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1. The Knowledge Requirement

WHAT THIS SECTION COVERS

Why human factors knowledge is mandatory for flight crew, who else benefits, and the scale of human error in aviation accidents.

Part 2 of the Air Regulations book is designed to meet the **ICAO requirements** of human factor knowledge for the flight crew. The relevant portions of the information are also useful to other key aviation personnel:

- Cabin Crew
- Air Traffic Controllers (ATCs)
- Maintenance personnel

Why the Human Element Matters

The human element is the **most flexible, adaptable and valuable** part of the aviation system — but it is also the **most vulnerable** to influences which can adversely affect its performance.

KEY STATISTIC — ACCIDENT CAUSATION

Throughout the years, **three out of four** accidents have resulted from less than optimum human performance. This has commonly been classified as *human error*.

Human errors are now considered as being **inherent to the cognitive function** of humans and are **generally inescapable**. A sound understanding of Human Performance and Limitations will help enhance performance and safety.

EXAM TIP

Remember the framing: human error is **not** a moral failing or laziness — it is an inherent cognitive feature. The objective of HPL training is to *manage* error, not eliminate it.

QUICK REVISION — SECTION 1

- Part 2 of Air Regulations meets **ICAO** human factor knowledge requirements.
- Relevant to: Flight Crew, Cabin Crew, ATCs, Maintenance.
- **3 out of 4** accidents result from less-than-optimum human performance.
- Human error is **inherent** and **generally inescapable**.

2. Disciplines Frequently Involved in Human Factors Activities

WHAT THIS SECTION COVERS

The multidisciplinary nature of Human Factors and the academic fields contributing to it.

Human Factors are **multidisciplinary in nature**. Information is drawn from many fields:

- **Psychology** — to understand how people process information and make decisions.
- **Psychology & Physiology** — sensory processes for detecting and transmitting information.
- **Anthropometry & Bio-mechanics** — body measures & movement for optimizing flight deck and cabin design.
- **Biology & Chronobiology** — body rhythms and sleep, effects in night flying and time-zone changes.
- **Statistics** — proper analysis or presentation of data from surveys/studies.

PRACTICAL ORIENTATION

Human Factors is **practical in nature**; it is **problem-oriented** rather than discipline-centered. It exists to solve real-world aviation problems.

Scope of Disciplines

Human Factors disciplines are **inclusive of, but not limited to**:

- Psychology
- Engineering
- Physiology
- Sociology

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- Anthropometry

Other disciplines with active representatives in Human Factors activities include:

- Education
- Physics
- Biochemistry
- Mathematics
- Biology
- Industrial design
- Operations research

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2.1 Disciplines Table (Authoritative)

Discipline	Definition	Specific Area of Interest	Typical Area of Application
Psychology	The science of mind and behavior.	Sensory characteristics, perceptual laws, learning principles, information processing, motivation, emotion, research methods, psychomotor skills, human errors.	Display requirements and design, control systems design, allocation of function, training systems requirements and methods, selection methods, effects of emotional and environmental stress on performance, simulation requirements.
Engineering	Applying the properties of matter and the sources of energy in nature to the uses of man.	Hydraulics, mechanical, structural, electrical, electronic, and aerodynamics design, systems analysis, simulation, optics.	Design of displays, design of controls, design of control systems, design of complex systems, design of optical systems, simulator design.
Human Physiology	Deals with the processes, activities, and phenomena characteristic of living matter, particularly appropriate to healthy or normal functioning.	Cell structure and chemistry, organ structure and chemistry, interaction of the various body constituents to promote health and function, functions and requirements of body systems.	Environmental systems, diet and nutrition, effects of environmental factors (heat, cold, hypoxia), establishment of environmental requirements.
Medicine	The science and art of preventing, alleviating, or curing disease and injuries.	Effects of various forces, radiation, chemical and disease agents; appropriate preventive methods of protecting health and well-being.	Toxicology of smoke, chemicals, impact protection, maintenance of health.

Discipline	Definition	Specific Area of Interest	Typical Area of Application
Sociology	The study of the development, structure, and function of human groups.	Small and large groups or "teams"; crew composition; behavior of passengers in emergency situations.	Crew selection, passenger safety.
Anthropometry	Study of human body sizes and muscle strength.	Anatomy, biodynamics, kinesiology.	Ground support equipment, access door size for maintenance, work station layout (reach, range of adjustment of seats, etc.)

