135 Bell-Irving Squadron

Level Two Handbook

PO 203 – Leadership

Part 1 – Leadership & Goal Setting for Level Twos

Within junior leadership, there are responsibilities for a Level Two cadet at the squadron. To make the second year of cadets a fun, challenging and dynamic experience, second year cadets should know their responsibilities.

There are some responsibilities common to every Level Two cadet in the squadron. They are:

Following the Chain of Command. Following the chain of command ensures that all information that must be passed up and down the chain is delivered. Following the chain of command prevents gaps in the information flow.

Setting the Example. A Level Two cadet must set a personal example in dress and deportment. A good leader will never ask more of their followers and teammates than they are willing to give themselves.

Being Firm, Fair and Friendly With Everyone, Especially New Recruits. No one is impressed with a Level Two cadet who yells, least of all new cadets. A highly influential and respected Level Two cadet is one who is consistent in their approach to people and each situation. Being approachable at all times should enable the cadet to fulfill all duties and responsibilities in an effective manner.

Being Respectful to Superiors and Subordinates. Using a proper tone of voice, looking people in the eyes when they speak and standing up straight is a physical way to show respect. If the Level Two cadet wishes to be treated with respect, they must display respect toward others.

Being Aware of Safety Hazards.

Displaying Initiative. Undertaking small matters, like cleaning up, before being told to do so is an example of using initiative. Superiors notice when small tasks are completed without any request to do so.

Setting Goals. Every leader needs to set goals. Goals allow people the opportunity to turn ideas into results. A goal is a glimpse of the future. Setting goals like improving their drill, dress and deportment, gives Level Two cadets something to strive for. By setting goals, and working towards them, a Level Two cadet will show commitment.

Answer the following questions on a separate piece of paper, using the information above.

1. List the responsibilities of Level Two cadets in the Squadron.
2. Why is setting goals important for a Level Two cadet?
3. Write down 1 short-term goal that you have as a Cadet that can be achieved within four weeks. Write down 1 long-term goal that you have as a Cadet that you can achieve by the end of the training year.

Part 2 – Principles of Leadership

Leadership is a demonstrable skill. This means it can be displayed and observed. Leadership can be learned and the skills involved can be improved with practice. Within leadership, there are set of principles that may be used to improve leadership ability.

Leadership is influence. The ability to influence others is fundamental within the leadership process. Everyone influences someone. People are influenced by those around them on a daily basis: friends, family, teachers, newsmakers, athletes, etc all influence others. In turn, those same people are influenced.

Influence can be positive or negative. There are many people who use their influence in a positive manner and while doing so help their community, their school, their family, and the world around them. There are some people who use their influence in a negative manner and while doing so do not help anyone including themselves.

Leadership can create opportunities in life. Qualities of leadership are learned and practiced, therefore improving your ability to lead may create opportunities in life. Through the Cadet Program cadets may be given many occasions to lead. Success in a leadership role may lead to greater leadership opportunities with bigger challenges, more responsibility, rewards, etc.

Answer the following questions on a separate piece of paper, using the information above.

1. Why is leadership a demonstrable skill?
2. Success in a leadership role may lead to what?
3. Describe what types of things could be considered being a positive influence in your community.
4. Describe a situation where you have used your influence to help the environment or to help your community.
5. Describe what types of things youth at your age could do in your community to be positive influence.

Part 3 – Effective Communication

Effective communication is a critical skill for leaders in a peer setting. Communication is the exchange of thoughts, messages and information. It is the process of sharing knowledge, interests, attitudes, opinions, feelings and ideas with others. Through communication one person can influence others. Effective communication may also be used to resolve and/or reduce problems and conflict.

Like any skill, the ability to communicate with competence must be learned and developed over a lifetime. Communication skills permit the flow of ideas from one individual to another or to a group, and vice versa. The process of communication can include both verbal and non-verbal messages.

Non-Verbal Communication

Non-verbal communication uses many channels for sending and receiving information. Information is received through all our senses (taste, sight, smell, touch and sound). Some aspects of non-verbal communication include:

Eye Contact. Looking directly at another person when speaking is an effective way of indicating sincerity and getting someone's attention.

Body Posture. The weight of the message being sent will be increased when facing the person being spoken to, standing or sitting closer to them and leaning forward. Using correct body posture when listening is also an effective way of indicating interest in the conversation.

Gestures. A message that has a body gesture attached to it takes on added emphasis.

Facial Expressions. When making a statement, make sure facial expressions agree with the message.

Voice Tone, Volume Changes. Shouting may cause people to become defensive, just a whispering may cause people to tune out the message. Make sure voice levels are correct for the space and that statements are convincing without being intimidating.

Being able to read non-verbal responses to communication, while leading in a peer setting, may help cadets understand how they are being perceived.

Sending, Receiving & Responding to Messages
Communication consists of three things: sending, receiving and responding to a message.

The sender must deliver a clear message, taking into consideration the characteristics of the individual(s) receiving the message. Is the person a child or an adult? Is there one person, or are there 20? These and similar factors all determine how the message should be sent.

Next, the message is received. It is important to remember that receivers translate what they have heard based on their own set of definitions, which may differ greatly for those of the sender.

The final component of communication is response. A response lets the sender know the message has been received. All three parts are necessary for effective communication.

Styles of Communication
Aggressive Communication. A person who is an aggressive communicator puts their own wants and needs ahead of everyone else and they often ignore or belittle other people's concerns.
Aggressive communicators often:
- talk over people and interrupt;
- make sarcastic, demeaning or threatening remarks;
- consider only their own point of view; or
- stand too close, lean over you or in some other way make you feel physically uncomfortable.

Aggressive communication usually leads to hostility, anger and resentment.

Passive Communication. A person who is a passive communicator puts other people's wants and needs ahead of their own and often denies what they want or need.
Passive communicators often:
- hardly ever say what they want or need;
- let others make decisions for them;
- avoid conflict and disagreement at all costs; and
- drop hints rather than directly request that something gets done.

Passive communication usually leads to bad feelings and damages relationships.

Assertive Communication. A person who is an assertive communicator uses skills based on mutual respect. Assertive communicators can say how they see things and hear how others see things. They work towards outcomes that satisfy everyone.
Assertive communicators often:

- are open and honest about what they are thinking and feeling;
- make direct requests if they want something done, leaving the option to say “no”;
- respect themselves and show respect to others; and
- are able to disagree without creating bad feelings.

Assertive communication usually results in clear and open communication.

Assertive people use a number of important communication skills. They ask questions to gather information and check that they have understood correctly. Assertive people say what is on their mind in a direct yet courteous way so there is no hidden message.

Using “I” Statements
One of the most important skills that an assertive communicator uses is making “I” statements. Assertive people use “I” language. An assertive communicator uses statements like “I’d like…”, “I’d appreciate…”, “I think….” and “I feel”… etc. They own their own messages and speak for themselves. Their suggestions are not weighted with advice, commands, and “shoulds” or “oughts”. Their feedback is constructive and free from blame.

Non-verbally assertive people:

- make appropriate eye contact;
- sit or stand comfortably erect;
- use open gestures to support their comments;
- speak in a clear, steady, firm tone of voice; and
- maintain open, unchanging and relaxed facial expressions that accurately reflect their thoughts.

Active Listening Skills
Assertive people also use active listening skills. These skills include:

- repeating the conversation back to the speaker, in their own words, to understand the speakers meaning;
- not talking about themselves;
- letting the speaker take the lead by encouraging them back to the issue if the speaker digresses;
- concentrating fully on what the speaker is saying;
- asking for clarification if it is needed;
- acknowledging the speaker’s feelings; and
- allowing for silence.

Answer the following questions on a separate piece of paper, using the information above.

1. Why are communication skills a fundamental part of leadership?
2. List four aspects of non-verbal communication.
3. Communication consists of three things; name them.
4. What are some characteristics of assertive communicators?
5. Assertive communication usually results in what?
6. Give three examples of “I” statements.

7. Give three examples of non-verbal communication used by assertive people.
8. Give two examples of active listening skills.

Part 4 – Positive Group Dynamics

In order for a peer group or team to perform at its highest level, each member of the team should display positive group dynamics. To demonstrate positive group dynamics, group members should:

- Contribute to the group's goal;
- Exhibit trust in the group;
- Create a safe environment for others to share their opinions;
- Follow the leader;
- Finish the task;
- Display esprit de corps; and
- Appreciate others within the group.

When placed within a peer setting, each cadet should display positive group dynamics. To display positive group dynamics, cadets must:

- Contribute to group discussions providing input. This means contributing to every discussion. Even if a cadet has no new or original ideas, agree or disagree with other member's suggestions. Ask questions.
- Offer support and volunteer to take on extra assignments.
- Be motivated. Be enthusiastic and ensure the best effort each time when working in a team setting.
- Participate in establishing the team's goals. Cadets will have to work to meet the team's goals, so cadets should have a say in determining them. Ensure group goals are consistent with the aims of the cadet organization.
- Try new things. Do not be afraid to take risks. Trying new things shows courage, and courage is a leadership quality. Remember the turtle: it is perfectly safe when it stays in its shell, but to move ahead, the turtle must stick its neck and feet out.
- Be sensitive to other points of view. Listen to the opinions of other team members. Do not be afraid to express your view even if it is different or even the opposite of everybody else's. Deal respectfully with teammates who disagree. Be willing to compromise to achieve a consensus.
- Know teammates' strengths and weaknesses. If members know their teammates' talents and limitations, it enables the team to use all its personnel to its best advantage. Being aware of teammates' individual habits may make working with them easier.
- Increase self-confidence through positive self-talk. Focusing on one's positive characteristics leads to increase self-confidence. To feel better about yourself, concentrate on the things done well and compliment yourself on those things. This is not always easy.
- Be cooperative. Be polite, be a team player, and support your teammates. Help them by distributing work evenly and by sharing information; do not compete.
- Resolve conflicts as quickly as possible at the lowest and most appropriate level. As mentioned in the PSRY program, if teammates have conflict, find a solution. Do not let problems fester and do not hold a grudge. Once conflicts are resolved, let them go.

- Celebrate successes. When the team completes a task or completes a goal, share in the enjoyment. Have a quick team meeting and compliment all team members on a job well done. Praise team members in front of others. Show appreciation to teammates who have been especially helpful. Everyone likes to be congratulated. This may lead to increased feelings of enthusiasm and self-confidence by members of the team.

Answer the following questions on a separate piece of paper, using the information above.

1. What attributes must a cadet display within the team to help the team be successful?
2. Are there some attributes that contribute more to the success of the team than other attributes? Why or why not?
3. Besides cadets, where else would these attributes be advantageous in a peer setting?
4. Why should successes be celebrated?

Part 5 –Influence Behaviours

Directive Behaviour

Generally, directive behaviour involves telling teammates what they are to do, and possibly, when, how, and to what standard they are to accomplish the task. Directive behaviour may be expressed as a simple request, a formal order, or something in between. Directive behaviour is appropriate when passing on and executing a supervisor's objective, when assigning and coordinating tasks, and when teammates lack information or experience and need guidance.

Directive behaviour is used most often in emergency situations where time, safety, and control of personnel are factors. Another example is drill. Drill is normally conducted using directive behaviour.

Persuasive Behaviour

Generally, persuasive behaviour is intended to influence decision-making and motivation. This is accomplished by explaining to, or convincing others why a certain course of action is necessary. Persuasive behaviour may involve rational argument based on facts, reason and logic and/or inspirational appeals which motivate others. This behaviour may allow teammates to understand the potential benefits to them created by the course of action and should aid teammates in their commitment to the task. Persuasive behaviour is appropriate to secure agreements or commitment and when particularly high or sustained levels of effort are required to accomplish a task.

There are many situations when persuasive behaviour is used. These may include problem-solving, counselling, teaching, etc. Persuasive behaviour is usually effective in a peer setting if all teammates display positive group dynamics.

Participative Behaviour

Generally, participative behaviour involves sharing decision-making with others. The primary objective is to improve the quality and/or acceptance of decisions. Participative behaviours employ two basic methods – individual or group consultations and joint decision-making. Obtaining advice, opinions and recommendations from others before sharing decision-making is essential. Sometimes teammates possess critical information or expertise and the knowledge may make the difference between success or failure of the task. The use of the participative behaviour depends on the availability of time to involve others. Teammates expect to be consulted on and have a voice in decisions that affect them.

There are many situations when participative behaviour is used including problem-solving, participating in team-building activities, resolving conflict in a peer setting, etc. Participative behaviour is usually effective in a peer setting because all teammates have a part to play in making the decision.

Answer the following questions on a separate piece of paper, using the information above.

1. When is directive behaviour most effective at cadets or at school? Why?
2. When is persuasive behaviour most effective at cadets or at school? Why?
3. When is participative behaviour most effective at cadets or at school? Why?
4. What are the differences between persuasive and participative behaviours?

Part 6 – Problem-Solving Process

A Problem is a doubtful or difficult matter requiring a solution.

Logical Analysis

One of the processes to solve problems is logical analysis, if there is sufficient time available or consideration of all the options. Logical analysis helps reduce a complex thought process into a simple format. However, some problems are very simple so all the steps in the process may not be used. If the team follows these steps, they should be able to create a plan to implement a solution. When a task is assigned to cadets in a peer setting, the cadets should follow all the steps in the logical analysis process. If a problem develops that cadets within a peer setting must solve, without being directed to do so, the cadets should begin the logical analysis at step 2.

Steps in Logical Analysis:

1. **Confirm the Task.** By understanding both the problem and the aim or intent of the person assigning the task, the team has the freedom to act within their initiative to lead the team to success, especially when factors or plans change.

2. **Identify the Problem(s).** Once a problem is understood, the team must consider the problem or challenges that may occur in the implementation. This usually requires breaking the problem down into its component parts ("do this, then this, then this...").

3. **Determine the "Critical Factor".** There is usually one overriding problem in which all other issues will depend. This is called the CRITICAL FACTOR. Once identified, a plan to solve the problem can be formed around solving the critical factor.

