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PROGRAMED TEXT

INTRODUCTION TO HELICOPTER ATTITUDE INSTRUMENT FLYING

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DEPARTMENT OF ROTARY WING TRAINING
UNITED STATES ARMY AVIATION SCHOOL
FORT RUCKER, ALABAMA

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TITLE: Introduction to Helicopter Attitude Instrument Flying	POI NO. 1-B-F18 FILE NO. 54-98-1

POI SCOPE: Contrast of attitude instrument flying and visual flying, instrument interpretation, instrument crosscheck, and basic techniques of attitude instrument flight.

INSTRUCTOR REFERENCES: TM 1-215, "Rotary Instrument Instructor Guide," and "Rotary Wing Basic Instrument Standardization Guide."

MATERIALS ISSUED TO STUDENTS: Programed text for introduction to helicopter attitude instrument flying, self-test, and answer sheet.

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DATE: July 1966

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DATE: July 1966

TABLE OF CONTENTS

PREFACE

This programed text is designed primarily to introduce helicopter attitude instrument flying to students in the helicopter instrument flying course and to initial entry students in the instrument phase.

To achieve the fullest benefit from this text, students should have completed the instruction on operation and use of flight instruments.

This text has been programed according to approved teaching methods, and thus will present to you just the right information to allow you to learn at your best rate of speed.

This publication is in two forms: one section is in the linear method where you read frames consecutively, and the next section is in the branching method where you do not necessarily read the frames consecutively. When using the branching method, the next page or frame that you read will always depend upon how well you understand the material just presented.

PERFORMANCE OBJECTIVES

Upon completion of this text, without notes or references, you should be able to:

a. Define instrument interpretation, instrument crosscheck, pitch, roll, yaw, and attitude functions of flight instruments.

b. Select the correct answer when comparing intuition versus actual aircraft attitude.

c. List the pitch attitude instruments.

d. List the roll attitude instruments.

e. Indicate instrument indications for variations in pitch and roll attitudes.

f. Identify the maneuvers depicted in diagrams or pictures of the instruments.

g. Compare aircraft attitude with the correct aircraft control.

SECTION I

The first section of this text is presented in a linear approach. Read each frame carefully, then provide the required response. If your initial response was correct, go on to the next frame. If your initial response was incorrect, re-read the frame before continuing. Beginning on page 1, follow the top column of frames to page 10, then return to page 1 to begin the second column, etc.

Now, turn to page 1.

[illegible] or rolling attitude of the aircraft is the [illegible]

[illegible] aircraft and the actual horizon.

Yaw is the movem[illegible]

---

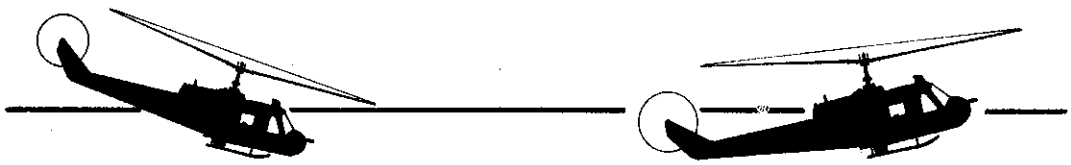
1. Instrument interpretation means to interpret or evaluate the flight instruments to determine the attitude of the aircraft.

10. A knowledge of pitch attitude, roll attitude, and yaw is helpful in attaining good instrument interpretation. The pitch attitude of the aircraft is the angular relationship between the longitudinal axis of the aircraft and the actual horizon.

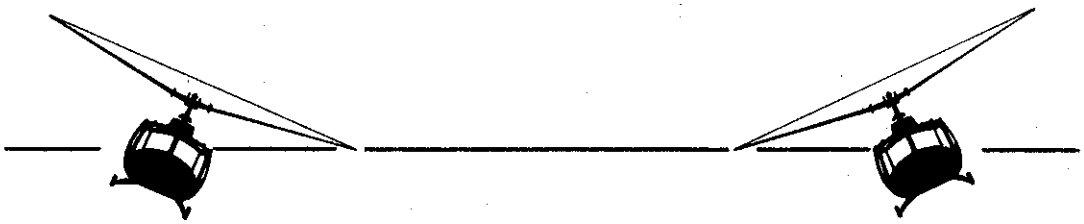
19. The banking or rolling attitude of the aircraft is the angular relationship of the lateral axis of aircraft to the actual horizon.