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2.2 Visualising the Multidisciplinary Web

```
flowchart TD
    HF([HUMAN FACTORS  
Problem-Oriented])
    HF --> PSY[Psychology  
mind & behavior]
    HF --> ENG[Engineering  
design & systems]
    HF --> PHY[Physiology  
body function]
    HF --> MED[Medicine  
health & injury]
    HF --> SOC[Sociology  
teams & groups]
    HF --> ANT[Anthropometry  
body size & reach]
    HF --> OTH[Other fields:  
Education, Physics,  
Biochemistry, Maths,  
Biology, Industrial Design,  
Operations Research]
```

```
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```

QUICK REVISION — SECTION 2

- HF is **multidisciplinary** & **problem-oriented**.
- Core 5: **Psychology, Engineering, Physiology, Sociology, Anthropometry**.
- Plus: Medicine, Education, Physics, Biochemistry, Maths, Biology, Industrial Design, Operations Research.
- Memory aid: "*Pilots Eat Pizza, So Always*" → **P**sychology, **E**ngineering, **P**hysiology, **S**ociology, **A**nthropometry.

3. Qualities of a Professional Pilot

WHAT THIS SECTION COVERS

The DGCA-recognised attributes that define a professional pilot — examinable as a list and as conceptual groupings.

The source lists the following **qualities of a professional pilot**:

1. Situation awareness
2. Flexibility
3. Task management
4. Effective communications
5. Threat and error management
6. High sense of responsibility
7. Aircraft handling skills
8. Sound knowledge of flying theory
9. Motivation
10. Physical fitness
11. Reliability
12. Balanced personality
13. Teamwork
14. Stress management
15. Quick reflexes

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16. Risk assessment capabilities
17. Decision making
18. Crew resource management

3.1 Grouping for Easier Recall

Cluster	Qualities
Cognitive / Mental	Situation awareness, Decision making, Risk assessment, Sound knowledge of flying theory, Threat & error management
Behavioural / Personal	Motivation, Reliability, High sense of responsibility, Balanced personality, Flexibility
Operational / Skill	Aircraft handling skills, Quick reflexes, Task management, Stress management
Social / Team	Effective communications, Teamwork, Crew Resource Management (CRM)
Physical	Physical fitness

STANDARD PRACTICE

A professional pilot continually develops these qualities through structured training, recurrent checks, simulator exercises and personal reflection. CRM training in particular is mandated for two-crew operations.

MEMORY AID — "SAFE PILOT"

Situation awareness · Aircraft handling · Flexibility · Effective communication · Physical fitness · Informed decision making · Leadership (teamwork/CRM) · Organisation (task management) · Threat & error management.

QUICK REVISION — SECTION 3

- 18 qualities listed by DGCA source — learn the full list verbatim.
- Five mental groupings: **Cognitive, Behavioural, Operational, Social, Physical**.
- Critical examinable items: SA, CRM, Decision Making, Threat & Error Management.

4. Causes of Aircraft Accidents

WHAT THIS SECTION COVERS

The base rate of accidents in commercial aviation, the dominant role of human factors, the specific deficiencies cited, and the most common form of accident.

4.1 Accident Rate

ACCIDENT RATE — COMMERCIAL AVIATION

The rate of accidents in commercial aviation (*excluding sabotage and acts of terrorism*) is approximately **1 accident per million airport movements**.

4.2 Human Performance as Root Cause

Most aircraft accidents are linked to deficiencies in human performance. These deficiencies may involve a variety of factors. The factors include:

- Poor lookout
- Situation awareness (SA)
- Decision-making
- Task organization
- Communication
- Failure to recognize threats to safety
- The commission of errors

4.3 Most Common Form of Air Accident

CRITICAL EXAM POINT

Controlled Flight Into Terrain (CFIT) is the **most common form of air accident**.

CFIT occurs when an airworthy aircraft, under the control of a qualified pilot, is flown unintentionally into terrain, water, or an obstacle — usually with no prior awareness by the crew. Because the aircraft is functioning normally, CFIT is overwhelmingly a **human factors** accident category (loss of situation awareness, poor decision-making, communication breakdown, navigation errors).