4. **Develop Alternate Solutions.** Create as many possible solutions as time allows drawing from the experience, knowledge, and initiative of the team.

5. **Compare Alternatives.** Each solution must then be compared by the team in order to decide on the best solution. To decide which solution is the best, some questions may be asked:
   a) Which solution is the simplest?
   b) Which solution is the safest? What is the worst possible outcome? What are the dangerous elements?
   c) Which solution is the most flexible?
   d) Which solution uses available resources in an economical manner?

e) Which solution will solve the critical factor and all other problems?

6. **Determine the Best Solution.** The team should choose the best solution to implement the plan of actions.

7. **Implement the Solution.** The team should create a plan to implement the solution and get the problem solved. If a plan does not work like the team wanted, they may try another of the alternative solutions.

8. **Evaluate the Plan and the Implementation.** The team should evaluate performance once the problem is solved. The team should examine the implementation of the solution and the needs that may not have been anticipated. Questions may include:
   a) Was the solution a good one?
   b) Was the plan to implement the solution a success?
   c) What can we do to improve the plan or the implementation for the next time?
   d) What lessons were learned?

Using the information given above, complete the attached Annex, titled "Problem Solving Scenario"

Part 7 – Personal Integrity

The most basic quality of leadership is personal integrity.

Integrity means moral uprightness; honesty. Personal integrity means doing the right thing, even if nobody is watching. People struggle daily with situations that demand decisions between what they want to do and what they ought to do.

According to John C. Maxwell, the author of a number of best-selling books on leadership, if a leader uses personal integrity, a leader should be consistent. If what the leader says and what the leader does is the same, the results by the team will be consistent.

For example,

The leader says to their team: "Be on time."	The leader arrives on time.	The team will be on time.
The leader says to their team: "Be positive."	The leader exhibits a positive attitude.	The team will be positive.
The leader says to their team: "Put others first."	The leader puts others first.	The team puts others first.

If what the leader says and what the leader does is not the same, the results by the team will be inconsistent.

The leader says to their team: "Be on time."	The leader arrives late regularly.	Some of the team will be on time, some will not.
The leader says to their team: "Be positive."	The leader exhibits a negative attitude regularly.	Some of the team will be positive, some will not.
The leader says to their team: "Put others first."	The leader puts themselves first.	Some of the team will put others first, some will not.

Aristotle, the Greek philosopher, once said, “We are what we repeatedly do. Excellence, then, is not an act but a habit.”

Personal integrity builds trust. To earn the trust of others, a leader should lead by example. If the leader’s words and actions match, teammates and followers should have trust and confidence in the group. Personal integrity usually results in a solid reputation, not just an image.

Answer the following questions on a separate piece of paper, using the information above.

1. What does integrity mean?
2. What does personal integrity build?

PO 207 – General Cadet Knowledge

Part 1 – Overview of Level 2 Training

Overview
The training program is broken into Performance Objectives (POs), which are the overall subjects, and Enabling Objectives (EOs), which are the topics within each PO.

PO 201 – Citizenship
Citizenship provides the cadets an opportunity to identify the role of an environmentally conscious Canadian citizen. The cadets will identify the rights and responsibilities of a Canadian citizen and the Government of Canada's *Code of Environmental Stewardship*.

PO 202 – Community Service
Community Service provides the cadets an opportunity to perform community service. The community service should provide a direct benefit to the community and promote good citizenship.

PO 203 – Leadership
Leadership provides the cadets an opportunity to demonstrate leadership attributes within a peer setting by positively contributing to a group, displaying a positive attitude toward learning, and being accountable for personal actions and choices.

PO 204 – Personal Fitness and Healthy Living
Personal Fitness and Healthy Living provides the cadets an opportunity to update their personal physical activity plans (from Proficiency Level One) for the training year. Cadets will participate in the Progressive Aerobic Cardiovascular Endurance Run (PACER) and will set new short-term and long-term goals for the training year. This PO gives the cadets some of the tools required to make more informed choices in order to follow a healthy lifestyle. This is important as physical fitness is one of the aims of the Cadet Program.

PO 205 – Recreational Sports
Recreational Sports provides the cadets the opportunity to participate in organized recreational team sports. This is important as physical fitness is one of the aims of the Cadet Program.

PO 206 – Air Rifle Marksmanship
Air Rifle Marksmanship provides the cadets an opportunity to participate in recreational marksmanship activities.

PO 207 – General Cadet Knowledge
General Cadet Knowledge provides the cadets with the information required to serve as a member of an Air Cadet squadron. Cadets will identify the training opportunities available in Level Two, recognize historical aspects related to Air Cadets, recognize the role of the local sponsor, and identify year two summer training opportunities.

PO 208 – Drill
Drill provides the cadets an opportunity to execute drill as a member of a squad. The cadets will execute left and right turns on the march, form single file from the halt as a squad in threes, and form single file from the halt as a squad in line.

PO 230 – Aviation History
Aviation History provides the cadets an opportunity to discuss Canadian aviation history. Cadets will discuss the Battle of Britain, Remembrance Day, the Battle of the Atlantic and D-Day.

PO 231 – Principles of Flight
Principles of Flight provides the cadets an opportunity to explain the principles of flight by identifying the four forces that act upon an aircraft, describing the production of lift, describing the types of drag, describing the aircraft axis movement and describing aircraft control surfaces.

PO 232 – Propulsion
Propulsion provides the cadets an opportunity to identify the characteristics of piston-powered aircraft. Cadets will identify types of engines, the components of an internal combustion engine, the four-stroke cycle and the functions of oil.

PO 240 – Aerospace
Aerospace provides the cadets an opportunity to participate in aerospace activities by simulating communicating in space, surviving in space and inventing a space technology item.

PO 260 – Aerodrome Operations
Aerodrome Operations provides the cadets an opportunity to participate in aerodrome operations activities. Cadets will identify aspects of basic airport operations and air traffic control.

PO 270 – Aircraft Manufacturing and Maintenance
Aircraft Manufacturing and Maintenance provides the cadets an opportunity to discuss aircraft fabrication and maintenance. Cadets will discuss avionics, aircraft systems, airframes and employment opportunities.

PO 290 – Aircrew Survival
Aircrew Survival provides the cadets an opportunity to participate in a field exercise. Cadets will construct, light, maintain and extinguish a signal fire, construct a lean-to-style shelter, construct a simple snare, construct ground-to-air signals, identify hiking techniques and operate a hand-held radio.

Part 2 - History of Air Cadets

Read the attached Annexes titled "History of the Royal Canadian Air Cadets", "Significant Events in the Air Cadet Program", and "Significant Dates in the Air Cadet League". Then, answer the following questions on a separate sheet of paper.

1. What interesting things did you learn that you did not know before the lesson?
2. Why did you find this information interesting?
3. Why do you think it is important to know information on the history of the Air Cadet Program?
4. Why do you think it is important to know information on the history of the Air Cadet League?

Part 3 – Role & Responsibilities of the Local Sponsor

Sponsor vs Sponsoring Committee
Sponsor: With respect to a cadet squadron, the organization or persons accepted by or on behalf of the Chief of Defence Staff (CDS) to undertake jointly with the Canadian Forces (CF) and the supervisory sponsor, responsibility for the organization and administration of the cadet squadron.

Sponsoring Committee/Branch: A working support committee that is a member of and supervised by the league and is compromised of persons who are approved, registered and screened in accordance with league policy to complete the functions required to support the squadron.

Local Sponsoring Body
Air Cadet squadron sponsors are usually community organizations or social clubs. In some cases, more than one organization sponsors a squadron. A sponsoring committee is formed to represent the sponsor(s) on a day-to-day basis.

Sponsoring committees are normally comprised of representative(s) of the sponsor, parents, and other civilians from the community. They are sometimes called parents' committees or civilian committees; however, not every parents' committee is a sponsoring committee. At 27 Squadron, the parents' committee is not the sponsoring committee – they are two separate committees.

Some examples of a local sponsoring body may include:

The Royal Canadian Legion (RCL). The RCL is the largest veterans-based community service organization in the country and contributes millions of dollars and voluntary hours to help Canadians, particularly veterans, seniors, and youth.

The Air Force Association of Canada (AFAC). The AFAC is a national not-for-profit aerospace and community service organization composed of aviation-minded citizens. Individual wings of the AFAC actively sponsor and support cadets and other community activities.

Lions Clubs. The Lions Clubs are internationally based and are the world's largest service club organization.

A Rotary Club. A rotary club's main objective is to encourage and foster the ideal of service as a basis of worthy enterprise.

A Parents' Committee. An Air Cadet squadron may also have a separate parents' committee to assist the sponsoring committee. A parents committee is usually made up of parents of current or former cadets from the squadron. These parents join to raise extra funds for the squadrons' activities.

Positions in the Local Sponsoring Body
The following is a list of positions within the sponsoring committee and the basic responsibilities corresponding to these positions. These positions may vary or terms may change from sponsor to sponsor.

- **Chairperson.** The chairperson is the senior official in the sponsoring body and is responsible for all activities/functions. All members must keep the chairperson informed of their activities and the chairperson in turn must keep the squadron informed of activities within the sponsor.
- **Secretary.** The secretary is responsible for maintaining all of the records and correspondence. During committee and general meetings, the secretary is responsible for recording the minutes.
- **Treasurer.** The treasurer is responsible for maintaining all financial records and transactions. All expenditures should be recorded for purposes of budgeting and financial reporting.

Secondary Sponsors
Some squadrons have a secondary sponsor that may assist in duties such as fundraising for the corps. Secondary sponsors usually consist of organizations such as, but not limited to: a parents' committee, a RCL, a Lions Club, or a Rotary Club.

Role of the Sponsor
It is the role of the sponsor to ensure responsibilities are met in accordance with the *Memorandum of Understanding*, for the proper and efficient delivery of the Cadet Program within Canada.

Responsibilities of the Sponsor
- **Fundraising.** It is the responsibility of the sponsor to organize fundraising activities in consultation with the squadron commanding officer (CO). Annual reports are to be produced by the sponsor when required by law.
- **Recruiting Cadets.** It is the responsibility of the sponsor to organize local community campaigns to attract cadets to become members of the squadron.
- **Attracting Officers to the Squadron.** It is the responsibility of the sponsor to conduct local campaigns to attract potential candidates within the community to become members of the Cadet Instructors Cadre (CIC) and civilian instructors (CIs). This is based on the needs confirmed by the CO of the squadron.
- **Screening Volunteers.** It is the responsibility of the sponsor to identify and conduct the screening process of potential volunteers. The sponsor is responsible for completing the process and providing these results to the league.
- **Providing Adequate Office and Training Facilities.** The sponsor is responsible for providing adequate office and training facilities, where they are not provided by DND. This is to include insurance requirements, as necessary.
- **Participating in Senior Cadet Rank Appointments.** The sponsor is responsible to assist with the selection process for senior cadets.
- **Participating in Selections for CSTC/Exchanges.** The sponsor is responsible for cooperating with the squadron CO to promote summer courses and exchanges and to participate in the selection process accordingly, in accordance with the league and DND agreements and responsibilities.

- **Participating in Selections for Honours and Awards.** The sponsor is responsible for participating in the joint selection process for honours and awards from the league and in initiating the selection process for league-specific awards.

Answer the following questions on a separate piece of paper, using the information above.

1. Identify three positions within the sponsoring body.
2. What is the primary role of the Chairperson? Who is the 27 Squadron Sponsoring Committee Chairperson?
3. What role does the sponsor play in fundraising?
4. Who is responsible for recruiting CIC officers, CIs and cadets to the squadron?
5. Who is responsible for screening volunteers?
6. Name the sponsoring body of 27 Squadron.

Part 4 – Year Two Cadet Summer Training Opportunities

Basic Fitness and Sports. The aim of this course is to improve the cadets' knowledge and skills in individual fitness and sports.

Military Band – Basic Musician. The aim of this course is to introduce fundamental music knowledge and skills, and for the cadets to achieve a basic music level.

Pipe and Drum Musician – Basic Pipe and Drum. The aim of this course is to introduce fundamental music knowledge and skills, and for the cadets to achieve a basic music level.

Basic Leadership. The aim of this course is to build on the knowledge and skills required for an emerging leader to complete a leadership assignment in a peer and small group setting. This course also allows cadets to develop knowledge and skills in drill and ceremonial.

Basic Aviation. The aim of the Basic Aviation course is to provide the cadets with the fundamentals of aviation including civilian, military and Air Cadet aviation opportunities, aviation history and basic airmanship.

Basic Aerospace. The aim of the Basic Aerospace course is to provide the cadets with the fundamentals of aerospace to include theoretical and practical principles of aerospace science and the principles of project management.

Basic Aviation Technology. The aim of the Basic Aviation Technology course is to provide the cadets with the fundamentals of aviation technologies to include aircraft fabrication, construction and maintenance. Cadets are given ample opportunity for the practical application of theoretical and practical skills.

Basic Survival. The aim of the Basic Survival course is to allow cadets to apply the basic survival pattern including fire construction, shelter construction, signal construction and food and water collection. Cadets are given ample opportunity for the practical application of theoretical and practical skills.

Prerequisites for Attending a Year Two Cadet Summer Training Course

The cadet must:

- be undergoing Proficiency Level Two training by the application deadline;
- successfully complete Proficiency Level Two by June 30 of the year the cadet wishes to attend the CSTC;
- be physically fit;
- have parental consent; and
- be recommended by the squadron Commanding Officer.

Cadets do NOT have to complete General Training (GT) to apply for their first three-week course.

Answer the following questions on a separate piece of paper, using the information above.

1. What are the prerequisites to attend a year two CSTC course?
2. What course(s) are you interested in applying for this year? Why?

PO 201 – Citizenship

Part 1 – Rights & Responsibilities of a Canadian Citizen

Every Canadian citizen is granted certain rights based on Canada's tradition of democracy and respect for human dignity and freedom. These rights are found in Canada's *Human Rights Codes* and in the Canadian *Charter of Rights and Freedoms*.