28. Yaw is the movement of the aircraft around the vertical axis.

Go on to page 3.



PITCH ATTITUDE



ROLL ATTITUDE

YAW

2. Instrument interpretation means to interpret or evaluate the flight instruments to determine the attitude of the aircraft.

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11. The pitch attitude of the aircraft is the angular relationship between the longitudinal axis of the aircraft and the actual horizon.

---

20. The banking or rolling attitude of the aircraft is the angular relationship between the lateral axis of the aircraft and the actual horizon.

---

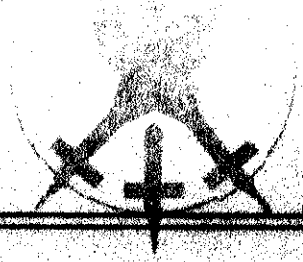
29. Yaw is the movement of the aircraft around the vertical axis.

---

3. interpret or evaluate

12. longitudinal; aircraft

21. lateral; aircraft



30. vertical

4. Instrument interpretation means to evaluate or interpret the flight instruments to determine the attitude of the aircraft.

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13. The pitch attitude of the aircraft is the angular relationship between the longitudinal axis of the aircraft and the actual horizon.

---

22. The banking or rolling attitude of the aircraft is the angular relationship between the lateral axis of the aircraft and the actual horizon.

---

31. Yaw is the movement of the aircraft around the vertical axis.

---

5. interpret or evaluate the flight instruments.

---

14. angular; longitudinal; aircraft

---

23. angular; lateral; aircraft

---

32. aircraft; vertical

---

6. Instrument interpretation means to evaluate or interpret the flight instruments to determine the attitude of the aircraft.

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15. The pitch attitude of the aircraft is the angular relationship between the longitudinal axis of the aircraft and the actual horizon

---

24. The banking or rolling attitude of the aircraft is the angular relationship between the lateral axis of the aircraft and the actual horizon

---

33. Yaw is the movement of the aircraft around the vertical axis

---

7. interpret or evaluate the flight instruments to determine the attitude

---

16. angular; longitudinal; aircraft; horizon

---

25. angular; lateral; aircraft; horizon

---

34. aircraft; vertical axis

---

8. By definition then, instrument interpretation means to interpret or evaluate the flight instruments to determine the attitude of the aircraft.

17. The pitch attitude of the aircraft is the angular relationship of the longitudinal axis of the aircraft and the actual horizon.

26. The banking or rolling attitude of the aircraft is the angular relationship of the lateral axis of the aircraft and the actual horizon.

35. Yaw is the movement of the aircraft around the vertical axis.

9. to interpret or evaluate the flight instruments to determine the attitude of the aircraft. (Return to page 1, item 10.)

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18. the angular relationship between the longitudinal axis of the aircraft and the actual horizon. (Return to page 1, item 19.)

---

27. the angular relationship between the lateral axis of the aircraft and actual horizon. (Return to page 1, item 28.)

---

36. the movement of the aircraft around the vertical axis. (Go to the following page.)

SECTION II

The next section of this text is in the form called "branching." Read each frame carefully, then select your answer and turn to the page indicated. If you have selected the correct response you may progress as directed. If you did not select the correct response, you will receive additional information and further instructions. Correct answers will enable you to by-pass many frames and thereby complete the text in less time.

Now, turn to page 11.

Instrument interpretation is closely associated with crosscheck or instrument coverage. Crosschecking means observing or interpreting two or more instruments to determine the attitude and performance of an aircraft. Although no specific method of crosschecking is recommended, those instruments which give the best information for controlling the aircraft in any given maneuver, should be used.

Based on what you have learned, would you say that intuition would be helpful in crosschecking?

1. Yes. Turn to page 13.

2. No. Turn to page 12.

ANSWER TO SELF-TEST QUESTION NO. 5:

Observing or interpreting two or more instruments to determine the attitude of the aircraft.

YOUR ANSWER: NO.

Very good. Utilizing intuition can get an aviator into serious trouble. A person's senses act primarily on the basis of gravity and provide reliable information while on the ground. When in flight, the aviator experiences acceleration and centrifugal forces that affect these senses exactly as gravity does, thus providing misleading information.

While crosschecking the instruments, the aviator learns and perfects a technique of combating the ill effects of the illusions.

Turn to page 14.