```

flowchart LR
    A[Accident Trigger] --> B{Aircraft  
Airworthy?}
    B -- No --> X[Technical Failure  
Mechanical Accident]
    B -- Yes --> C{Crew Aware  
of Threat?}
    C -- Yes --> D[Recoverable  
or Avoidable]
    C -- No --> E[CFIT  
Controlled Flight  
Into Terrain]
    E --> F[Human Factors  
Dominant Cause]

```

```

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style D fill:#e8f5e9,stroke:#2e7d32

```

COMMON CONFUSION

Don't confuse **CFIT** (Controlled Flight Into Terrain — aircraft serviceable) with **LOC-I** (Loss Of Control In-flight — aircraft departs controlled flight). Both are human-factors heavy, but CFIT is explicitly named in the syllabus as "the most common form" — that's the testable phrase.

QUICK REVISION — SECTION 4

- Accident rate: **~1 per million airport movements** (excluding sabotage & terrorism).
- Most accidents linked to **deficiencies in human performance**.
- Specific factors: poor lookout, SA, decision-making, task organization, communication, failure to recognise threats, commission of errors.
- **CFIT is the most common form of air accident.**

5. Human Factors — Physiological Demands & Adaptation

WHAT THIS SECTION COVERS

The environmental stresses imposed by flight, the body's compensatory mechanisms, and the absolute limit of oxygen deprivation.

5.1 Environmental Changes of Greatest Physiological Significance

In aviation, the demands upon the **compensatory mechanisms** of the body are numerous and of considerable magnitude. The environmental changes of greatest physiological significance involved in flight are:

- a) marked changes in barometric pressure,*
- b) considerable variation in temperature, and*
- c) movement at high speed in three dimensions.*

The **limiting factors** in adjustment of the human body to flight must be appreciated.

5.2 The Body's Remarkable Adaptive Capacity

Human beings have the remarkable ability to adapt to their environment. The human body:

- Makes adjustments for changes in **external temperature**.
- Acclimates to **barometric pressure variations** from one habitat to another.
- Compensates for **motion in space** and **postural changes** in relation to gravity.
- Performs all these adjustments **while meeting changing energy requirements** for varying amounts of physical and mental activity.

5.3 Compensating for Reduced Oxygen Supply

The human body can adjust to **acute and chronic reductions** in its oxygen supply by:

1. Increasing respiratory rate
2. Chemical changes in the blood
3. Increasing the production of red blood cells

```

graph TD
    A["A[Reduced Oxygen Supply  
Acute or Chronic]"] --> B["B[Body Compensation]"]
    B --> C["C[1. Increased  
Respiratory Rate]"]
    B --> D["D[2. Chemical Changes  
in Blood]"]
    B --> E["E[3. Increased  
Red Blood Cell Production]"]
    C --> F["F([Restored O2 Delivery])"]
    D --> F
    E --> F
    F -- "F -. Failure / Total Absence .->" --> G["G[Death in  
5-8 minutes]"]

    style A fill:#fff8e1,stroke:#f57c00
    style B fill:#e8f1fb,stroke:#2c5aa0
    style F fill:#e8f5e9,stroke:#2e7d32
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```

ABSOLUTE PHYSIOLOGICAL LIMIT

As efficient as the body is, a **complete absence of oxygen** will cause death in approximately **5 to 8 minutes**.

5.4 Why HPL Training is Mandatory

THE 73% STATISTIC

Human factors are cited as a **major cause in over 73% of accidents**. This figure **has not changed since the 1950's**.

If the accident rate is to be decreased, Human Factors issues in aviation must be:

- Better understood, and
- Human Factors knowledge more broadly and proactively applied.

TRAINING OBJECTIVES

It is necessary that a better understanding of human capabilities and limitations — **both physical and psychological** — are known to aviators. It is also necessary for the flight crew personnel to train to ensure:

- Safe and efficient operation
- Reducing error
- Avoiding stress
- Increasing efficiency

Worked Example — Oxygen-Free Survival Window

Scenario: Rapid cabin depressurisation at FL350 with both pilots experiencing simultaneous oxygen mask failure (a worst-case *complete absence of oxygen* at altitude).

Available time before death: **5 to 8 minutes** (per source).