All Canadians have the following rights:
- **Equality Rights.** Every citizen is entitled to equal treatment before and under the law, and equal protection and benefit of the law without discrimination.
- **Democratic Rights.** Every citizen has the right to participate in political activities including voting and being elected to political office.
- **Legal Rights.** Every citizen has the right to be presumed innocent until proven guilty, the right to retain a lawyer and to be informed of that right and the right to an interpreter in court proceedings.
- **Mobility Rights.** Every citizen has the right to enter and leave Canada, and to move to and take up residence in any province.
- **Language Rights.** Every citizen has the right to use either the English or French language in communications with the federal government and certain provincial governments.
- **Minority Language Education Rights.** In general, English and French minorities in every province and territory have the right to be educated in their own language.

Canadians also enjoy fundamental freedoms of religion, thought, expression, peaceful assembly and association.

If Canadian citizens have their rights violated by the federal, provincial or territorial governments or their rights are violated by others, Canadian citizens can challenge that action in court.

English and French are the two official languages of Canada. They are an important part of our national heritage and national identity.

Canadian citizens share certain common responsibilities. These responsibilities are:
- understanding and obeying Canadian laws;
- participating in Canada's democratic political system;
- voting in elections;
- allowing other Canadians to enjoy their rights and freedoms; and
- appreciating and helping to preserve Canada's multicultural heritage.

All Canadians are encouraged to become informed about political activities and to help better their communities and the country by reading a newspaper, watching news programs, etc.

Answer the following questions on a separate piece of paper, using the information above.
1. Where are the rights of a Canadian citizen found?
2. Which of the rights of a Canadian citizen do you think is the most important? Why?
3. What are some ways Canadian citizens may become informed about political activities?
4. Which of the responsibilities of a Canadian citizen do you think is the most important? Why?

Part 2 – Principles of Environmental Stewardship

As part of being a responsible Canadian citizen, cadets should be aware of their role in protecting the environment. The Government of Canada has enacted legislation in order to ensure the protection of the environment and that human health is not endangered.

To reflect the Government's dedication to protecting the environment, in all aspects of its operations and activities, it has created the Government of Canada's *Code of Environmental Stewardship*. It commits to:

- incorporating environmental concerns in relevant decisions. The Government must take environmental concerns into account in every decision and piece of legislation it writes and passes;
- ensuring environmental considerations are incorporated in purchasing practices. The Government must consider the environment when it purchases anything, from submarines to paper products;
- applying environmentally responsible practices in disposal. The Government must use environmentally responsible practices when acquiring, using, transporting, storing and disposing of hazardous materials. A hazardous material is any item or agent which has the potential to cause harm to humans, animals, or the environment, either by itself or through interaction with other factors. These materials may be biological, nuclear, chemical, etc.;
- meeting or exceeding federal environmental laws. The Government has pledged to meet or exceed the letter and spirit of federal environmental laws and, where appropriate, to be compatible with provincial, territorial and international standards;
- reusing, recycling and reducing waste. The Government has to find methods to seek cost-effective ways to reduce the use of raw materials, toxic substances, energy, water and other resources. The Government has also promised to recycle and reuse items where appropriate; and
- improving the level of environmental awareness. The Government has undertaken the task of improving the level of environmental awareness throughout the public service. It stresses to its employees the environmental and health benefits of environmental awareness and encourages and recognizes beneficial actions of employees.

To ensure the Cadet Program stays well within the Government's *Code of Environmental Stewardship*, a Cadet Administrative and Training Order (CATO) 11-08, *Environmental Protection and Stewardship*, was created. This order prescribes national policy for the Canadian Cadet Organization/Cadet Instructor Cadre (CCO/CIC) on environmental matters. The CCO/CIC must ensure the protection of the environment during all activities by adopting environmentally sound practices and by complying with federal, provincial and territorial environmental legislation and regulations, municipal environmental bylaws, as well as the DND's environmental regulations.

The term due diligence is found throughout CATO 11-08, *Environmental Protection and Stewardship*. The definition of due diligence is the exercise of reasonable care in the conduct of one's business or duties. To demonstrate due diligence, a member must show that they did all that any reasonable person would have done in the same circumstance to avoid a foreseeable risk of harm to the environment. If due diligence is not practiced and an offence in violation of environmental legislation occurs there may be legal liabilities.

Answer the following questions on a separate piece of paper, using the information above.

1. Why should cadets be aware of their role in protecting the environment?
2. What is the definition of due diligence?
3. What is being done or can be done to reduce, reuse and recycle at the squadron?

4. What is being done or can be done to improve environmental awareness at the squadron? In the community?

PO 204 – Healthy Lifestyle & Physical Fitness

Part 1 – Healthy Food Choices

Canada's Food Guide
Health Canada's Food Guide describes how much of each type of food is required as part of a healthy eating pattern. There are four food groups in the guide; vegetables and fruit, grain products, milk and alternatives, and meat and alternatives.

Vegetables and Fruit
Consuming plenty of vegetables and fruit may help reduce the risk of cardiovascular disease and certain types of cancer. This food group provides nutrients such as carbohydrates, vitamin A, vitamin C, potassium, magnesium, and B vitamins. Vegetables and fruit are the most prominent food group in the guide because of the important role these foods play in healthy eating.

Grain Products
Consuming the required amount of grain products may help to reduce the risk of cardiovascular disease. Grain products, particularly whole grains, are a source of fibre and are usually low in fat. Whole grains contain all three edible layers of the grain seed or kernel, which provides a greater combination of nutrients. This food group provides nutrients such as carbohydrates, B vitamins (e.g. thiamin, riboflavin, niacin and folate), iron, zinc, and magnesium. The grain products food group is the second most prominent food group in the guide.

Milk and Alternatives
Consuming the required amount of milk and alternatives may help to develop strong bones and reduce the risk of osteoporosis. This food group provides nutrients such as calcium, vitamin A, vitamin D, vitamin B12, riboflavin, zinc, magnesium, potassium, protein and fat.

Meat and Alternatives
Consuming the required amount of meat and alternatives food group provides nutrients such as iron, zinc, magnesium, B vitamins (e.g. thiamin, riboflavin, niacin, vitamin B6, and vitamin B12), protein, and fat.

Food Guide Servings
A food guide serving is a specified quantity of food from each of the food groups. It is used to help people understand how much food is recommended every day from each of these groups. This is generally close to what a person would eat in one sitting (e.g. one apple). When eating out, food portions are often large and contain more than one serving of a food group. It is important to recognize the food groups that make up a meal and how much food is on the plate, in order to count the food guide servings in a meal.

Recommended Daily Intake
The recommended daily intake outlined in Canada's Food Guide describes what amount of food people should eat based on age and gender. Following the recommended daily intake will help people to:

- take in the required vitamins, minerals and other nutrients;
- reduce the risk of obesity, type two diabetes, heart disease, certain types of cancer and osteoporosis; and
- achieve overall health and vitality.

Answer the following questions on a separate piece of paper, using the information above.

1. What is a food guide serving?
2. What is one benefit of following the recommended daily intake?

Using the information from Canada's Food Guide, on a separate piece of paper, write down the food you had in your lunch. Then, identify the food group(s) to which it belongs and how many servings it would be. Then, total the number of servings for each food group.

Part 2 – Healthy Lifestyles

Smoking

Known facts about smoking include:

- adolescence is the usual time a person will start smoking;
- youth in grades six and seven are considered to be at the critical stage for deciding whether to experiment with smoking; and
- cigarette smoking is more addictive and harder to quit than some other substances such as heroin and cocaine.

Known physical effects of smoking include:

- dry skin and premature wrinkling;
- a longer healing time for a smoker's acne;
- hair loss in some teenagers;
- yellow teeth and tooth decay; and
- an increased occurrence of oral cancer in some people.

Statistics about smoking:

- It is estimated that 55% of young men and 51% of young women who start smoking by the age of 15 will die before age 70 if they continue to smoke.
- Tobacco kills more than 40 000 Canadians every year.

Consequences of smoking may include:

- cancer of the lungs, mouth, sinuses, throat, brain, breast, uterus, bladder, kidney, thyroid, lymph glands, and blood;
- serious ailments such as bronchitis, pneumonia, emphysema, strokes, heart attacks, ulcers, cataracts, gum disease, tooth decay, ear infections, dry skin, early aging, and impotence;
- respiratory problems such as increased coughing, phlegm, wheezing, chest colds, and shortness of breath;
- asthma attacks or increased asthma symptoms;
- cold fingers and toes due to poor circulation; and
- a dulled sense of smell and taste.

Nutrition Choices

Following Canada's Food Guide, will ensure a person eats the amount and type of food that is recommended to help achieve a healthy lifestyle. Eating the amount and type of food recommended and following the tips in Canada's Food Guide will help:

- meet the body's needs for vitamins, minerals, and other nutrients;

- reduce the risk of obesity, type 2 diabetes, heart disease, certain types of cancer, and osteoporosis; and
- contribute to overall health and vitality.

Just as important as eating the right amount of food is eating the right types of foods. People should be encouraged to eat foods that are lower in fat, sugar, and salt.

The benefits of eating well include:
- better overall health,
- lower risk of disease,
- healthy body weight,
- feeling and looking better,
- more energy, and
- stronger muscles and bones.

Regular Physical Fitness
Benefits of regular physical activity contribute to the following:
- overall health,
- improved fitness,
- better posture and balance,
- weight control,
- stronger bones and muscles,
- energy level, and
- an increase in relaxation and reduction in stress.

Health risks that may result from inactivity include:
- premature death,
- heart disease,
- obesity,
- high blood pressure,
- adult-onset diabetes (type 2),
- osteoporosis,
- stroke,
- depression, and
- various forms of cancer.

63% of Canadians are not active enough to get the health benefits they need from physical activity.

Youth require 60 to 90 minutes of physical activity every day.

Answer the following questions on a separate piece of paper, using the information above.
1. What are some of the benefits of choosing not to smoke?
2. How can nutrition choices affect your overall health?
3. What are some benefits you can get from being physically active in your daily life? What can you do to improve your level of daily physical activity?

Part 3 - Physical Benefits of a Healthy Lifestyle

Healthy Growth and Development

Studies, in recent years, have shown that over half of young people are not active enough for healthy growth and development. According to the Canadian Community Health Survey in 2000-2001, 56% of Canadian's aged 12 to 19 were physically inactive and as many as 82% may not have been active enough to meet international guidelines for optimal growth and development.

Healthy Heart

Eating more nutritious foods, not smoking, and being physically active can help maintain a healthy heart. A healthy body weight, for example, can help to lower risk factors for heart disease by decreasing blood cholesterol, fat levels, and high blood pressure. Cardiovascular disease, such as heart disease, stroke, and atherosclerosis– hardening and narrowing of the arteries, is the number one cause of premature death in Canada.

Stronger Bones and Muscles

Physical activity, especially strength activities, can contribute to the maintenance of bone mass through adulthood, by helping develop the bony and muscular tissue during childhood. Daily physical activity in adolescence and early adulthood is positively correlated to mineral density and the skeleton's bone density. This development of mineral density and bone mass may help reduce the risk of osteoporosis later in life. Strength activities will lead to stronger muscles and help them stay strong over time. Stronger bones and muscles can also lead to better posture and balance among people of all ages.

Weight Control

Physical activity affects body composition and helps weight loss. Active individuals are at less risk of becoming overweight. Having a healthy body means maintaining a healthy body weight. Having a healthy weight does not necessarily mean being extremely slim and having a low body weight. A healthy body weight should encourage physical, social, and psychological well-being. In 1988, Health and Welfare Canada introduced the "healthy weights strategy". This strategy promotes healthy eating opposed to dieting and regular physical activity versus intense exercise. For adults, healthy body weight can be determined by the Body Mass Index (BMI) and the waist-hip ratio (WHR).

The BMI is intended for individuals 18 years of age and older. As individuals under 18 years of age are still developing, they should not rely solely on the BMI to determine if they have a healthy body weight.

According to the World Health Organization (WHO) in 2002, there were approximately one billion people in the world who were overweight or obese and only 800 million who were hungry/starving or underweight. According to the Canadian Community Health Survey conducted in 2004, obesity rates in adolescents aged 12 to 17 have tripled from 3% to 9% in the past 25 years.

Being inactive and/or overweight increases the risk of heart disease, osteoarthritis, diabetes, various cancers, and back injuries.

Lower Health Risks

Regular participation in at least 30 minutes of moderate physical activity can help prevent some chronic conditions, such as:

- **Cardiovascular Disease (CVD):** Regular physical activity can reduce the risk of heart disease by as much as 50%.
- **Osteoporosis:** In Canada, about one out of four women and one out of eight men over 50 years of age, develops osteoporosis. The risk of osteoporosis may be reduced through regular physical activity during childhood and adolescence.
- **Cancer:** Regular physical activity can help in the prevention of certain types of cancer, such as breast and colon cancer. Research shows that overall 30% to 35% of all cancers can be prevented by eating well, maintaining a healthy weight, and by including physical activity into one's lifestyle.
- **Type 2 Diabetes:** Physical activity, together with decreased fat intake, can help in the prevention of type 2 diabetes by as much as 58%.

Studies have shown that females are less active than males. In 2000, only 30% of females and 40% of males were considered active enough to meet the minimum requirements of daily physical activity. This dropped to 12% for females and 24% for males by 2002.

Answer the following questions on a separate piece of paper, using the information above.

1. How does living a healthy lifestyle affect a person's ability to grow and develop? What healthy lifestyle choices can you make to ensure this?
2. What does it mean to have a healthy body weight? How can this be achieved?
3. What types of chronic conditions/illnesses could you avoid by living a healthy lifestyle? What can you do to avoid these conditions/illnesses later in life?

Part 4 - Psychological Benefits of a Healthy Lifestyle

Positive Self-esteem

Positive self-esteem requires a person to have a good opinion of their own character and abilities. Self-esteem can be measured by how worthy individuals feel in various social, physical, and academic situations. Individuals with high self-esteem generally view themselves in a positive manner and can appreciate their abilities, as well as their potential and limitations. Those with low self-esteem generally tend to be more passive and dependent in reacting to stress and demands and are more likely to conform to social pressures, while also being pessimistic about their abilities.