ANSWER TO SELF-TEST QUESTION NO. 14:

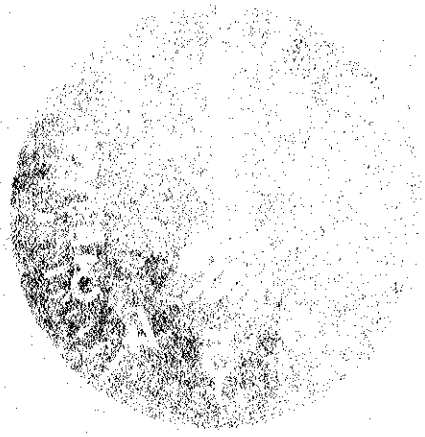
a. Straight climb.

YOUR ANSWER: YES.

You are way off. Intuition can give you a false indication of aircraft attitude. Cross-checking enables the aviator to repeatedly prove that his intuition is wrong; thus, he develops the habit of checking the instruments before changing the attitude of the aircraft.

As experience is gained in relying on instruments, distracting impressions of the mind become easier to overcome, the aviator must learn to ignore confusing sensory information and rely only on the objective evidence provided by the aircraft's instrumentation.

Turn to page 11 and select another answer.



ANSWER TO SELF-TEST QUESTION NO. 6:

True.

Remember, instrument interpretation means to interpret or evaluate the flight instruments to determine the attitude of the aircraft. Now, let's talk about the pitch attitude instruments.

The altimeter gives an indirect reading of pitch attitude in level flight. At a given power setting the altimeter reading should remain constant, and any movement of the altimeter needle may be considered as an immediate indication of a change or need for a change in pitch attitude.

If there is no change in power and altitude is being lost, the nose is _____.

1. Low, page 17.

2. High, page 15.

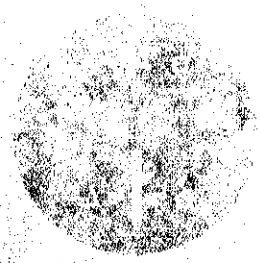
ANSWER TO SELF-TEST QUESTION NO. 1:

To interpret or evaluate the flight instruments to determine the attitude of the aircraft.

YOUR ANSWER: HIGH.

You're joking! If altitude is being lost, the nose is low. If altitude is being gained, the nose is high. In either case, corrective action to return the aircraft to level flight should be promptly initiated.

Now, turn to page 16. Study the diagram and go on to page 17.



ANSWER TO SELF-TEST QUESTION NO. 14:

b. Level turn.


ALT
0
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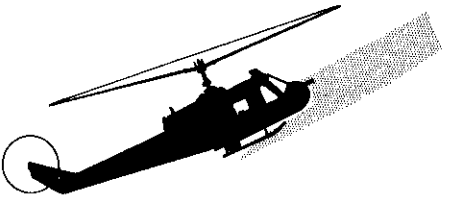


ALT
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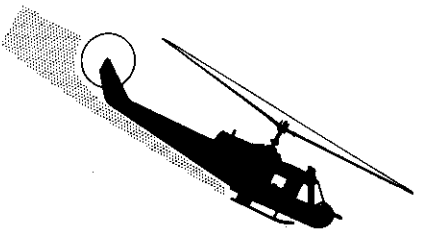


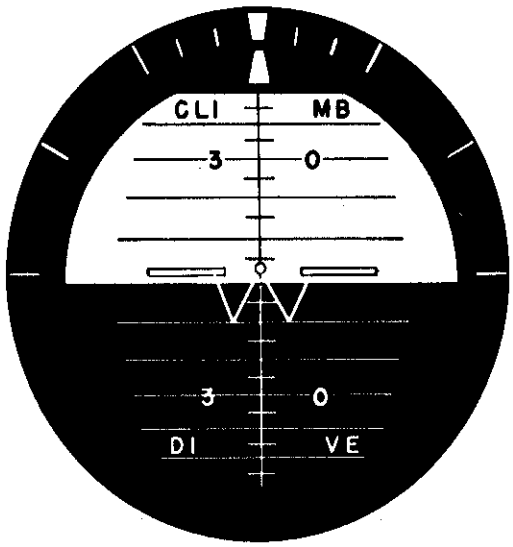
YOUR ANSWER: LOW.

Absolutely correct. With no change of power in level flight, any change in altitude gives an indication of pitch attitude change. The attitude indicator is used in conjunction with the altimeter as an aid in pitch control. The attitude indicator gives a direct and immediate indication of any change in pitch attitude of the aircraft.