However — Time of Useful Consciousness (TUC) at FL350 is only ~30–60 seconds, far shorter than the death window. **Useful actions (donning mask, initiating emergency descent) must be completed within seconds, not minutes.**

Lesson: The "5–8 minutes to death" figure does not mean you have 5–8 minutes to act. Useful function ends in well under a minute at cruising altitudes — hence the absolute priority of the "Oxygen Mask — ON, 100%" memory item.

QUICK REVISION — SECTION 5

- Three flight environment stressors: **barometric pressure, temperature, high-speed 3-D motion.**
- Body adjusts to: temperature, pressure, motion, posture, energy demand.
- Oxygen compensation: ↑ **respiratory rate, blood chemistry change, ↑ RBC production.**
- Complete oxygen absence → death in **5–8 minutes**.
- Human factors cause **>73%** of accidents — unchanged since the **1950's**.

6. Accident Distribution by Phase of Flight

WHAT THIS SECTION COVERS

The recreated DGCA chart of accident percentages versus phase of flight, with the critical insight that *accident risk is wildly disproportionate to flight time*.

6.1 The Headline Insight — Risk vs. Time

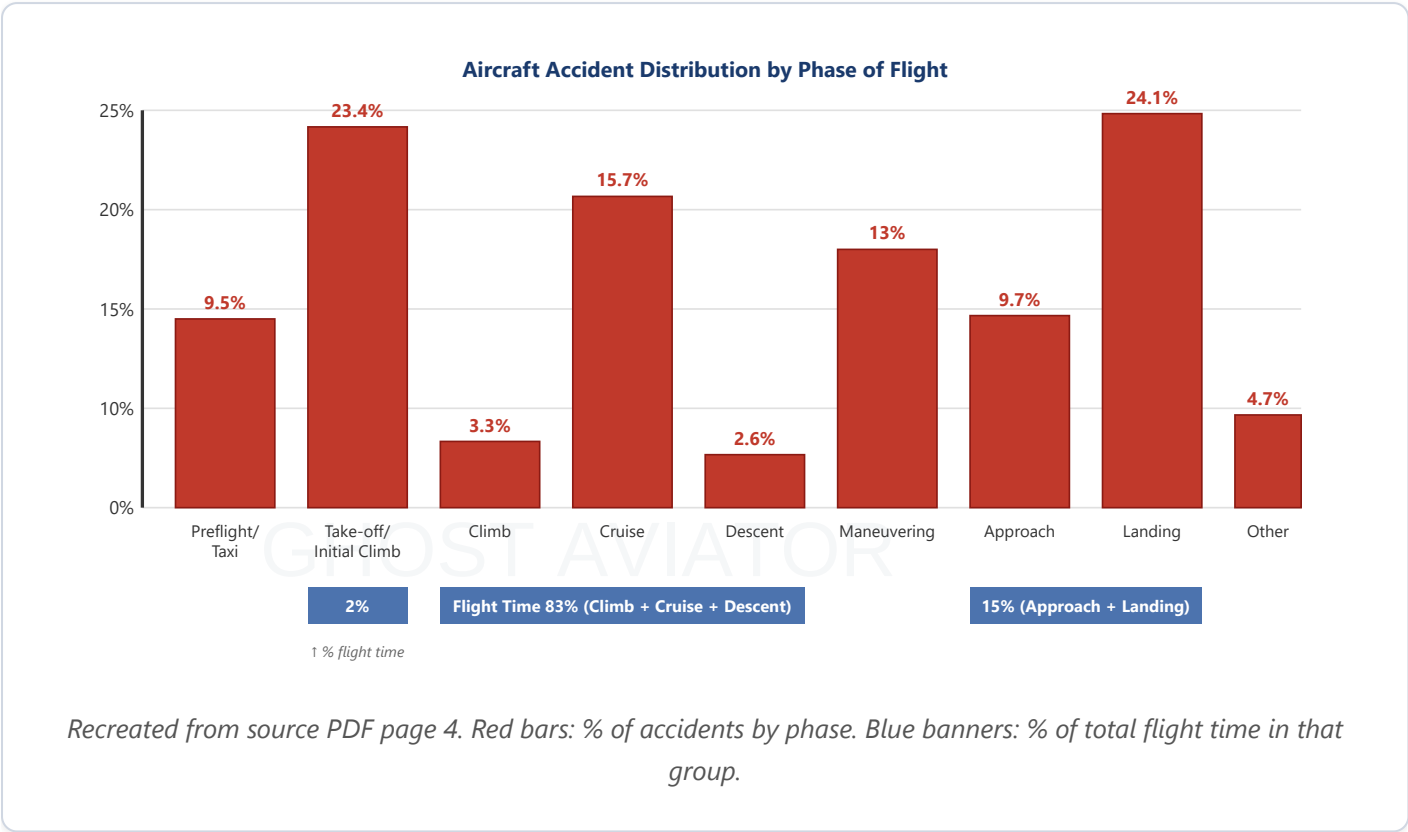
Phase Group	% of Flight Time	% of Accidents	Risk Indicator
Take-off & Initial Climb	2%	23.4%	Disproportionately high
Cruise (Climb + Cruise + Descent)	83%	~21.6%	Low (relative to time)
Approach & Landing	15%	~33.8%	Disproportionately high