Making new friends is easier when a youth participates in activities involving other youth. For example, if an individual participates in a sports team or a recreational club, there are more opportunities to meet new people. As well, an individual who is living a healthy lifestyle, is often more self-confident, making it easier to meet new people and make friends. According to the Canadian Fitness and Lifestyle Research Institute, physical activity appears to have a positive influence on youth's social lives and the number of same-gender and opposite-gender friends they have.

Positive Self/Body Image

Self/body image is how an individual perceives their own physical characteristics and how they evaluate themselves based on this perception of self. This is then formulated into a self/body image as an individual perceives their own body, how it looks to them, and how they think it looks to others. Having a positive self/ body image comes with the idea that a wider range of body weights, shapes, and sizes are healthy and normal. The reality of genetics encompasses the fact that not all people can be the same shape and size and that not everyone can or should meet the body type seen often in the media.

Higher Energy

Nutrition choices have a direct effect on the amount of energy the body produces. Although the body requires foods from all four food groups, Health Canada recommends that 55% of calories should come from carbohydrates, which should be in the form of starches and natural sugars. These starches and sugars are digested and changed into glucose and are burned during regular physical activity.

Physical activity can also lead to high energy as it determines the amount of energy expended and therefore leads to energy balance (the amount of energy ingested in the forms of carbohydrates, fat, protein and alcohol, should equal the amount expended). Physical activity increases oxygen throughout the body. Endorphins are also increased, therefore, leading to higher levels of energy. Many studies show that physically active youth tend to sleep and eat better than those who are more sedentary or less active.

Reduced Stress/Increased Relaxation

Regular physical activity appears to be associated with better self-esteem and a decrease in anxiety and depression symptoms in normal situations. Flexibility activities are especially effective in ensuring the muscles are relaxed. Individuals who are more physically active and eat balanced, nutritious meals are more likely to have positive self-esteem and self/body image, leading to a reduction in anxiety and negative feelings about their sense of self.

Answer the following questions on a separate piece of paper, using the information above.

1. How does making healthy food choices and maintaining an active lifestyle affect an individual's self-esteem?
2. What is self/body image? How can you strive to maintain a positive self/body image?
3. What are some ways you can reduce stress and increase your level of relaxation?

Complete the attached annex titled "Ways I Can Achieve a Healthy Lifestyle".

PO 230 – Canadian Aviation History

Part 1 – Aircraft Flown during WWI

Sopwith Triplane

The Sopwith Triplane was a single-seater Triplane fighter aircraft used by the British in WWI. It was nicknamed the Tripe or the Tripehound. The Triplane was a successful attempt to produce a fighter with outstanding manoeuvrability and excellent visibility for the pilot. Even though the Triplane remained in front-line service for less than a year, it was so successful that it inspired several German Triplane designs.

The all-Canadian B Flight of No. 10 Squadron, equipped with Triplanes, downed 87 enemy aircraft between May and July 1917. The all-Canadian B Flight was called the Black Flight because of the black markings of their airplanes. Their aircraft were named: Black Maria, Black Sheep, Black Prince, Black Roger, and Black Death.

Bristol F.2B Fighter "Brisfit"

The versatile Bristol Fighter (B.F.) was a manoeuvrable, heavily armed two-seater biplane.

One of the most successful fighters of the war, it got off to a poor start during "Bloody April" when it was introduced to the Western Front by the inexperienced pilots and observers of 48 Squadron.

In the mistaken belief that the aircraft was structurally weak, pilots were instructed to avoid violent manoeuvres during combat. Heeding this advice, the pilots of six B.F. 2B fighters encountered Manfred von Richthofen (The Red Baron) and his flight of five Albatros D.III near Douai (northern France). In a fight that lasted almost 30 minutes, four Bristol Fighters were shot down.

Answer the following questions on a separate piece of paper, using the information above.

1. What type of aircraft was the Sopwith Triplane?
2. What plane was the most successful fighter of the war?

Part 2 – Battle of the Atlantic

The Battle of the Atlantic began on the first day of the war in Europe on September 1, 1939 and continued until May 8, 1945. It was the longest campaign of WWII, an extremely bloody one, and the single battle on which the whole outcome of the war depended.

For six long years the Canadian Navy was one of the principle contenders in what was to be known as the "Battle of the Atlantic." Beginning the war with a mere 13 vessels and 3000 men, the Royal Canadian Navy ended the Battle of the Atlantic with 373 fighting ships and over 90 000 men.

Bridging the Atlantic was the key to strategic supply. Only with the delivery of massive North American resources to Britain and Europe could the Allies defeat Hitler's Germany, the most powerful of the Axis nations. To transport as many men and goods as possible, it was necessary to organize and control ship movements and protect ships from enemy attack. Therefore, convoys were formed to regulate ship movements and more effectively provide escorts both by sea and air.

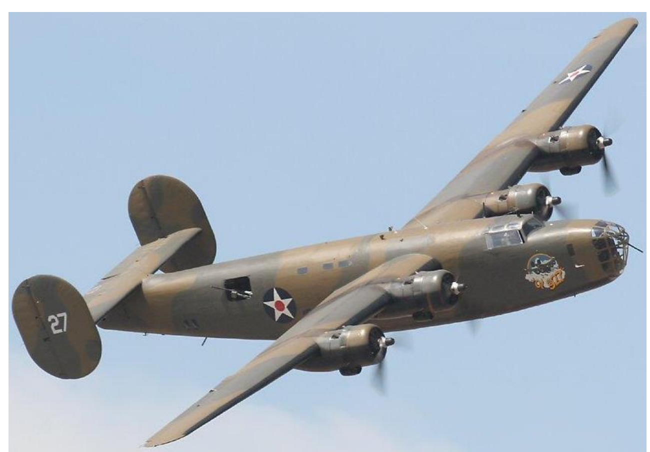
It was in maintaining the Atlantic lifeline through convoy protection that Canadian seamen and airmen played an increasing vital role. The RCAF had been flying patrols from Newfoundland since 1939 and the first Maritime patrol squadron had been stationed at Gander since 1940. It provided air support to the Newfoundland Escort Force. In the eastern Atlantic region, the convoys were guarded by the RAF Coastal Command which included RCAF squadrons. Thus flying from both sides of the Atlantic and from Iceland, aircraft patrolled the entire route except for a gap of about 483 km in mid-ocean. More and more Canadian seamen were crossing the Atlantic to engage in battle closer to the enemy. As they returned to British waters, men of both the Canadian Navy and Air Force showed the benefits of training and hard experience.

Allied Forces and Axis Powers
The Battle of the Atlantic was a struggle between the Allied and Axis powers (mainly Britain and Germany) for control of the sea routes between the Americas, Europe and Africa.

From the very onset of hostilities, Britain faced a second threat to her survival, as Germany was determined to starve the British people into submission by destroying their sea communications and cutting them off from overseas supplies. Gaining control of the entire coast of Europe from Narvik, Norway to the Pyrenees Mountains in France and Spain, the Germans set out from every harbour and airfield in western Europe to cut the lifelines to Britain.

During the six years of the Battle of the Atlantic, the Axis powers lost over 700 U-boats and 32 000 seamen, and the Allied powers lost more than 3000 ships and 40 000 seamen. The vast majority of the Allied losses were merchant ships and the civilian seamen and passengers who sailed in them.

Aircraft Flown During the Battle of the Atlantic
B-24 Liberator Bombers
The B-24 Liberator was a ten-seat long-range bomber/reconnaissance aircraft.



An unsung hero of the Allied war effort, the B-24 Liberator was actually produced in greater numbers than any other U.S. aircraft during WWII.

First flown on December 29, 1939, the Consolidated Aircraft Corporation's B-24 Liberator came along more than four years after the famous and popular Boeing B-17 Flying Fortress, and showed somewhat improved range and payload capabilities over the Fortress.

The Liberator is best known for the daring long-range raids on the oilfields of Ploesti, Romania in 1942 and 1943 and for its effectiveness as a submarine hunter.

Though instrumental in both the European and Pacific theatres, the B-24’s long-range capabilities were particularly effective in the vastness of the Pacific where it excelled as a bomber, reconnaissance platform and as a supply transport.

Curtiss Kittyhawk Mk.1 Fighter-Bomber
The Curtiss Kittyhawk Mk.1 served initially at Dartmouth, Nova Scotia where it was the only fighter unit available for east coast defence, and subsequentially transferred to Annette Island, Alaska as part of the RCAF reinforcement for the USAAF.

The pilots made the 644 km trip by air – the first fighter unit to fly from coast to coast.

The Kittyhawk Mk.1 served with the RCAF from October 9, 1941 to December 16, 1946 before being struck off strength. However, they were used predominantly in the home air defence role, which was reduced during the latter portion of the war.

The Kittyhawk Mk.1 mounted four .50 cal. machine guns in the wings and had shackles under the fuselage for a 52 U.S. gallon drop tank or a 136-227 kg bomb. Racks on the outer wings could also carry six nine kg bombs.

Answer the following questions on a separate piece of paper, using the information above.
1. What were the dates of the Battle of the Atlantic?
2. How many ships and people were lost in the struggle?
3. What is the B-24 Liberator best known for?
4. What were the dates the Kittyhawk served with the RCAF?

Part 3 – Battle of Britain

The Battle of Britain was fought from August 8, 1940 until October 31, 1940. The Battle of Britain was the first major battle to be fought wholly in the air, with both sides having roughly the same number of fighter aircraft. It was the largest and most sustained bombing campaign yet attempted and the first real test of the strategic bombing theories that had emerged since the previous World War.

The battle can be roughly divided into four phases:
- July 10–August 11: Kanalkampf, the Channel battles
- August 8–August 23: Adlerangriff, the early assault against the coastal airfields
- August 24–September 6: the Luftwaffe targets the airfields – the critical phase of the battle
- September 7 onward: the day attacks switch to British towns and cities

The Battle of Britain marked the first time that the Nazis were stopped and that air superiority became clearly seen as the key to the war. Though the battle was small in the number of combatants and casualties, had the Germans won, the war would have taken a very different path. The British victory marked the first failure of Hitler’s war machine. The Royal Air Force lost 375 pilots and 358 pilots were wounded.

Allied Forces & Axis Powers
The Battle of Britain was between the United Kingdom and Germany and Italy.

The Battle of Britain is the name commonly given to the attempt by the German Luftwaffe, as part of German Blitzkrieg tactics, to gain air superiority over the Royal Air Force (RAF), before a planned sea and airborne invasion of Britain (Operation Sealion). Neither Hitler nor the German Wehrmacht believed it possible to carry out a successful amphibious assault on the British Isles until the RAF had been neutralized.

Secondary objectives were to destroy aircraft production and ground infrastructure, to attack areas of political significance, and to terrorize the British people with the intent of intimidating them into seeking an armistice or surrender.

The RAF roll of honour for the Battle of Britain recognizes 510 overseas pilots as flying at least one authorized operational mission with an eligible unit of the Royal Air Force or Fleet Air Arm between July 10 and October 31, 1940. This included pilots from Poland, New Zealand, Canada, Czechoslovakia, Belgium, Australia, South Africa, France, Ireland, the United States of America, Jamaica, Palestine and Southern Rhodesia (Zimbabwe).

The highest scoring unit during the Battle of Britain is remarkably the No. 303 Polish Fighter Squadron.

Aircraft Flown During the Battle of Britain
Hawker Hurricane Mark I

The Hawker Hurricane Mark I was a single-seater fighter with a Rolls-Royce Merlin engine. It was a low-wing all-metal cantilever monoplane armed with eight Browning machine-guns – four in each wing set to fire forward outside the airscrew disc. The maximum speed was 539 km/h.

The Hurricane was regarded as less ‘twitchy’ than the Spitfire and provided a more stable gun platform. The RAF’s preferred tactic was, if possible, to deploy the Hurricane’s awesome fire power against formations of less-agile bombers and to set up the Spitfires against fighter escorts waiting to pounce from a higher altitude.

The Spitfire Mark 1

The Spitfire Mark 1 was a similar single-seater fighter with a Rolls-Royce Merlin engine. It was a low-wing all-metal cantilever monoplane armed with eight Browning machine-guns – four in each wing set to fire forward outside the airscrew disc. The maximum speed was 589 km/h.

The Spitfire’s one-piece sliding moulded canopy gave the best visibility, the pilot having a better chance of spotting an enemy.

Qualities of Both Aircraft
In both these aircrafts the armour in the front and back protected the pilot.

The Spitfire and Hurricane would out-turn the Bf-109E or Emil (German Aircraft) because the Bf-109 pilots were afraid to push the plane to its limits due to the fact that the Bf-109 did not give the pilot any warning that it was going to stall, unlike the Spitfire and Hurricane, which gave the pilot plenty of warning that the plane was about to stall by shaking violently.

Both the Spitfire and Hurricane were slower in a power dive and had the drawback of being equipped with a float-type carburetor, which cut out under negative g-forces. Both the RAF fighters were easy to fly and forgiving with both rough handling and novice pilots.

The Hurricane was a superbly steady gun platform and the closely clustered .303 machine guns in each wing proved very destructive. A drawback to the Hurricane was the presence of a fuel tank just behind the cockpit firewall, which could catch fire and within a few seconds severely burn the pilot before he managed to bail out.

Answer the following questions on a separate piece of paper, using the information above.

1. What were the dates of the Battle of Britain?
2. Who was the battle between?
3. What was the maximum speed of the Spitfire Mark 1?
4. What was a drawback to the Hurricane?

Part 4 – Annual Day of Commemoration / Remembrance Day

"At the eleventh hour, of the 11th day, of the 11th month of the year 1918, after more than four years of continuous fighting, hostilities on the main battlefront of the greatest war in history came to an end" (Brigadier C. N. Barclay, 1968).