With the instrument properly set for level flight, and it is noted that the miniature aircraft is above the horizon bar, is the nose of the aircraft high or low?

1. High, page 18.

2. Low, page 19.



ANSWER TO SELF-TEST QUESTION NO. 14:

c. Descending turn (left).

YOUR ANSWER: HIGH.

You've got it. Using the attitude indicator, the nose of the aircraft can be placed in approximately the correct position for any desired pitch attitude.

The vertical speed indicator is used in conjunction with the altimeter and the attitude indicator to aid in pitch control. If the instrument is reading zero when in level flight, any movement of the needle from the zero position indicates a change in pitch attitude. (See diagram below.)

If the air is smooth, what is your interpretation of pitch attitude if the needle indicates a rate of climb?

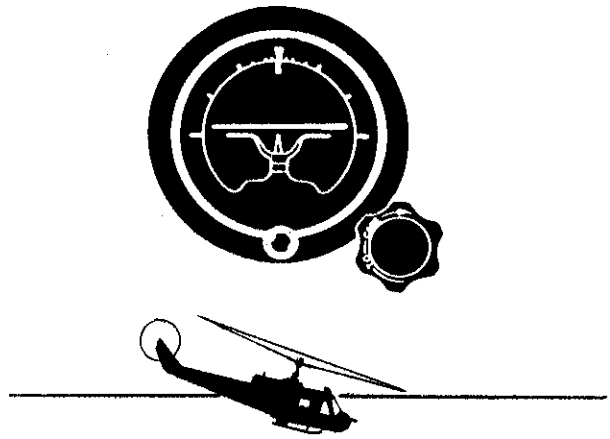
Nose high, page 21.

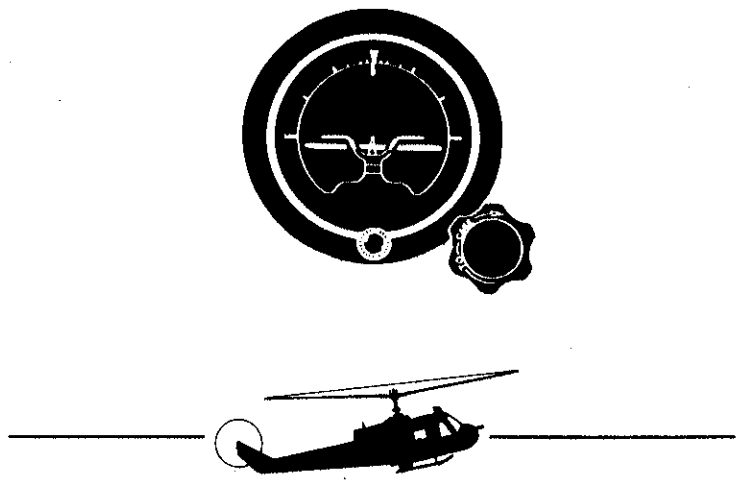
Nose low, page 20.

YOUR ANSWER: LOW.

Wrong. In visual flight, the proper pitch attitude is attained by raising or lowering the nose in relation to the actual horizon. In instrument flight, the attitude indicator supplants the actual horizon. If the nose of the aircraft is above the horizon, then the miniature aircraft will be above the horizon bar of the attitude indicator.

Study diagram below and then please turn to page 18.

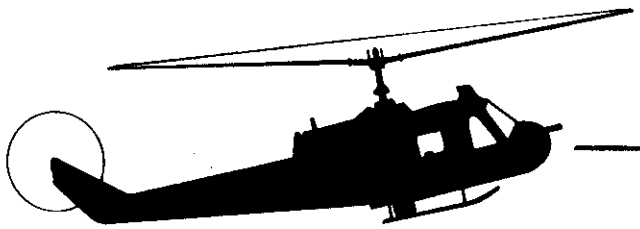




YOUR ANSWER: NOSE LOW.

Come now! Remember, we are talking about pitch attitude. If the needle indicates a climb, then the nose of the aircraft is high. In fact, if immediate corrective pressure is applied to return the needle to zero, the altimeter usually will indicate no change in attitude.

Study the diagram and go on to page 21.



ANSWER TO SELF-TEST QUESTION NO. 2:

The angular relationship between the longitudinal axis of the aircraft and the actual horizon.

YOUR ANSWER: NOSE HIGH.