CRITICAL PATTERN

Only **17%** of flight time (take-off + approach + landing) accounts for the majority of accidents. Conversely, the cruise — comprising **83%** of flight time — sees a far smaller share. The take-off and landing phases are the highest-risk operational windows.

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6.2 Phase-by-Phase Accident Percentages (DGCA chart, recreated)



6.3 Numerical Breakdown

Phase	% of Accidents	Rank (highest = 1)
Landing	24.1%	1
Take-off & Initial Climb	23.4%	2
Cruise	15.7%	3
Maneuvering	13%	4
Approach	9.7%	5
Preflight / Taxi	9.5%	6
Other	4.7%	7
Climb	3.3%	8
Descent	2.6%	9

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EXAM TIP — "MOST ACCIDENTS TAKE PLACE DURING..."

The DGCA-correct answer is **Approach and Landing**. Even though "Take-off and Initial Climb" is a single very high figure (23.4%), the combined Approach + Landing phases ($9.7\% + 24.1\% = 33.8\%$) represent the largest share of all accidents.

SOP IMPLICATION

The "sterile cockpit" rule below **10,000 ft** exists precisely because approach/landing and take-off/climb dominate the accident statistics. Crew workload management and discipline in these phases is the single biggest accident-prevention lever.

QUICK REVISION — SECTION 6

- Flight time split: T/O+Climb **2%** | Cruise group **83%** | App+Landing **15%** .
- Highest accident phase: **Landing (24.1%)**, followed by Take-off/Initial Climb (23.4%).
- Combined Approach + Landing = **33.8%** → "Most accidents take place during Approach and Landing."
- Cruise sees only 15.7% of accidents despite occupying most flight time.

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Practice Questions & Detailed Answers

5 MCQs from source · Each with correct answer, full explanation, distractor analysis, and instructor's note

HOW TO USE THIS SECTION

Attempt each question *before* reading the answer. If you got it wrong, read the explanation and the distractor analysis — that is where the deepest learning happens. Use the anchor links to revisit the relevant study section for any concept you are unsure of.

Q1. As a cause of accidents, the human factor:

- A. Is cited in approximately 73% of aviation accidents.
- B. Has increased accidents exponentially since 1970.
- C. Has been generally due to high workload in the cockpit.

✓ Correct Answer: **(A)** Is cited in approximately **73%** of aviation accidents.

Explanation: The source explicitly states: "Human factors are cited as a major cause in over **73%** of accidents. This figure has not changed since the 1950's." This is the single most frequently tested numerical fact in the HPL syllabus.

→ [See Section 5.4 above for full context](#)

Why the other options are wrong:

- **(B)** — The source says the figure has *not changed since the 1950's*, meaning the human-factors share has been **stable**, not increasing exponentially. The proportion has held steady even as absolute accident rates have improved.
- **(C)** — High workload is one contributing factor among many (others include poor lookout, SA, decision-making, communication, task organization). Reducing human-factors causation to "high workload" alone is too narrow and is not what the source states.

Instructor's Note: Memorise the exact phrase — "human factors cited in approximately 73% of accidents" and "unchanged since the 1950's." The combination of high percentage + stable over decades is the testable concept: even with advances in technology, the human element remains the dominant accident factor.

Q2. The rate of accidents in commercial aviation:

- A. Is approximately 52 accidents per million airport movements.
- B. Has worsened considerably since 1970.
- C. Is approximately 1 accident per million airport movements.

