameter is such that the guide slides in easily when the cylinder is heated.

5. When lapping-in a cylinder by hand, a safety block should be used to
   1- prevent the piston from going too far into the cylinder.
   2- maintain a uniform pressure on the cylinder walls.
   3- protect the valves and valve assembly.
   4- prevent the piston from being pulled too far out of the cylinder.

6. If each power impulse of an eight-cylinder, four-cycle engine continues for 120°, there is
   1- a power lapse of 30°.
   2- a power overlap of 30°.
   3- a power overlap of 75°.
   4- no lapse or overlap of power.

7. A nitrided cylinder should not be ground to more than .015" oversize because
   1- the entire nitrided layer might be ground away.
   2- the taper of the cylinder barrel would be increased beyond the maximum tolerance.
   3- the wall is thinner than on a conventional type cylinder.
   4- the compression ratio would be increased beyond the factory specifications.

8. If an engine is allowed to operate too long at the idling speed
   1- it will cause excessive carbon formation.
   2- the spark plugs may become fouled.
   3- the exhaust valves may burn or warp.
   4- immediate failure to the engine may result.

9. If valves are seating properly but have sharp or feathered edges, the most probable immediate effect on the engine would be
   1- loss of compression.
   2- preignition.
   3- intermittent missing of all the cylinders.
   4- detonation.

10. When "pulling through" an engine by means of the propeller, if a decided lack of compression accompanied by the wheezing sound of escaping air is noted on one cylinder, the trouble with the engine may be
   1- a crack in the cylinder head.
   2- a bent push rod.
   3- a leak in the induction system.
   4- a cracked exhaust manifold.

11. If an engine backfires through the carburetor, it may be due to
   1- an exhaust valve sticking open.
   2- a warped exhaust valve.
   3- a broken intake push rod.
   4- an intake valve sticking open.

12. Before starting a radial engine that has been standing for two hours or more, it is best to pull the propeller through a few times by hand in order to
   1- remove the excess oil from the lower cylinders.
   2- determine if the propeller is secure.
   3- free any pistons that may be stuck.
   4- lubricate the cylinder walls.

13. When piston pins are fitted into aluminum pistons, the proper way to fit them is to
   1- put the piston in hot water and then insert the pin cold.
   2- ream the piston.
   3- press the pin into the piston, using an arbor press.
   4- drive the pin into the piston, using a rawhide hammer.

14. When an entry of any minor repair is made in the aircraft engine logbook, along with other things required by the Civil Air Regulations, it is necessary to include
   1- the signature of the CAA Aviation Safety Agent approving the repair.
   2- a detailed diagram showing the nature of the repair.
   3- the signature and certificate number of the mechanic in charge of or making the repair.
   4- the length of time required by the mechanic to make the repair.

15. Civil Air Regulations require that structural aircraft engine parts which are used to modify, maintain, or repair certificated engines must be
    1- of greater strength than the original replaced parts.
    2- supplied by the original manufacturer or manufactured in accordance with approved drawings.
    3- inspected and then installed by a certificated engine mechanic.
    4- replaced or installed only by the factory or certificated repair station.

(4) Section Four - Lubrication and Oiling Systems.

1. The lubrication system of an aircraft engine, in addition to reducing friction between moving parts and compensating for greater bearing clearances, performs the very important function of
    1- indicating the various cylinder head temperatures of the engine.
    2- keeping the engine warm during cold weather operations.
    3- preventing the oxidation of metal parts.
    4- conducting heat from the engine.

2. Excessive oil consumption and fouling of the spark plugs may be caused by
    1- worn piston rings.
    2- excessive clearance at cam hub bearing.
    3- filling the oil tank above the predetermined limit.
    4- oil bypassing back to the scavenger pump.

3. The use of oil of too low a viscosity for existing climatic temperatures is indicated by
    1- a rapid fluctuation of the pressure gauge needle.
    2- high fuel consumption.
    3- high oil pressure.
    4- low oil pressure.

4. Continuous excessive fluctuation of the oil pressure gauge needle, other than a defective gauge, sometimes indicates
    1- a plugged oil tank vent.
    2- excessive tension on the oil pressure relief valve spring.
    3- a leak in the oil suction line.
    4- air bubbles in the oil pressure line.

5. An oil radiator usually is located in the cooling system between the
    1- engine outlet and the automatic oil temperature regulator.
    2- oil pressure pump and the engine oil outlet.
    3- oil tank and the automatic temperature regulator in the pressure line.
    4- the automatic temperature regulator and the supply tank.