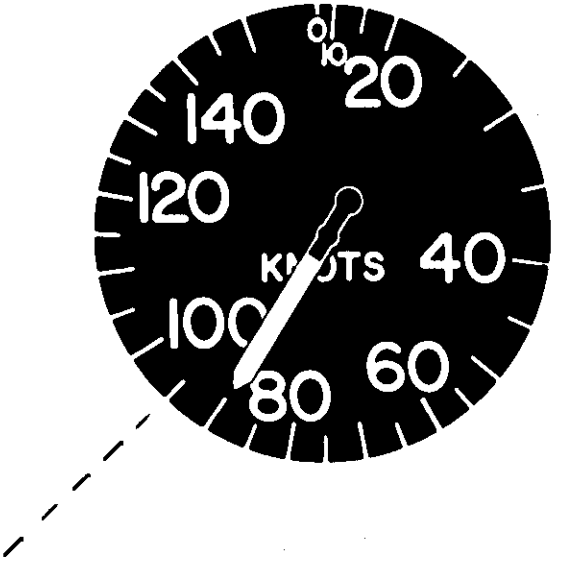
You are 100 percent correct. An increase in altitude will follow if no corrective action is taken; pitch attitude can also be verified by crosschecking the altimeter and attitude indicator.

The airspeed indicator gives an indirect reading of the pitch attitude. With a given power setting and the correct altitude, the aircraft is in level flight and the airspeed remains constant.

If the airspeed increases, the nose is:

High, page 22.

Low, page 23.

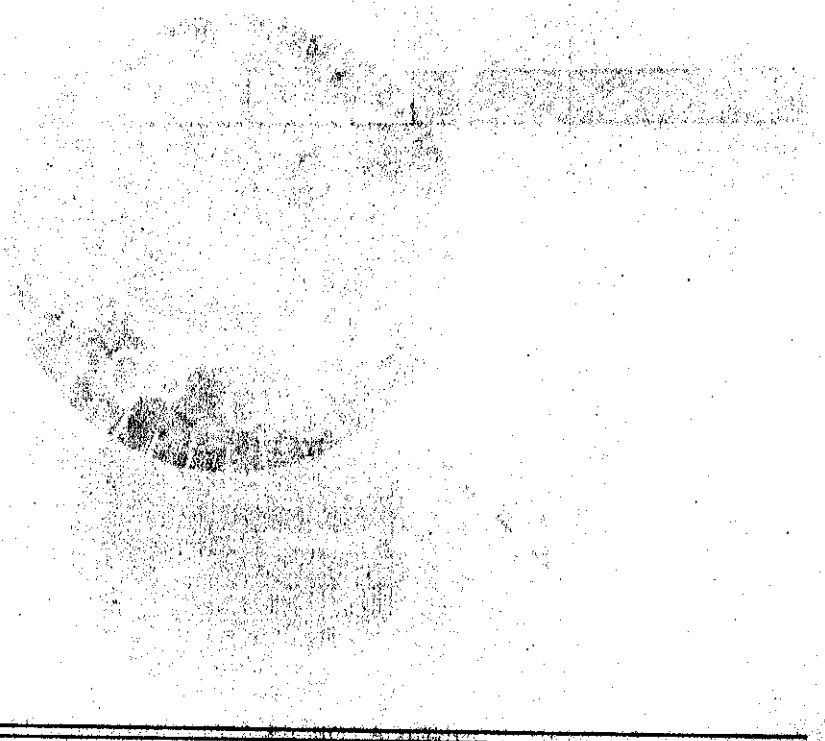


THE AIRSPEED INDICATOR AS A PITCH INDICATING INSTRUMENT

YOUR ANSWER: HIGH.

You're guessing. If the airspeed increases, the nose is low and should be raised. Any time the nose is lowered, an increase in airspeed will follow. A rapid change in airspeed indicates a large change in pitch; a slow change in airspeed indicates a small change in pitch.

Go back to page 21; read again and select another answer.



ANSWER TO SELF-TEST QUESTION NO. 14:

d. Climbing turn (left).