✓ Correct Answer: **(C)** Is approximately **1 accident per million airport movements** .

Explanation: The source states verbatim: "The rate of accidents in commercial aviation (excluding sabotage and acts of terrorism) is approximately **1 accident per million airport movements** ." The qualifier "excluding sabotage and acts of terrorism" is important — accident statistics do not count deliberate hostile acts.

→ [See Section 4.1 above](#)

Why the other options are wrong:

- **(A)** — 52 per million is wildly higher than the actual rate. Commercial aviation is one of the safest forms of transport precisely because the rate is around 1 per million, not 52.
- **(B)** — Commercial aviation safety has *improved* dramatically since 1970, not worsened. While the human-factors *proportion* of accidents has stayed constant (~73%), the absolute accident rate has fallen significantly.

Instructor's Note: Watch for examiners using slightly varied phrasing: "per million flights," "per million airport movements," "per million departures." The DGCA source uses "**per million airport movements**" — quote that exact unit.

Q3. The most common specific cause of pilot-induced accidents is:

- A. Poor pre-flight planning.
- B. Hypoxia.
- C. Controlled Flight Into Terrain (CFIT).

✓ Correct Answer: **(C)** Controlled Flight Into Terrain (CFIT).

Explanation: The source states verbatim: "Controlled Flight Into Terrain (CFIT) is the most common form of air accident." CFIT happens when a fully airworthy aircraft, with a qualified pilot at the controls, is unintentionally flown into terrain, water or an obstacle — almost always due to loss of situation awareness, poor navigation, or communication breakdown.

→ [See Section 4.3 above](#)

Why the other options are wrong:

- **(A) Poor pre-flight planning** — A contributing factor in many accidents, but not classified by the source as the "most common form." It is one of several deficiencies, not the dominant category.
- **(B) Hypoxia** — A serious physiological hazard at altitude, but a relatively rare *cause* of accidents compared to CFIT. Hypoxia accidents occur but they are not the most common form.

Instructor's Note: The DGCA terminology is "**most common form of air accident**" → CFIT. Don't be confused by modern industry reports that may rank Loss of Control In-flight (LOC-I) higher in fatality counts — for the DGCA RTR/HPL exam, the source defines CFIT as the most common form. Stick to the source.

Q4. Most of the accidents take place during:

- A. Cruise.
- B. Approach and Landing.

C. Take off and initial climb.

✓ Correct Answer: **(B)** Approach and Landing.

Explanation: Reading the source chart of accident phase distribution:

- Landing: **24.1%**
- Approach: **9.7%**
- **Approach + Landing combined: 33.8%**
- Take-off + Initial Climb: **23.4%**
- Cruise: **15.7%**

Approach and Landing together account for the largest share of all aircraft accidents — despite this group occupying only ~ **15%** of total flight time.

→ See Section 6.2 chart and 6.3 table above

Why the other options are wrong:

- **(A) Cruise** — Cruise is the longest phase by time (~**83%** of flight time including climb & descent) but accounts for only ~ **15.7%** of accidents. It is one of the *lowest* risk phases per unit time.
- **(C) Take-off and initial climb** — A very high-risk phase at **23.4%** of accidents in only **2%** of flight time, but smaller in absolute share than Approach + Landing combined (**33.8%**).

Instructor's Note: Two facts to keep separate: (1) Highest risk per unit time = Take-off & Initial Climb (23.4% of accidents in just 2% of time). (2) Largest absolute share of accidents = Approach & Landing combined (33.8%). The DGCA exam question "Most accidents take place during..." is asking for absolute share, so the answer is **Approach and Landing**.

Q5. Most aircraft accidents are linked to:

A. Deficiencies in human performance.

- B. Technical failures.
- C. Adverse weather conditions.

✓ Correct Answer: **(A)** Deficiencies in human performance.

Explanation: The source states verbatim: "Most aircraft accidents are linked to deficiencies in human performance." This connects directly to the **73%** statistic — human factors are the dominant root cause. The specific deficiencies named include poor lookout, situation awareness, decision-making, task organization, communication, failure to recognize threats, and the commission of errors.