An annual day of commemoration for Canada's war dead began after WWI. With some 60 000 Canadians killed, the war produced a profound sense of loss in a country whose greatest military tragedy to date had been 267 dead in the South African War of 1899-1902.The huge cost of the so-called "Great War" was startling for Canada, as it was for all combatant nations.

As early as April 1919, Isaac Pedlow, Member of Parliament (MP) for South Renfrew, Ontario, introduced a motion in the House of Commons to institute an annual "Armistice Day" to be held on the second Monday of November. Members agreed that there should be a special day to mark the Armistice, but were split over the day on which it should be held. Responding to the views of the veterans' community, many argued that it should occur on the actual anniversary of the Armistice–November 11. Those who had come through the war felt that a solemn occasion marking the deaths of 60 000 comrades was important enough to merit this distinction. A special appeal sent out by King George V to the Empire on November 6, urging the year-old Armistice be marked by the suspension of all ordinary activities and the observance of two minutes of silence at precisely 11:00 a.m. on November 11, settled the issue. This was how Canada marked its first Armistice Day.

The term "armistice" denotes the cessation of hostilities in a conflict and it was used universally for the final silencing of the guns that ended the WWI at 11:00 a.m. on November 11, 1918.

On March 18, 1931, A.W. Neil, MP for Comox-Alberni in British Columbia, introduced a motion in the House of Commons to have Armistice Day observed on November 11 and "on no other date." Concerns about the holiday's impact on business, he claimed, were "irrelevant."

At the same time, another MP, C.W. Dickie of Nanaimo, also speaking on behalf of veterans, introduced a motion changing the name from Armistice to Remembrance Day. This term, he felt, better “implies that we wish to remember and perpetuate.” As historian Denise Thompson has suggested, “the term ‘Remembrance Day’ placed the emphasis squarely upon memory – and by extension upon the soldiers whose deaths were being remembered – rather than upon the Armistice, a political achievement in which rank-and-file soldiers were not directly involved.” Parliament quickly adopted these resolutions and Canada held its first Remembrance Day on November 11, 1931.

Remembrance Day has remained the official title for the annual commemoration ever since, although the term Armistice Day is sometimes used interchangeably, but unofficially. Remembrance Day, a more flexible and inclusive term, readily accommodates the remembrance of war dead from WWI, WWII, the Korean War, other conflicts and peacekeeping.

Every year, ceremonies are held at cenotaphs in cities and towns across the country, involving prayer, recitations and playing the traditional military bugle calls of “Last Post” followed by “Reveille.” Remembrance Day ceremonies offer veterans the opportunity to remember and salute fallen comrades and all Canadians an occasion to reflect on the sacrifices made and the tragedies endured in their name.

Answer the following questions on a separate piece of paper, using the information above.

1. When did the annual day of commemoration begin?
2. How did Canada mark its first Armistice Day?
3. When did Canada hold its first Remembrance Day?
4. What do Remembrance Day ceremonies offer?

Part 5 – D-Day

On June 6, 1944, the “Second Front” became a reality.

In the weeks before that, the Allied Air Forces had attacked the transportation network used to move German troops and equipment.

On D-Day itself, delayed one day by bad weather in the English Channel, powerful air and naval support, as well as ground-breaking specialized armoured vehicles, such as tanks capable of “swimming”, helped the infantry to get ashore on five beaches—two each for the Americans and British and one for the Canadians. Anglo-American-Canadian forces landed on the open beaches of Normandy, north and west of the city of Caen, France.

Canadian Soldiers Landing at Juno Beach
Canadian airmen and sailors were among the first into action.

The Royal Canadian Air Force had already been involved for several months in bombing key enemy targets in the invasion area; roads, bridges, railways, airfields and command and communications centres. Now they flew as part of the 171 Allied squadrons that attacked on D-Day.

As H-Hour approached, RCAF Lancasters of No. 6 Bomber Group dropped thousands of tons of explosives on German coastal defences.

While it was still dark in the early hours of June 6, Allied paratroopers, including 450 Canadians, jumped from aircraft or landed in gliders behind German coastal defences. The 3rd Canadian Infantry Division and 2nd Canadian Armoured Brigade formed the Canadian assault force on D-Day, while 1st Canadian Parachute Battalion jumped as part of the great airborne force protecting the flanks of the landing. Canadian destroyers, corvettes, minesweepers, landing ships and landing craft supported the landings, as did the many RCAF squadrons overhead.

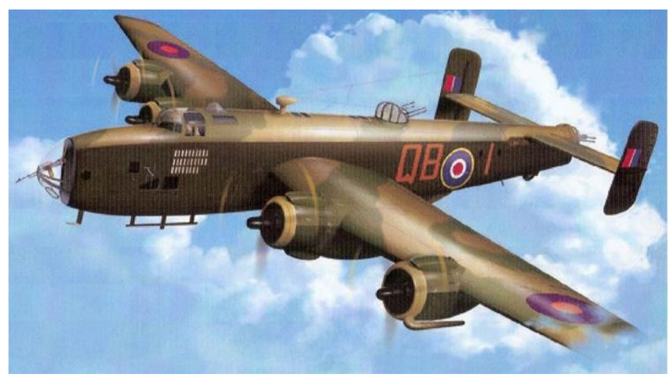
Separated by gusty winds, outnumbered and only lightly armed, they nevertheless captured a German headquarters, destroyed a key bridge and seized an important crossroad, all the while sowing confusion and disorder within enemy ranks. 340 Canadian soldiers died, 547 were wounded and 47 were taken prisoner.

Aircraft Flown During D-Day
Black and White Striped MK IXB

The black and white striped MK IXB was a Spitfire.

The day before D-Day at the RAF Station Tangmere near Chichester in the south of England ground crew painted black and white “invasion stripes” on their Spit IXs. In the dangerous skies over France, these markings would indicate to friendly fighters to not shoot. Aircraft without stripes were fair game.

Halifax LW170



The Halifax LW170 had an unusual combat history in the RCAF. From May to August 1944, this aircraft participated in 28 missions to Germany and France during the critical days preceding and during D-Day. The Halifax LW 170 participated in the bombing and destruction of the German heavy guns, which threatened the entire Allied invasion fleet on the historic morning of June 6, 1944. Finally, due for major maintenance in August 1944, LW170 was replaced by other Halifaxes and consigned to repairs, or at worst, the scrap yard. Fate intervened and this Halifax was repaired and was to be handed over to a weather patrol squadron where it soldiered on until just after the end of the war in 1945.

RCAF Lancaster

The four-engine Avro “Lancaster”, a direct development of the unsuccessful twin-engine Manchester became the ‘mighty pulveriser’ of the RAF’s Bomber Command, able to carry the great 990 kg “Ten-Ton Tessie”, also known as the “Grand Slam”, the heaviest bomb-load lifted by any bomber of WWII.

Its most notable exploits were the breaching of the Mohne and Eder dams in the Ruhr, Germany in May 1943 and also the sinking of the German battleship Tirpitz in November 1944.

A total of 420 Lancaster Xs were built in Canada in Malton, Ontario and Canadian units in the Commonwealth Tiger Force would have flown Lancaster Xs in the Pacific had the war lasted into 1946.

After service with the twelve squadrons of the RCAF's No. 6 Group in Bomber Command during the war, the Lancaster was used by the RCAF in varied post-war roles, including photo reconnaissance, air/sea rescue and maritime reconnaissance.

The Lancaster was finally retired from the RCAF on April 1, 1964, after being used in service for more than twenty years.

Answer the following questions on a separate piece of paper, using the information above.

1. What is the date of D-Day?
2. How many Canadian soldiers died on D-Day?
3. Who were among the first into action at Juno Beach?
4. What did the black and white stripes indicate to friendly fighters?
5. How many missions did the Halifax LW170 participate in during the critical days preceding and during D-Day?
6. What was the Lancaster's most notable exploits?

PO 231 – Principles of Flight

Part 1 – Four Forces

Weight
The weight of an aircraft is the force that acts vertically downward toward the centre of the Earth and is the result of gravity.

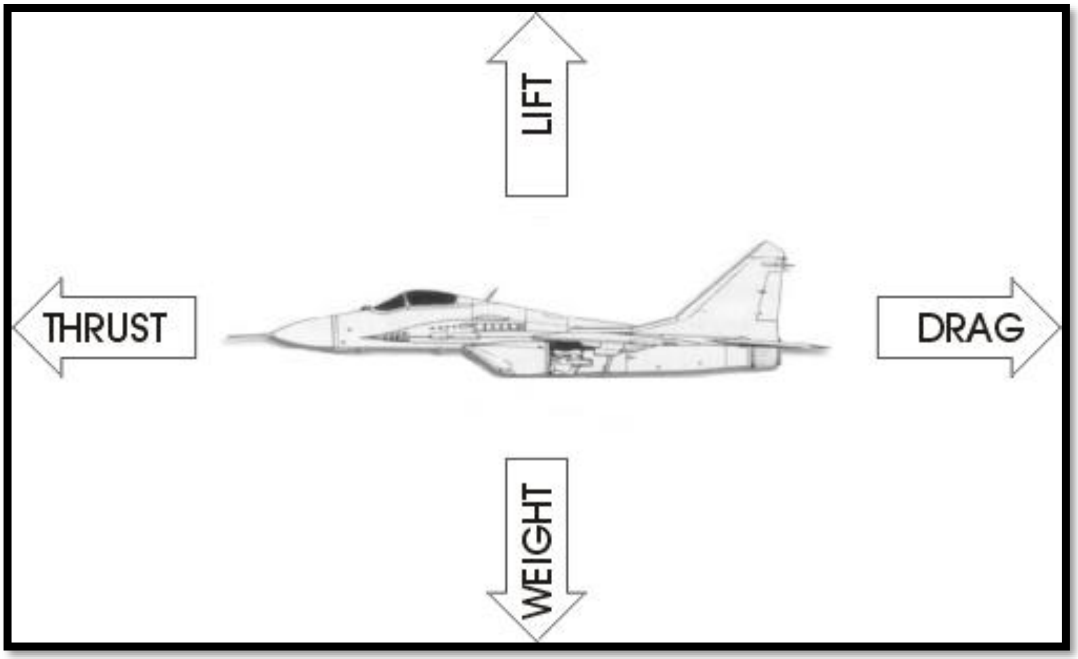
Drag
Drag is the resistance that any object experiences as it moves through the air. The design of an aircraft can minimize drag but cannot avoid it entirely. An aircraft can use drag to control flight and manoeuvre by pushing on the passing air.

Thrust
Thrust is a force that moves an aircraft forward. A glider spends the energy it has gained and moves forward by trading the speed of descent for forward motion. It gets this control by using its weight to push upon the air below. With its nose lowered, it slides forward over the air below.

Lift
A glider's wings are designed to project out into the passing air. Glider's wings are usually very large for the size of aircraft because a glider depends on its wings to develop lift without help from an engine or a propeller. As air moves over and under the wing, the air is used by the wing to generate lift.

The object of gliding is to get as much forward distance as possible, while losing as little altitude as possible for each unit of energy that the glider loses in descent. The distance travelled forward compared to the altitude lost is referred to as glide ratio.

The glider's wing is designed to develop lift because lift reduces the rate of descent while allowing forward motion. The lift of the aircraft's wing will counteract the aircraft's weight, to a degree, and this will improve the aircraft's glide ratio. Generally, the larger the wing, the more lift can be developed.



Equilibrium
A powered aircraft also experiences weight, drag and lift as does a glider. However, while a glider can gain forward motion only by trading the energy of its descent for thrust, a powered aircraft can generate thrust by running its engine.

A powered aircraft, though, can attain equilibrium, which is something a glider cannot do. Equilibrium is a condition where lift equals weight or thrust equals drag. Pilots often refer to this as flying straight and level.

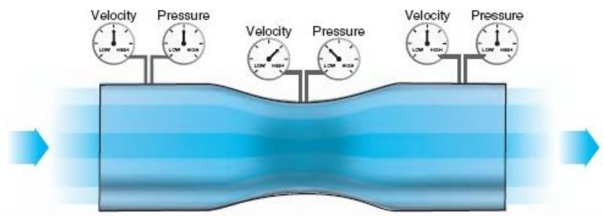
If lift is greater than weight, the aircraft will climb higher.
If weight is greater than lift, the aircraft will descend.
If thrust is greater than drag, the aircraft's forward speed will increase.
If drag is greater than thrust, the aircraft's speed will decrease.

Answer the following questions on a separate piece of paper, using the information above.
1. In what direction does weight and gravity act?
2. What is drag?
3. What causes the glider to move forward?
4. What is required for an aircraft wing to develop lift?
5. What is aircraft equilibrium?
6. What is necessary for an aircraft to climb higher?

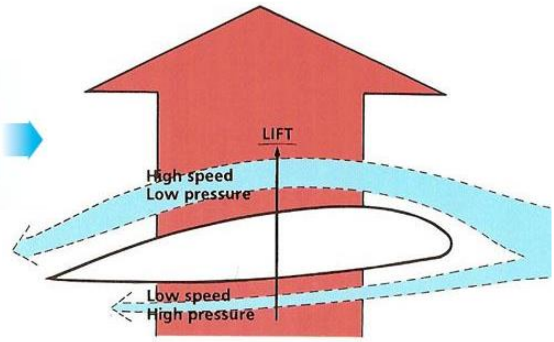
Part 2 – Production of Lift by an Aircraft Wing

Newton's Laws of Motion
Air follows Newton's laws of motion:
- Newton's first law predicts that air, being a gaseous fluid, tends to remain in motion when it is moving.
- Newton's second law of motion requires that a force must be applied to change the air's motion.
- Newton's third law of motion allows the aircraft wing, by applying a force that changes the motion of air, to develop lift through an opposite and equal reaction.

Bernoulli's Principle
To develop the equal and opposite reaction described by Newton's third law of motion, the wing is given a shape that takes advantage of Bernoulli's Principle to make the air change direction.