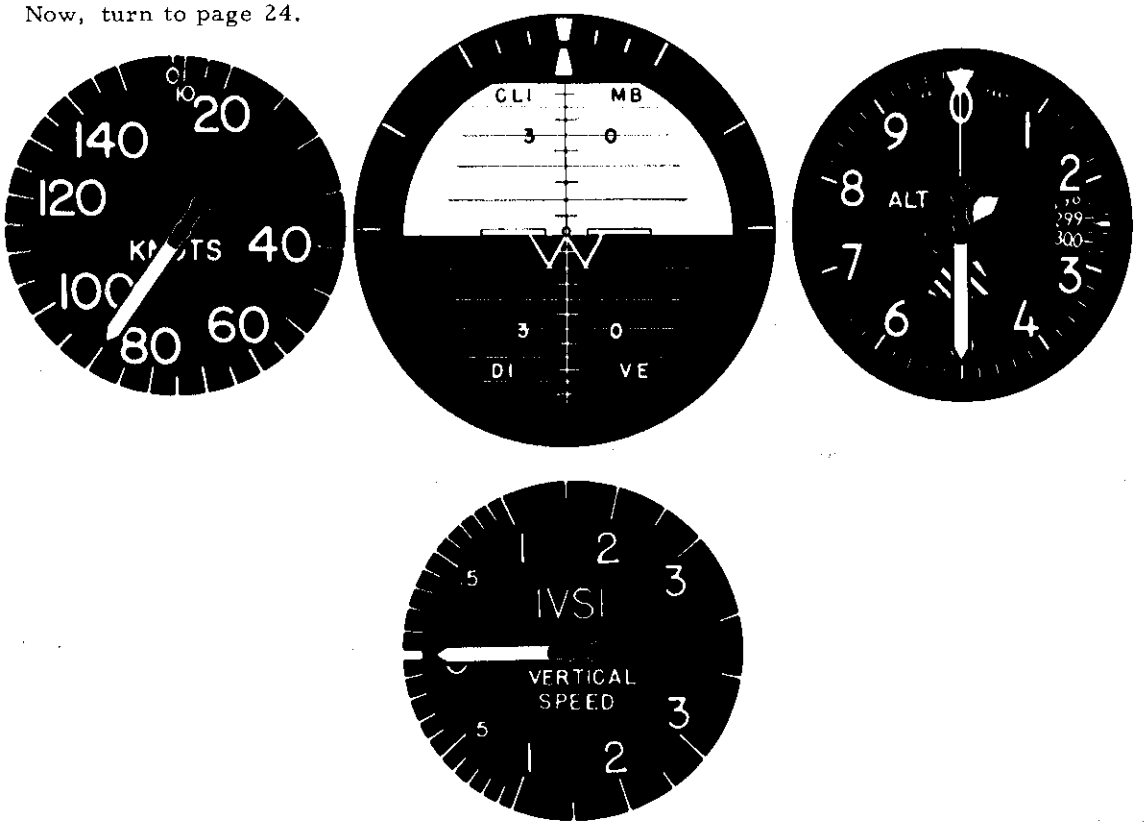
YOUR ANSWER: LOW.

Correct. A nose-low attitude will certainly cause the airspeed to increase if no corrective action is taken. If the nose is high, the airspeed will decrease requiring that the nose be lowered.

In review, remember that the four pitch attitude instruments are: altimeter, attitude indicator, vertical speed indicator, and airspeed indicator.

Regardless of which instrument shows a deviation, a correction must be applied with a continuing crosscheck to determine the effectiveness of the correction in maintaining a constant pitch attitude.

Now, turn to page 24.



ANSWER TO SELF-TEST QUESTION NO. 7:

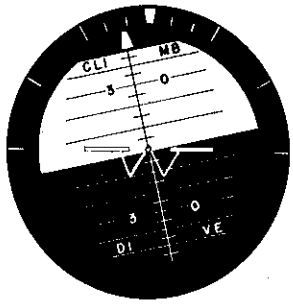
Attitude indicator, airspeed indicator, altimeter, and vertical speed indicator.

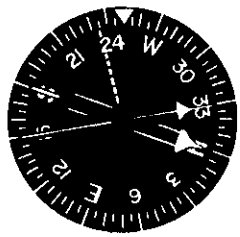
Earlier, we defined the banking or rolling attitude of an aircraft as the angular relationship of the lateral axis of the aircraft to the actual horizon. To maintain a straight course in visual flight, the aircraft must be kept level with the actual horizon. Instruments which indicate banking or rolling attitude are: attitude indicator, heading indicator, and turn-and-slip indicator. Which instrument gives an immediate indication of turning?

Attitude indicator, page 25.

Heading indicator, page 27.

Turn-and-slip indicator, page 26.





YOUR ANSWER: ATTITUDE INDICATOR.