→ See Section 4.2 above

Why the other options are wrong:

- **(B) Technical failures** — Modern aircraft are highly reliable. Pure mechanical/technical failures account for a small minority of accidents — well under 30% — and even when technical issues occur, the accident often becomes "human factors" because of how the crew managed the failure.
- **(C) Adverse weather** — Weather can be a contributing factor, but the underlying cause is usually a human *decision* to fly into, around, or below the conditions. Weather alone rarely defeats a sound crew decision and procedure.

Instructor's Note: Q5 is the conceptual sibling of Q1. Q1 asks for the percentage (73%); Q5 asks for the category (deficiencies in human performance). Both point to the same core truth: the human element is the dominant accident factor. Memorise both formulations.

Master Reference Tables & Answer Key

A. Consolidated Numerical Reference

Value	What it refers to	Section
3 out of 4	Accidents resulting from less-than-optimum human performance	§1
~1 per million	Accident rate per million airport movements (commercial aviation, excluding sabotage & terrorism)	§4.1
>73%	Accidents in which human factors are a major cause	§5.4
1950's	Year since when the 73% human-factors figure has not changed	§5.4
5 to 8 minutes	Time to death with complete absence of oxygen	§5.3
2%	Flight time spent in Take-off & Initial Climb	§6.1
83%	Flight time spent in Climb + Cruise + Descent group	§6.1
15%	Flight time spent in Approach & Landing	§6.1
23.4%	Accidents in Take-off / Initial Climb	§6.3
24.1%	Accidents in Landing (highest single phase)	§6.3
9.7%	Accidents in Approach	§6.3
15.7%	Accidents in Cruise	§6.3
13%	Accidents in Maneuvering	§6.3
9.5%	Accidents in Preflight / Taxi	§6.3
4.7%	Accidents — Other	§6.3
3.3%	Accidents in Climb	§6.3

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Value	What it refers to	Section
2.6%	Accidents in Descent	§6.3
33.8%	Combined Approach + Landing accidents (derived)	§6.3

B. Mnemonics & Memory Aids

Mnemonic	Stands for	Use it for
P-E-P-S-A ("Pilots Eat Pizza, So Always")	Psychology · Engineering · Physiology · Sociology · Anthropometry	Core 5 disciplines in Human Factors
SAFE PILOT	SA · Aircraft handling · Flexibility · Effective comms · Physical fitness · Informed decisions · Leadership · Organisation · Threat/error mgmt	Qualities of a professional pilot
"3 P's" of flight stress	Pressure · Posture (motion 3-D) · "Phahrenheit" (temperature)	Three environmental changes of greatest physiological significance
"R-C-R"	Respiration ↑ · Chemistry of blood · Red cell production ↑	How the body compensates for reduced O ₂
"5 to 8 — don't be late"	5–8 minutes to death with no oxygen	Anchor the absolute O ₂ -deprivation limit
"73 since '53"	73% human-factors cause, unchanged since the 1950's	Headline accident-causation statistic

C. Quick Definitions Glossary

Term	Definition (per source)
Psychology	The science of mind and behavior.
Engineering	Applying the properties of matter and the sources of energy in nature to the uses of man.
Human Physiology	Deals with the processes, activities, and phenomena characteristic of living matter, particularly appropriate to healthy or normal functioning.
Medicine	The science and art of preventing, alleviating, or curing disease and injuries.
Sociology	The study of the development, structure, and function of human groups.
Anthropometry	Study of human body sizes and muscle strength.
CFIT	Controlled Flight Into Terrain — the most common form of air accident.
Human Factors	Multidisciplinary, problem-oriented field concerned with solving practical human-performance problems in aviation.

D. Answer Key — Quick Self-Test Review

Q.No.	Correct Option	Topic	Section
1	A	Human factor cited in ~73% of accidents	§5.4
2	C	~1 accident per million airport movements	§4.1
3	C	CFIT — most common form	§4.3
4	B	Approach & Landing — largest accident share	§6
5	A	Deficiencies in human performance	§4.2

FINAL WORD

The single biggest takeaway from Chapter 23: **Human performance is the dominant variable in aviation safety.** Aircraft are extraordinarily reliable; weather is largely forecastable; what remains is the human — flexible and valuable, yet vulnerable. Mastering human factors knowledge is therefore not academic; it is the highest-leverage thing a professional pilot can do for safety.

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