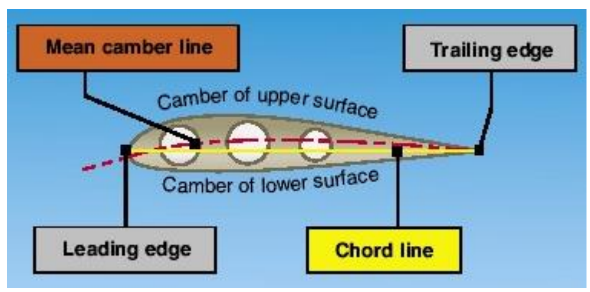
Bernoulli's Principle states that the total energy in a system remains constant. If one element of an energy system is increased, another needs to decrease to counter balance it. So, if air speed increases, pressure decreases and if speed decreases, pressure increases. This is an inverse relationship between airspeed and air pressure. This part of Bernoulli's Principle is often referred to as the venturi principle. The shape of the wing is carefully calculated to decrease pressure above while increasing pressure below.



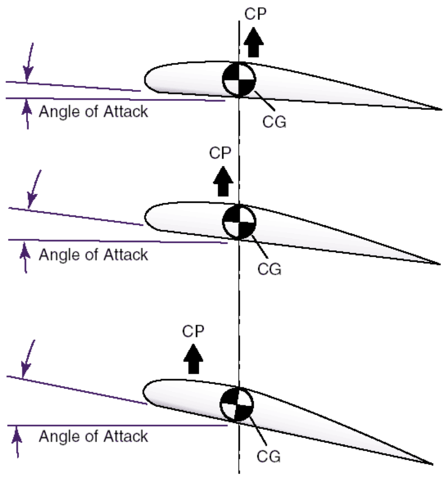
Air under the wing moves more slowly and is slightly squashed so it is at a higher pressure than the air above the wing.

The pressure of moving air can be examined by blowing gently over a small piece of curved paper. The air does not push the paper down as might be intuitively assumed. Instead, the paper behind the curve rises toward the moving air. This happens because the air pressure drops over the paper due to the air's increased speed – this would seem to match the description of speed/pressure relationship. The curvature in the paper enhances the effect of the lowered air pressure.

Angle of Attack
An aircraft wing is an airfoil because of its cross-sectional shape. The top surface is curved outward (convex curvature). Therefore, the air flowing over the top has further to go, over the curve, and so it must move faster which, as we know, will result in lower pressure. This happens above the wing.



Below the wing, the air is deliberately slowed to increase its pressure. This is done by curving the surface slightly inward (concave curvature) and by sloping the wing so that it is slightly higher at the front (leading edge) than it is at the back (trailing edge). This angle of the wing's under-surface, which encounters the moving air, is called the wing's angle of attack.



The greater the wing's angle of attack, the more air the under-surface of the wing will encounter, thereby generating more lift. This is a direct relationship between angle of attack and lift. Increasing the wing's speed will also cause it to encounter more air, thereby generating more lift. This is also a direct relationship between speed and lift.

There is a limit to the amount of lift that can be produced by merely increasing the angle of attack. Long before the wing becomes vertical, it stops generating lift above and this often happens abruptly. The wing "stalls" and stops generating lift when this happens.

Answer the following questions on a separate piece of paper, using the information above.

1. How does air follow Newton's third law of motion?
2. What relationship exists between air speed and air pressure?
3. What is the wing's connection between Newton's third law and Bernoulli's Principle?
4. What determines how much lift is produced by a wing at a given speed?

Part 3 – Drag

Drag is the force that opposes the forward motion of an aircraft. The two main types of drag are parasite drag and induced drag.

Parasite drag is caused by those parts of the aircraft that do not generate lift such as the fuselage, landing gear, struts, antennas, wing tip fuel tanks, etc. Any drag caused by openings, such as those in the cowling and those between the wing and the ailerons and flaps, add to parasite drag.

Induced drag is produced by those parts of an aircraft that are active in producing lift, such as the wings. Induced drag is the result of the wing and is therefore a part of lift and can never be eliminated.

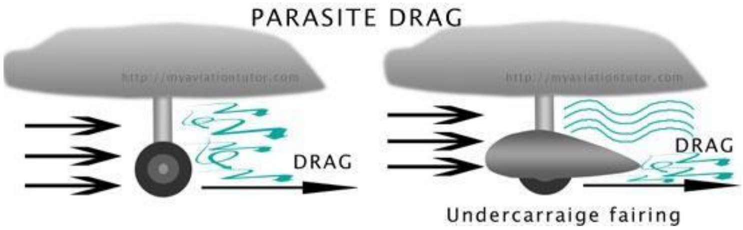
It is true that drag does limit an aircraft's performance. However, drag also allows the pilot to control flight because an aircraft turns by increasing the drag in certain areas using control surfaces that push on the passing air. Without drag, an aircraft could not fly in a controlled manner.

Parasite Drag

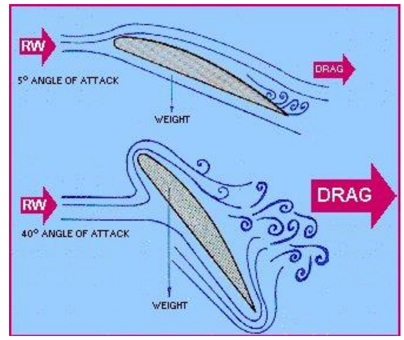
Parasite drag is broken down into two components:

- **Form drag** refers to the drag created by the form or shape of a body as it resists motion through the air.
- **Skin friction** refers to the tendency of air flowing over a body to cling to its surface.

Although parasite drag can never be eliminated, it can be reduced. One method is to remove parts of the aircraft that cause it. For this reason, retractable landing gears have been developed. Another method is to streamline those parts that cannot be eliminated. Skin friction can be reduced substantially by the removal of dust, dirt, mud or ice that has collected on the aircraft.



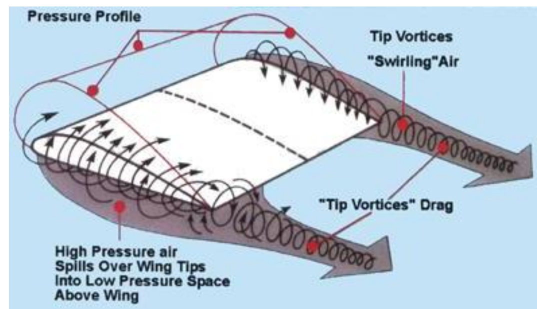
Induced Drag



Induced drag is another force that opposes the forward motion of the aircraft, but it is produced by those parts of an aircraft that are active in producing lift. Induced drag results from the wing and is therefore a part of lift that can never be eliminated.

Induced drag increases as the angle of attack increases and decreases as the angle of attack decreases.

Induced drag can only be reduced during the initial designing of the aircraft. The phenomenon known as wing tip vortices is testimony to the existence of induced drag.



Aircraft are often fixed with upwardly swept wing tip “winglets” to reduce wing tip vortices and their associated induced drag.

The various forms of drag change with different flying conditions and, in general, they increase with speed. As well, when the pilot uses control surfaces, they produce both form drag and induced drag.

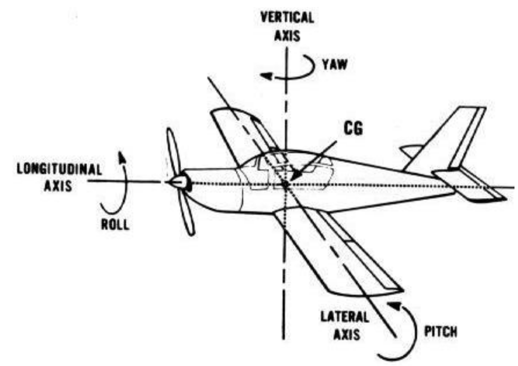
Answer the following questions on a separate piece of paper, using the information above.

1. What causes parasite drag?
2. What produces induced drag?
3. How do aircraft designers reduce form drag?
4. What is the relationship between angle of attack and induced drag?
5. What is the relationship between drag and air speed?

Part 4 – Axial Movements of an Aircraft

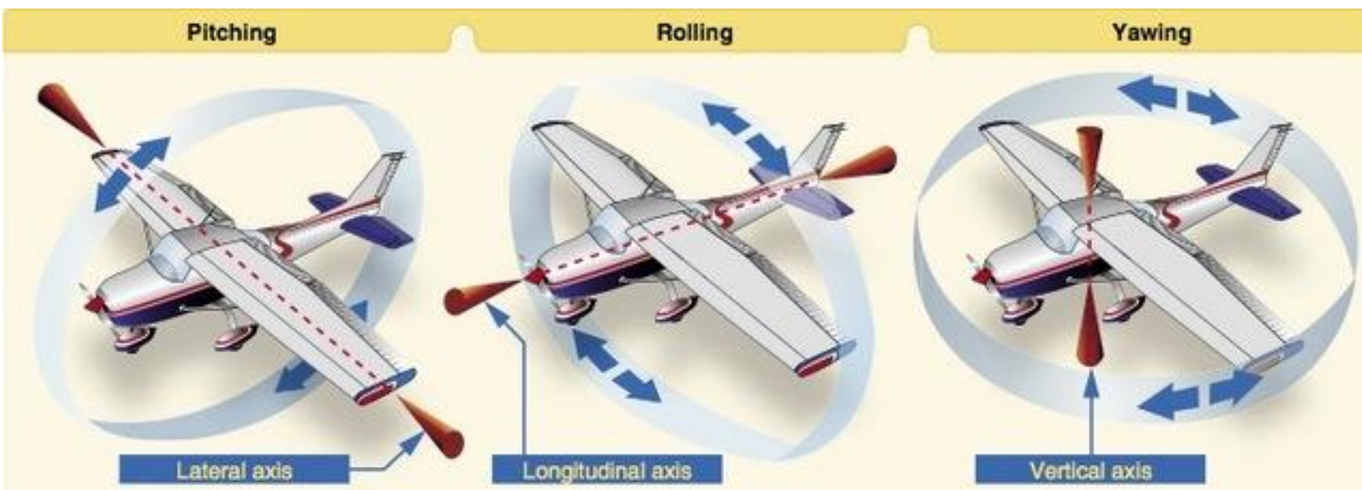
When an aircraft is airborne, it can move in almost any direction. All movement of the aircraft takes place around the centre of gravity. This is the aircraft’s balance point, or point through which all weight acts downwards.

An aircraft is said to move around an axis. This is an imaginary line running through the centre of gravity of the aircraft and around which the aircraft rotates. There are three such axes and the aircraft may rotate around one, two or all three axes at the same time. They are:



- **The Longitudinal Axis.** It runs lengthwise through the fuselage from the nose to the tail and passes through the centre of gravity.
- **The Lateral Axis.** It runs from wingtip to wingtip through the centre of gravity.
- **The Vertical Axis.** It runs vertically through the centre of gravity. It is situated at right angles to the other axes.

Rolling. Movement of an aircraft about the longitudinal axis is called roll.
Pitching. Movement of an aircraft about the lateral axis is called pitch.
Yawing. Movement of an aircraft about the vertical axis is called yaw.



It is possible for an aircraft to move in only one axis at a time but it is not necessary. Although an aircraft can climb or descend using only pitch around the lateral axis, movement around all three axes simultaneously is necessary for efficient flight.

When riding a bicycle around a high-speed turn, it is necessary to not only yaw to make the turn, but efficient cycling requires the cyclist to lean into the turn, (or roll) slightly as the turn is made. A turn without leaning would be very slow and inefficient and would be the mark of a beginner cyclist.

Similarly, an aircraft normally makes a “bank” manoeuvre in a level turn, involving movement about the longitudinal as well as the vertical axis. A climbing or descending turn requires that movement around the lateral axis be included as well.

Answer the following questions on a separate piece of paper, using the information above.

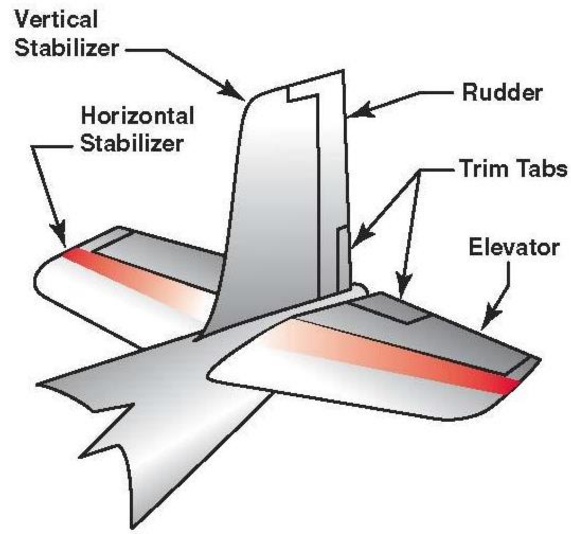
1. What are the three axes of an aircraft called?
2. What is roll?

3. What is yaw?
4. What axial movements are normally used in a level turn? Why?

Part 5 – Aircraft Control Surfaces

Aircraft Tail Section (Vertical & Horizontal Stabilizer)

An aircraft's empennage is very often called the tail section. Its most obvious parts are the vertical and horizontal stabilizers, each of which has other names as well. The vertical stabilizer is sometimes referred to as the fin and the horizontal stabilizer is sometimes referred to as the tailplane.



The rudder is hinged to the back of the vertical stabilizer or fin. It is used to steer (yaw) the aircraft around the vertical axis.

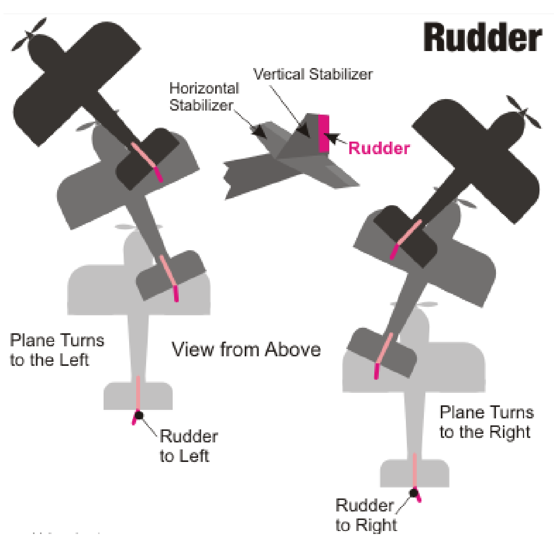
The elevator is hinged to the back of the horizontal stabilizer or tailplane. It is used to climb or descend by changing pitch around the lateral axis.