6. The main purpose of lagging the oil lines is to
    1- seal the lines and connections to prevent leaks caused by high pressures.
    2- reinforce the lines to prevent or eliminate vibration.
    3- insulate the lines to prevent the dissipation of heat during cold weather.
    4- prevent the oil and oil lines from overheating.

7. The presence of oil in the intake manifolds of a supercharged radial engine indicates
   1- excessive clearance in the master rod bearing.
   2- worn supercharger oil slinger or seals.
   3- improperly seated intake valves.
   4- that the scavenger pump is not working properly.

8. Excessive oil is prevented from accumulating on the cylinder walls by
   1- machining circular grooves in the piston skirts.
   2- hollow passages in the piston skirts.
   3- the use of slipper type pistons.
   4- the use of oil control rings in the piston skirts.

9. Worn connecting rod bearings in an engine cause
   1- an excessive oil temperature.
   2- a higher operating temperature.
   3- a complete loss of oil pressure.
   4- a higher oil consumption.

10. Excessive oil coming out of the crankcase breather may be caused by
   1- too great a tension on the breather adjusting screw.
   2- stuck piston rings.
   3- an excessive clearance in the oil pressure pump gears.
   4- a faulty oil pressure relief valve.

11. If the oil pressure gauge fluctuates and alternately picks up and drops to zero, the first thing to look for is
   1- the oil pump losing its prime.
   2- an air leak in the pressure lines.
   3- the oil pressure relief valve sticking.
   4- the amount of oil in the supply tank.

12. If the oil temperature increases slightly and the oil pressure drops considerably, one cause may be
   1- that the pressure relief valve is held open.
   2- a clogged breather pipe.
   3- a broken piston ring.
   4- a cracked cylinder head.

13. Oil tanks are vented in order to
   1- prevent excessive pressures from forming in the tank.
   2- cool the oil.
   3- prevent the oil from foaming.
   4- maintain uniform pressure throughout the lubrication system.

14. In some aircraft engines, the deposit of sludge and sediment in the oil is collected by
   1- breaking up the sediment or sludge and passing it on to the sump screen.
   2- a special housing surrounding the filter.
   3- discharging it through the bypass into the crankcase drain.
   4- conducting the oil to the oil sump.

15. Blue smoke from the engine exhaust probably indicates
    1- pressure relief valve stuck in the open position.
    2- worn or stuck piston rings.
    3- too low a tension of the spring on the pressure relief valve.
    4- too high a viscosity of the oil.

(5) Section Five - Propellers.

1. In extremely cold weather, when operating with a hydraulically operated two-position propeller, it is good practice to leave the propeller in high pitch position when the engine is not running in order to
    1- prevent the oil from draining out of the cylinder.
    2- keep the piston from seizing the cylinder.
    3- prevent the oil from congealing in the cylinder.
    4- facilitate starting the engine.

2. Increasing the tension of the governor speeder spring on a constant speed, hydraulically operated propeller tends to cause
    1- an increase in the blade angle, thereby decreasing the engine R.P.M.
    2- no appreciable change in the engine R.P.M.
    3- an increase in the governor oil pressure.
    4- a decrease in the blade angle, thereby increasing the engine R.P.M.

3. Holes are drilled in the metal tips of wood propellers in order to
    1- balance the propeller.
    2- lighten the metal tipping.
    3- allow moisture to escape.
    4- allow moisture to enter the wood to prevent laminated wood from shrinking.

4. When an airplane is to remain inoperative for any length of time, the wooden propeller blades should be
    1- placed in a vertical position.
    2- placed in horizontal position.
    3- coated with Cosmoline.
    4- plugged at the tips with putty to prevent moisture from entering.

5. At the time of overhaul, a steel propeller hub should be inspected by
    1- etching.
    2- magnafluxing.
    3- nitriding.
    4- anodizing.

6. If, in examining a wood propeller, a mechanic finds a scratch 1/8 inch deep across the blade, he should
    1- fill it with glue and varnish it when thoroughly dry.
    2- discard the propeller.
    3- send the propeller to the factory for repair.
    4- fill the scratch with plastic wood and refinish.

7. Wood propellers may be balanced horizontally by
   1- inserting lead plugs in small holes in the light blade near the hub.
   2- drilling holes in the metal tipping.
   3- applying a small brass plate on the light blade near the hub.
   4- applying solder to the metal tipping.