No. The attitude indicator shows pitch and roll attitude directly. Of course, if a bank is indicated, a turn will follow; however, it does not give an immediate indication of turning.

Go back to page 24 and select a better answer.

ANSWER TO SELF-TEST QUESTION NO. 10:

a. Above.

b. Climb.

c. Low.

YOUR ANSWER: TURN-AND-SLIP INDICATOR.

No. The turn-and-slip indicator is a roll, rate, and trim instrument. The needle indicates the rate of turn; the ball of the indicator shows the quality of control coordination. It is also an aid in roll control. The question was, "Which instrument gives an immediate indication of turning?"

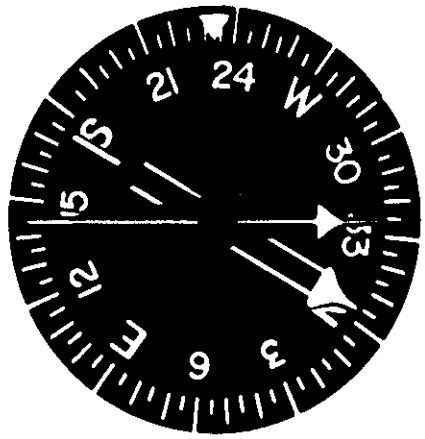
Pick another answer on page 24 and try again.

ANSWER TO SELF-TEST QUESTION NO. 9:

Roll, rate, and trim.

YOUR ANSWER: HEADING INDICATOR.

Absolutely. The heading indicator gives an immediate indication of turning. When available, the heading indicator is an important bank instrument during straight flight.



The banking attitude is shown directly on which of the following instruments?

1. Heading indicator, page 30.

2. Attitude indicator, page 29.

3. Turn-and-slip indicator, page 28.

ANSWER TO SELF-TEST QUESTION NO. 3:

Angular relationship between lateral axis of aircraft and actual horizon.

YOUR ANSWER: TURN-AND-SLIP INDICATOR.

Not really. The turn-and-slip indicator indicates rate and quality of turn. The banking attitude is not shown directly on the turn-and-slip indicator.

Try another solution on page 27.

ANSWER TO SELF-TEST QUESTION NO. 4:

The movement of the aircraft around the vertical axis.

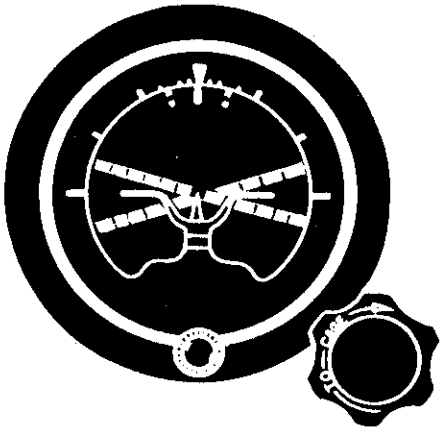
YOUR ANSWER: ATTITUDE INDICATOR.

Good thinking. The banking or rolling attitude is shown directly on the attitude indicator. If the aircraft starts to turn, the turn can be stopped by leveling the wings of the miniature aircraft with reference to the horizon bar.

The turn-and-slip indicator is a roll, rate, and trim instrument. Is this a true statement?

Yes, page 32.

No, page 31.



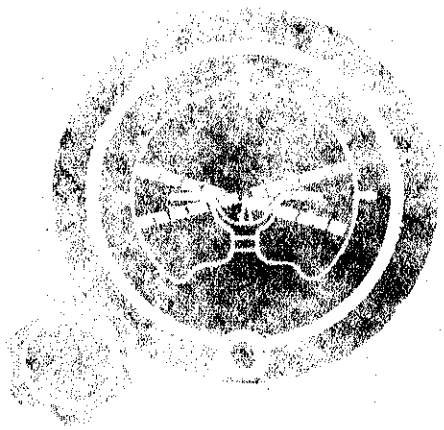
ANSWER TO SELF-TEST QUESTION NO. 11:

a. Attitude indicator.

YOUR ANSWER: HEADING INDICATOR.

Before agreeing or disagreeing, let's review momentarily. We just decided that the heading indicator gives an immediate indication of a turn. Indirectly, it shows bank if the aircraft is in trimmed flight, but the banking attitude is not shown directly on the heading indicator.

Turn back to page 27 and select the right answer.



YOUR ANSWER: NO.