The horizontal and vertical stabilizers also reduce unwanted pitch and yaw. The control surfaces are held straight by the passing wind. This is because the air moving past the flat surfaces of the stabilizers tends to resist a change of direction as predicted by Newton's second law (a force must be applied to alter the motion of the air).

The vertical stabilizer, or fin, provides the aircraft with directional stability. Air moving past the fin resists any unwanted yaw around the vertical axis.

The horizontal stabilizer, or tailplane, provides the aircraft with longitudinal stability. That is, air moving past the tailplane resists unwanted roll around the longitudinal axis and unwanted pitch around the lateral axis.

Rudder & Yaw



The rudder is located at the very back of the aircraft, hinged to the trailing edge of the vertical stabilizer, or fin.

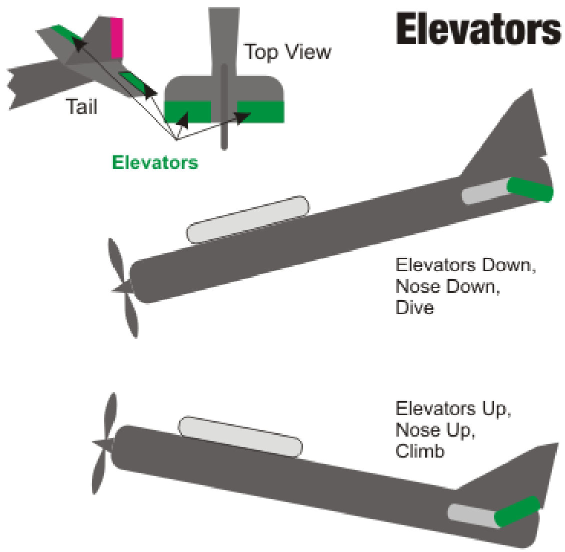
The rudder can be turned left and right to give the pilot directional control. The rudder rotates the aircraft about its vertical (yaw) axis by pushing the tail to the left or to the right.

Pressure applied to the right pedal moves the rudder to the right. When the rudder is turned to the right side of the fin, the tail moves to the left This moves the nose of the aircraft to the right, causing the aircraft to yaw to the right around its vertical axis.

Pressure on the left rudder pedal displaces the rudder to the left into the airflow. When the rudder is turned to the left side of the fin, this increases pressure on the left side and forces the tail to move to the right, causing the aircraft to yaw to the left around its vertical axis.

The rudder is operated by the rudder bar or pedals in the cockpit. The pedals work together. When the bar or pedals are level the rudder is straight. Pressure applied to the right pedal moves the left pedal upwards and vice versa.

Elevators



Both the left and right portions of the horizontal stabilizer, or tailplane, have a moveable control surface known as an elevator.

The elevator, of which there is normally a left and a right section, is located on the trailing edge of the horizontal stabilizer. It is used to give the pilot lateral control. The pilot controls the elevator by pushing or pulling on the control column.

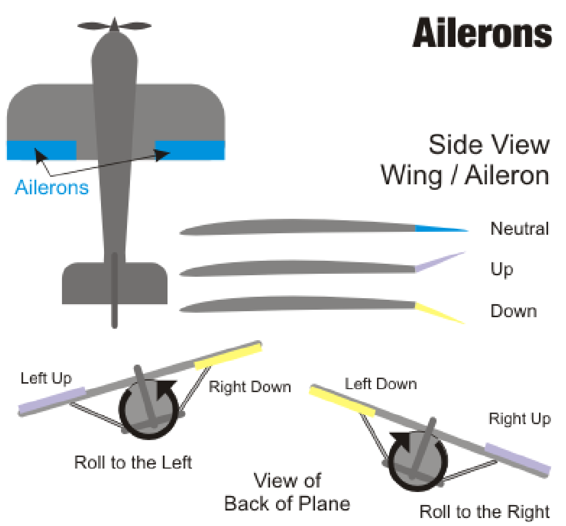
Pushing the control column forward lowers the elevator into the wind passing under the tailplane, pushing the empennage up. This causes the aircraft's nose to drop and the aircraft will descend.

Pulling the control column back raises the elevator into the wind passing over the tailplane, pushing the empennage down. This causes the aircraft's nose to rise and the aircraft will climb.

These pitch movements take place around the lateral axis.

Ailerons

The surfaces that control roll are located near the ends of the wings on the trailing edge. They are called ailerons.



Ailerons operate simultaneously, but in opposite directions. When the right aileron rises to push the right wing down, the left aileron lowers to push the left wing up.

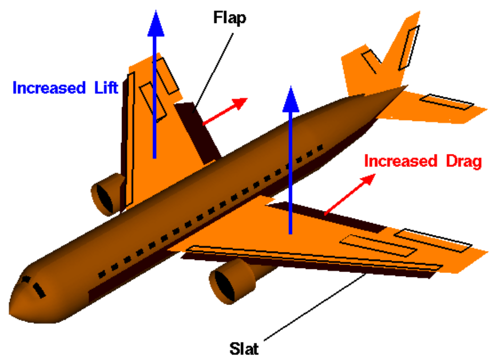
The down-going aileron increases the wing's lift and the up-going aileron decreases the wing's lift. Therefore, the left wing's lift increases and the right wing's lift decreases. The left wing lifts and the right wing descends, so the aircraft rolls to the right and keeps rolling until the ailerons are retracted.

When the control column is moved to the right, the left aileron moves down and the right aileron moves up so the aircraft rolls to the right into a banked position. When the control column is moved to the left, the left aileron goes up and the right one moves down so the aircraft rolls to the left into a banked position.

When the pilot wants to stop the roll and stay in a banked position, the control column is returned to centre and the ailerons retract. To recover from the roll into a level position, the ailerons must be extended into the opposite directions. They are then retracted for level flight.

Flaps

Flaps are located nearer the fuselage on the trailing edge of the wing.



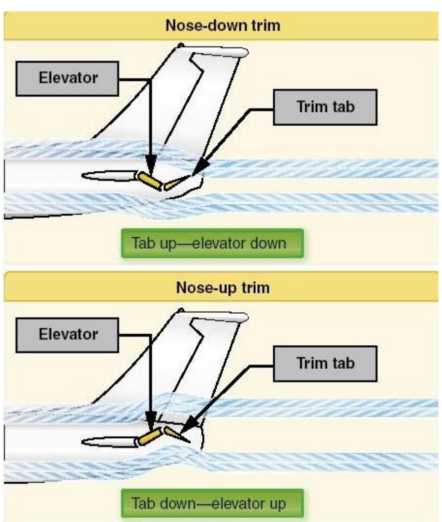
Both flaps operate together. They are raised together and they are lowered together with one control mechanism.

Flaps are lowered to create lift and to slow the aircraft. When they are lowered into the air moving past the under-surface of the wing, they slow the air and the air pushes them up, creating lift while simultaneously slowing the aircraft by creating both form drag and induced drag. When fully lowered, the drag created exceeds the lift generated. Flaps allow for shorter and safer landings.

The aircraft's flaps are also located on the trailing edge of the wing, as are ailerons, but the flaps are placed

Trim Tabs

Trim tabs were developed to hold control surfaces in position without constant control pressure from the pilot.



A pilot has to do a lot of work to hold control surfaces in position. When the pilot has set a course in a crosswind, the control surfaces often have to stay in a working position for long periods of time. To save the pilot from having to do this, trim tabs were invented.

A trim tab is a small, adjustable control surface that can be extended from the trailing edge of an aircraft's control surface. So, it is a control surface that is hinged onto a larger control surface. The wind, pushing on the trim tab when it is extended, provides the force necessary to hold the aircraft's main control surface in position.

Trim tabs are often found on the trailing edge of the rudder, the elevators and on the ailerons.

Dynamically Balanced Control Surfaces

Dynamically balanced control surfaces were developed to make pilots' work easier. These surfaces use air pressure to help move the controls by having a portion of the control surface in front of its own hinge to catch the passing air. This takes the load off the pilot's control mechanism. That way, the wind itself helps push the control surface into the position that the pilot has selected, making the controls feel lighter.

Answer the following questions on a separate piece of paper, using the information above.

1. What axial movements do the elevator and the rudder produce?

2. How do flaps help with landings?
3. How does the pilot stop the roll and stay in the banked position?
4. How do flaps affect an aircraft's landing performance?
5. What are trim tabs for?

PO 232 – Aircraft Engines

Part 1 – Types of Aircraft Engines

A powered aircraft needs a means of propulsion to overcome drag and allow the wings to generate sufficient lift to overcome weight.

The propeller and jet engine are very closely related, providing thrust by the same means – the acceleration of a mass of air. The propeller generates thrust by acting on a large mass of air, giving it a relatively small acceleration. The jet engine does exactly the same thing by giving a larger acceleration to a smaller mass of air.

The most common engine types used for aviation propulsion employ internal combustion and they include:

- rocket engines,
- gas turbine jet engines, and
- reciprocating piston-powered engines.

The earliest vehicle engines were rocket engines used to power ancient Chinese fire arrows. This method of propulsion proved so effective that, with many improvements, it is still commonly used today for many applications including space exploration.

Piston-powered internal combustion engines were developed in the late nineteenth century and are the most common vehicle engine. In many ways, pistons are the most complicated system of converting the chemical energy of fuel into the energy of motion but they are found in many places, including aircraft, automobiles, boats and lawnmowers.

Gas turbine jet engines are improvements upon simple ramjets. The ramjet is a liquid-fuelled rocket-like engine, which uses atmospheric oxygen to burn fuel. One of the most limiting aspects of a ramjet is that it requires high velocity to work. Therefore it cannot start combustion until it is up to speed. Air-launched missiles are one of the few applications of ramjet engines.

Any turbine converts the energy of moving liquid or gases, such as jet exhaust or wind, into rotary motion to turn a shaft. A windmill is a turbine which uses wind energy to turn a shaft. Among other advantages, adding a turbine to the simple ramjet allows a compressor to generate high-pressure air so that the gas turbine jet engine can be started from a resting, or static, position.

A gas turbine jet engine that provides thrust, with no rotating shaft output, is a TURBOJET engine.
A gas turbine jet engine that provides thrust and also drives a propeller is a TURBOPROP engine.

A gas turbine engine that drives a helicopter rotor is usually a TURBOSHAFT engine. In a turboshaft helicopter engine, the output driveshaft is separate from the compressor turbine shaft so that engine speed is not tied to the helicopter’s main rotor speed.

The most common variation of the gas turbine jet engine is the TURBOFAN, which is a hybrid of a turbojet and a turboprop. The turbofan has a fan that provides thrust with bypass air, in place of a propeller, adding to the reactive thrust of the ejected exhaust gases. This application allows the aircraft to go faster than normal propellers could go, while also reducing engine noise and allowing the aircraft to make efficient use of fuel. The noise reduction and fuel efficiency of turbofans make them very effective for commercial aviation.

Answer the following questions on a separate piece of paper, using the information above.

1. Which engine type was the first to be used for propulsion?
2. Why does a gas turbine jet engine need to have a starting motor?

Part 2 – Major Components of Piston-Powered Internal Combustion Engine

Cylinder. In order to understand how an engine works, it is necessary to first know what parts make up an engine. The cylinder is the main component. This is where the combustion of a gasoline and air mixture takes place.

Piston. The piston is found in the cylinder and is driven up and down by the exploding air and fuel mixture.

Connecting Rod. The piston is attached by a connecting rod to the crankshaft. The connecting rod is joined to the piston and to the crankshaft with bearings which allow movement so that the reciprocating (up-and-down) motion of the piston can be transformed into rotary (spinning) motion of the crankshaft.

Crankshaft. As the piston drives up and down, the connecting rod rotates around the crankshaft, turning it. The crankshaft can rotate while the piston goes up and down.

Camshaft. The crankshaft often turns a second shaft called a camshaft. The cams are bumps on the camshaft that open and close the intake and exhaust valves at the correct time. Of course, the crankshaft also powers the aircraft's propeller. Each cylinder has at least one set of valves operated by the cams on the camshaft. The intake valve opens to let the mixture of gasoline and air into the cylinder and then it closes. Once this is done and the mixture is burnt, the exhaust valve opens to release the exhaust and then closes.

Distributor. The gasoline and air mixture is ignited by a spark plug. Most aircraft have two spark plugs in every cylinder. The fuel takes time to burn completely. Because of this time delay, the spark must happen at just the right time; a fraction of a second before the piston has reached the top of its stroke. In a multi-cylinder engine such as aircraft use, an electrical signal must be sent to each cylinder's spark plug at exactly the right time. The timing and distribution of spark sometimes relies on a central distributor, which is worked by gears from the crankshaft. Should this distributor fail, the engine will stop. A better, though more expensive method, is to equip each cylinder with its own spark timing and delivery system.

Carburetor. Before fuel is delivered to the cylinder for detonation, it is mixed with air in exact proportion. A fuel injector or a carburetor does this. For effective detonation and clean burning, the fuel must be broken into tiny droplets and mixed with air.

Oil Sump. The moving parts of the engine all need to be coated with engine oil. Oil is provided under pressure to make sure that all moving parts are coated. A wet sump stores the oil supply in the crankcase with the crankshaft, while a dry sump stores the oil in a separate tank and delivers it to the engine via piping.

Aircraft Engine Arrangements

The horizontally opposed engine is most commonly used in general aviation airplanes. This engine has two banks of cylinders lying flat, directly opposite each other and working on the same crankshaft. There may be four, six or eight cylinders. The advantage of this engine type is its flat shape that generates less form drag. Form drag is a force that opposes the aircraft's movement through the air.