8. Before removing a hydraulically operated, nonfeathering constant speed propeller from the propeller shaft, a mechanic first should
   1- remove the counterweight lock pin.
   2- put the propeller in full high pitch.
   3- disconnect the propeller governor.
   4- put the propeller in full low pitch.

9. Wood propeller tips are covered with fabric to
   1- prevent moisture from entering the blade.
   2- maintain a more efficient aerodynamic surface.
   3- allow, when balancing, for removal of material which will not affect the strength.
   4- minimize splitting along the grain.

10. If the governor fails, a hydraulically operated feathering propeller tends to
   1- go to low pitch.
   2- go to high pitch.
   3- remain unchanged.
   4- fluctuate between high and low pitch position.

11. If a hydraulically operated, two-position propeller shifts into high pitch position during take-off, the cause may be
   1- a defective counterweight assembly.
   2- a rapid drop in oil pressure.
   3- a rapid rise in oil pressure.
   4- excessively worn index pins.

12. During the assembly of a two-bladed, adjustable pitch aluminum alloy propeller, the proper procedure for correcting a slight vertical unbalance is to
   1- drill the blade butts and add lead wool.
   2- shift the hub clamp rings.
   3- paint the light blade.
   4- reprofile the blades.

13. A precaution necessary to keep the hub nut from seizing the shaft is to
   1- dust the threads with flake graphite.
   2- dip the nut in engine oil.
   3- coat the nut with white lead mixed with oil.
   4- hand tighten the nut.

14. Civil Air Regulations require that when an airplane with a tail wheel is fully loaded and placed in a horizontal position, the minimum clearance of the propeller from the ground must be
    1- one-eighth the diameter of the propeller.
    2- sufficient to clear the ground.
    3- one-half of the diameter of the landing wheels.
    4- nine inches.

15. Under CAA rulings, any certificated airplane engine mechanic may make the following repair:
    1- major repairs on a propeller near the hub by using an inlay that is seven per cent of the chord.
    2- balance a wooden propeller by adding solder to the metal tips.
    3- the repair of a minor crack in a solid steel propeller.
    4- cold straighten an aluminum alloy propeller blade which has a bend of not more than 25° at.15 blade thickness.

(e) Answers to Sample Aircraft Questions.

(1) Rigging and Assembly.

Question	Answer
1.	4
2.	2
3.	1
4.	4
5.	3
6.	4
7.	1
8.	4
9.	4
10.	3
11.	3
12.	1
13.	2
14.	2
15.	1

(2) Wood, Fabric Covering, and Doping.

Question	Answer
1.	3
2.	3
3.	3
4.	1
5.	3
6.	1
7.	4
8.	4
9.	3
10.	2
11.	2
12.	1
13.	4
14.	4
15.	3

(3) Sheet Metal and Welding.

Question	Answer
1.	4
2.	4
3.	4
4.	4
5.	3
6.	3
7.	3
8.	2
9.	1
10.	2
11.	2
12.	1
13.	2
14.	3
15.	3

(4) Hydraulic Systems.

Questions	Answer
1.	1
2.	3
3.	3
4.	3
5.	2
6.	1
7.	4
8.	3
9.	4
10.	4
11.	2
12.	2
13.	3
14.	2
15.	3

(f) Answers to Sample Aircraft Engine Questions.

(1) Carburetors and Carburetion.

Questions	Answer
1.	1
2.	3
3.	3
4.	4
5.	3
6.	3
7.	4
8.	2
9.	1
10.	3
11.	1
12.	1
13.	2
14.	2
15.	2

(2) Magnetos and Ignition Systems.

Question	Answer
1.	4
2.	1
3.	2
4.	4
5.	2
6.	3
7.	1
8.	4
9.	4
10.	3
11.	2
12.	2
13.	4
14.	4
15.	4

(3) Theory and Maintenance of Power Plants.

Question	Answer
1.	1
2.	2
3.	2
4.	1
5.	1
6.	2
7.	1
8.	2
9.	2
10.	1
11.	4
12.	1
13.	1
14.	3
15.	2

(4) Lubrication and Oiling Systems.

Question	Answer
1.	4
2.	1
3.	4
4.	4
5.	4
6.	3
7.	2
8.	4
9.	4
10.	2
11.	4
12.	1
13.	1
14.	2
15.	2

(5) Propellers

Question	Answer
1.	3
2.	4
3.	3
4.	2
5.	2
6.	2
7.	4
8.	2
9.	4
10.	1
11.	2
12.	2
13.	3
14.	4
15.	2

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