Look at the question again. Roll, rate, and trim. Of course, it is a true statement. The needle shows rate and in trimmed flight with the ball centered; it is an excellent roll (bank) instrument. The ball is the quality control.

Now, turn to page 32.

YOUR ANSWER: YES.

A truer word was never spoken. The needle indicates rate of turn and thus is an aid for roll control. The ball of the indicator shows the quality of control coordination, whether in turning or straight flight. If the ball is off center, the aircraft is yawing (slipping or skidding).

A. SLIPPING

B. SKIDDING

C. BALANCED

All available bank instruments are used to indicate straight flight. In straight-and-level flight, a constant heading can be maintained by reference to the heading indicator and by keeping the wings level with reference to the attitude indicator. Without the heading or attitude indicator, straight flight can be maintained by reference to the turn-and-slip indicator.

As the use of each instrument is learned, should it be included in the crosscheck sequence?

Yes, page 34.

No, page 33.

ANSWER TO SELF-TEST QUESTION NO. 8:

Attitude indicator, heading indicator, and turn-and-slip indicator.

YOUR ANSWER: NO.

How could you say such a thing? Some of the primary reasons for a poorly executed maneuver are: failure to observe the appropriate instruments, omitting an instrument entirely from the crosscheck, placing too much emphasis on a single instrument, and gazing too long at the wrong instrument.

Please go on to page 34.

ANSWER TO SELF-TEST QUESTION NO. 12: Two of the following:

1. Failure to observe the appropriate instrument.
2. Omitting an instrument entirely from the crosscheck.
3. Placing too much emphasis on a single instrument.
4. Gazing too long at the wrong instrument.

YOUR ANSWER: YES.

By all means!

Remember, that proper crosschecking and instrument interpretation are vital, even in visual flight. During instrument flight, the instruments serve a dual purpose: reference of the attitude of the aircraft, and an indication of whether that attitude will produce the desired performance. Control technique is identical to that in visual flight. A good instrument pilot interprets instruments rapidly and accurately.

In straight-and-level flight, which controls are used for maintaining heading, altitude, airspeed, and trim?

Cyclic, page 35.

Collective, page 37.

Cyclic, collective, pedals, page 36.

YOUR ANSWER: CYCLIC.

Yes, up to a point. However, the cyclic only controls heading and altitude and of course changes in pitch attitude affect the airspeed.

Turn back to page 34 and select a better answer.

ANSWER TO SELF-TEST QUESTION NO. 13:

a. Pitch attitude control - 3 cyclic.

b. Roll attitude control - 3 cyclic.

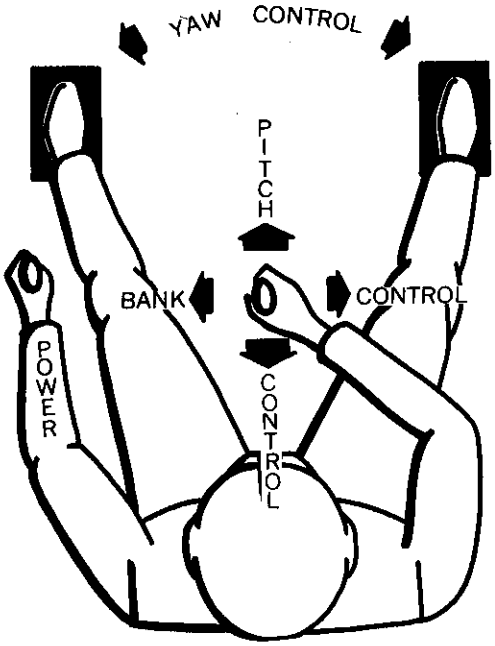
c. Yaw control - 2 pedals.

d. Power control - 1 collective.

YOUR ANSWER: CYCLIC, COLLECTIVE, PEDALS.

Certainly, all controls are needed during straight-and-level flight; heading and altitude are maintained with cyclic control, airspeed with power, and trim with pedals. Power is used to adjust variations of altitude only if the desired altitude cannot be maintained by varying pitch attitude without exceeding ±10 knots airspeed. (100 feet altitude variation or greater: use power adjustment.)

Turn to page 38.



POWER, PITCH, AND BANK CONTROL

YOUR ANSWER: COLLECTIVE.

Only partly right; collective in straight-and-level flight is used to control airspeed. It certainly isn't used for heading or trim control.

Try again by selecting the correct answer on page 34.