Many larger older aircraft had radial engines. In this design the cylinders were arranged in a circle at the front of the engine with the cylinder tops pointed outwards. The crankshaft ran through the middle of the cylinders to the front of the aircraft. Radial engines had many cylinders; some aircraft from World War II had 13 cylinders.

Some older aircraft have in-line engines. This was the first type of aircraft engine used in great numbers. In an in-line engine, the cylinders are lined up in a row from the front of the engine to the back, with the tops pointed up. The crankshaft runs under the cylinders to the front of the aircraft.

Answer the following questions on a separate piece of paper, using the information above.

1. Where does combustion take place in a piston-powered engine?
2. Why does the piston go up and down?
3. How are the cylinders arranged in an in-line engine?
4. Why are horizontally opposed engines the favoured design for small aircraft engines?

Part 3 – Cycles of a Four Stroke Engine

The parts of an engine work together in a cycle to turn the aircraft's propeller. In most aircraft engines, this cycle has four distinct stages called strokes:

- the **intake stroke** draws fuel and air into the cylinder;
- the **compression stroke** forces the fuel and air into the combustion chamber;
- the **power stroke** transmits the energy of the exploding fuel to the crankshaft; and
- the **exhaust stroke** cleans the cylinder of exhaust fumes and prepares it for the next intake stroke.

During the first (intake) stroke, the intake valve opens to let the gasoline and air mixture into the cylinder and the piston moves down to draw the mixture into the cylinder. The exhaust valve is closed during this stroke.

In the second (compression) stroke, both valves are closed while the piston moves up to compress the mixture.

In the third (power) stroke, both valves remain closed while the spark plug ignites the gas, which burns, expands and forces the piston down again.

In the fourth (exhaust) stroke, the exhaust valve is open to let the burnt gases out while the intake valve is closed. The piston moves up again to force the burned gases out through the open exhaust valve.

After the exhaust stroke, the whole process repeats itself thousands of times per minute, causing the crankshaft to turn the propeller on the aircraft.

Operation of Valves and Camshafts

Other important components of piston-powered four-stroke internal combustion engines are the cam systems, which operate the valves. Since the crankshaft rotates with the piston movements, its rotation is used to provide signals to the valves, telling them when to open. The usual method is to arrange for the crankshaft to turn a secondary shaft (camshaft) that has lobes, or cams, raised on its surface. The shape of the cam is such that it mechanically pushes its associated valve open just the right amount at just the right time.

Timing of Electrical Ignition Spark Distribution

Even though an explosive detonation like that found in a piston-powered engine cylinder seems to happen in an instant, time is actually required. The engine turns very fast, thousands of revolutions per minute, so time is short. To ensure that the fuel is burned completely and that all energy is recovered from the fuel, the spark that sets off the detonation must be delivered while the piston is still rising on the compression stroke.

The engine operation must proceed as follows:

- Fuel and air mixture must be available for all cylinders, all the time, in a multi-cylinder engine.
- The intake stroke of the piston must take place with the intake valve open and the exhaust valve closed.
- The compression stroke of the piston must take place with both valves closed.
- Electrical signals must be delivered to spark plugs just before the piston completes the power stroke, when both valves are closed.
- The power stroke of the piston must take place with both valves closed.
- The exhaust stroke of the piston must take place with the exhaust valve open and the intake valve closed.
- The camshaft must push each valve open and closed at the right times.

Answer the following questions on a separate piece of paper, using the information above.

1. How many complete revolutions of the crankshaft are in four strokes?
2. What pushes the valve open the right amount at the right time?
3. Why is the spark delivered to the cylinder early, during the compression stroke?
4. On which strokes is one valve open?

Part 4 – Functions of Oil

Oil plays an important role in the functioning of an aircraft engine. Oil fulfills four important functions:

- Lubricating,
- Sealing,
- Cooling, and
- Flushing.

Lubricating

Oil lubricates the engine by creating a smooth surface between parts that rub together, such as the piston when it moves up and down in the cylinder.

Oil is manufactured in different grades and viscosities. The grade of a particular sample of oil is a measure of its ability to maintain its viscosity, or resistance to flow, under extreme temperatures. The viscosity, or resistance to flow, affects the oil's stickiness. Low-viscosity oil flows more easily than high viscosity oil. Oil thins as its temperature is raised so the correct grade of oil must be selected for the intended condition when the engine is at operating temperature. Oil that is too thin (too low a viscosity number) at operating temperature will result in low oil pressure and will not protect the engine component surfaces adequately. Oil that is too thick will result in too high an oil pressure and will not be delivered in sufficient quantity when the engine is cold.

A good grade of oil is one in which the changes in viscosity, due to widely varying operating temperatures, are small.

Cold oil is often too thick to be delivered to the engine component's metal surfaces in sufficient quantity so when an engine is cold it should not be run fast or given a load. An aircraft will often be seen sitting still with the engine and propeller running while the engine oil comes up to temperature, just like a car in the winter.

Sealing
Oil seals the combustion chamber by preventing the expanding gases from leaking out during the power stroke. It does this by creating a barrier between the engine components so that air and other gases cannot get through. This is especially important in the cylinder, so that the exploding gasoline and air mixture does not escape.

Oil has conflicting demands to meet. A high viscosity (resistance to flow) provides the best seal for the combustion chamber but a low viscosity enables the oil to be delivered in greater quantity to bearing surfaces. The same oil must do both jobs and so the engine manufacturer must consider both of these competing requirements when specifying the viscosity and grade of oil to be used.

Cooling
Some parts of the engine get hotter than other parts. Areas near the combustion chamber get particularly hot and need to be cooled. Oil cools hot spots in the engine by carrying heat away and equalizing temperature within the engine. This equalization of temperature also helps to bring a cold engine up to operating temperature quickly.

Oil must maintain its viscosity while near the heat of the combustion chamber and so manufacturers of oil have developed viscosity modifiers that lessen the change of viscosity that results from temperature change. Engine manufacturers take this into consideration when specifying what oil to use.

Flushing
Oil flushes the engine. It removes and holds tiny particles and grit, which are harmful to the engine. This means the oil carries away dirt and debris from the engine as it flows through. This is why it is important to change oil at frequent intervals as specified by the engine manufacturer.

As the oil is continuously circulated around the engine it passes through an oil filter. This filter fills with debris and must also be changed at regular intervals to remain effective, just as in a car.

Answer the following questions on a separate piece of paper, using the information above.

1. How does oil lubricate an engine?
2. What part of the engine does oil help seal and why?
3. How does oil cool hot spots in the engine?
4. How does oil clean the engine?

PO 240 – Aerospace

Part 1 – Advancements in Aerospace Technology

Refer to the attached Annexes titled "Information Cards". Then, answer the following questions on another sheet of paper.

1. What is a current advancement in aerospace technology that has impacted Earth today?
2. What advancement in aerospace technology is of most interest to you and why?
3. What is a current technology item in use today designed by the Canadian Space Agency?

Part 2 – Invent a Space Technology

Travelling to and From Space

One of the biggest challenges for astronauts is travelling to and from space. The astronaut's body and the space shuttle experience a large amount of stress through turbulence as they pass through the Earth's atmosphere. Temper Foam is a cushioning material that is shock absorbent and is also softest where the body contacts it. It is a NASA-developed technology that is used in the seats on the space shuttle to reduce the stress through turbulence that the astronauts experience during the violent shaking during launch.

Heat stress that occurs as they re-enter the Earth's atmosphere is also another challenge. Imagine a place with no air, with temperatures that vary from extreme hot to extreme cold, and where particles of dust travel at speeds that could kill you. These are just some of the situations astronauts have to cope with when they travel in space.

The Living Environment

The strangest condition in space is the lack of gravity. Gravity is a force that makes objects move toward each other. The Earth's gravity keeps your feet on the ground and makes objects fall down by pulling them toward Earth. On a spaceship, there is no gravity and everything floats in the air. Velcro is used to anchor objects and prevent them from floating around. It takes time for an astronaut's body to adjust to living in space and many astronauts suffer from space sickness for the first few days or weeks of a mission.

Astronaut apparel has evolved over the decades from Mercury's aluminium foil-looking outfits to the bulky, 275-pound whites now used on space walks outside the space station. The U.S. suits are easier to work in for long periods of time but their complexity causes more maintenance. The one-size-fits-all Russian suits are used a few times and thrown away, but they are also not easy to work in.

NASA is hoping to make new suits that are both high-tech and low-maintenance.

Answer the following questions on a separate piece of paper, using the information above.

1. What is one of the biggest challenges with space technology?
2. What is the strangest condition an astronaut experiences in space?
3. What do many astronauts suffer from for the first few days or weeks in space?

Part 3 – Space Survival Scenario

Refer to the attached Annexes titled "Space Survival Scenario". Choose 5 items you will need to survive. Rank them in order of importance. Then, answer the questions below on a separate piece of paper.

1. What were the items that you selected to survive in space?
2. Why did you select these survival items?
3. What was the most important item on your list and why?

PO 260 – Aerodrome Operations

Part 1 – Aspects of ATC

The ATC system is a vast network of people and equipment that ensures the safe operation of commercial and private aircraft.

The air traffic controller's' immediate concern is safety, but controllers must also direct planes efficiently to minimize delays. Their main responsibility is to organize the flow of aircraft into and out of the aerodrome.

Air traffic controllers coordinate the movement of air traffic to make certain that planes stay a safe distance apart. They prevent collisions between:
- aircraft,
- aircraft and obstructions, and
- aircraft and vehicles on the manoeuvring area.

In addition, air traffic controllers keep pilots informed about changes in weather conditions such as wind shear, a sudden change in the velocity or direction of the wind that can cause the pilot to lose control of the aircraft.

ATC Authorization
An ATC clearance is an authorization from an ATC unit for an aircraft to proceed within controlled airspace under specific conditions. Some air traffic controllers regulate traffic through designated airspaces; others regulate airport arrivals and departures.

RADAR
The name "RADAR" is an abbreviation for "radio detection and ranging". To operate, radar requires a highly directional radio transmitter/antenna and a scope, or screen, to display the information received by the antenna.

The principle uses of radar in aviation are:
- ATC;
- fixing positions of airplanes in flight;
- detecting thunderstorm activity; and
- approaching and landing guidance to airplanes.

The use of radar in ATC greatly increases the use of the airspace and permits expansion of flight information services.

NORDO
Aircraft without radio (NORDO) are not permitted to operate at most large controlled airports. Where they are permitted to operate (less busy controlled airports), they are directed by visual signals. A pilot must be alert to the light signals from the tower letting you know what to do.

Prior to initiating a NORDO flight, the pilot should contact the control tower to inform the controllers of their intentions and to secure a clearance for operation within the airspace. The tower will then be expecting the pilot and will be prepared to give the pilot light signals.

Light Signals for Aircraft on the Ground
- **Flashing Green.** Cleared to taxi.
- **Steady Green.** Cleared for take-off.
- **Flashing Red.** Taxi clear of runway in use.
- **Steady Red Light.** Stop.
- **Flashing White.** Return to the starting point at the airport.
- **Blinking Runway Lights.** Vehicles and pedestrians are to vacate the runway immediately.

Light Signals for Aircraft in the Air
- **Steady Green Light.** Clear to land.
- **Steady Red Light or Red Flare.** Do not land. Continue in circuit.
- **Flashing Green Light.** Recall signal. Return for landing (usually to recall an airplane which has taken off or has been previously waived off with a red light). This will be followed by a steady green light when the approach path and landing area is clear.
- **Alternating Red and Green Light (U.S.).** Danger. Be on alert. This signal may be used to warn you of such hazards as danger of collision, ice on runways, etc.
- **Flashing Red Light.** Airport unsafe. Do not land.
- **Red Pyrotechnical Light.** Do not land for the time being.

Answer the following questions on a separate piece of paper, using the information above.
1. What is the air traffic controller's immediate concern?
2. What are the three main things that air traffic controllers prevent collisions between?
3. What is an ATC clearance?
4. What does the abbreviation "RADAR" mean?

Complete the attached Annex titled "NORDO Signals".

Part 2 – Basic Aerodrome Operations

Basic Aerodrome Operations
Basic operations at a civilian aerodrome are generally divided into three categories. They are air traffic control, ground control and airport maintenance.

Air Traffic Control. The task of ensuring safe operations of commercial and private aircraft falls on air traffic controllers. They must coordinate the movements of thousands of aircraft, keep them at safe distances from each other, direct them during takeoff and landing, direct them around bad weather and ensure that traffic flows smoothly with minimal delays.

Ground Control. Ground control, sometimes known as Ground Movement Control (GMC) or Surface Movement Control (SMC) is responsible for the airport "manoeuvering" areas, including all taxiways, holding areas, and some transitional aprons or intersections where aircraft have arrived and vacated the runways and departure gates.

Airport Maintenance. Airport maintenance is responsible for a variety of airport field maintenance work, including general maintenance and construction work. They operate equipment and service a variety of power and general maintenance equipment in the upkeep of runways, taxiways, and aprons as well as perform other related duties.

The Role of Ground Controllers

Once an aircraft has landed, ground controllers provide the pilot with precise taxi information to passenger gates.

From the cockpit, it is difficult to assure that there is sufficient clearance between the aircraft structure and any buildings or other aircraft. Marshalling personnel are provided to assist aircraft when arriving at and departing from passenger gates.

While the goal of ground controllers is to maintain aircraft in such a manner as to assure safe flight, they must provide clearance for aircraft-to-taxi on the ground at the aerodrome while creating a safe environment while an aircraft is on the ground.

Ground Facilities

Ground facilities and services assist with aircraft arrivals and departures. The following are some of the ground services and facilities that can be found at a basic aerodrome.

Runway Maintenance: Runway maintenance is responsible for the runway upkeep within the airport grounds. Duties range from tarmac servicing to keeping the runways in good condition. During the winter, the main focus of the work is on runway and taxiing area maintenance.

Runway Lighting: Runway lighting is used at airports which allow night landings. Seen from the air, runway lights form an outline of the runway. A particular runway may have some or all of the following:

- **Runway End Identification Lights (REIL).** A pair of synchronized flashing lights installed at the runway threshold, one on each side.
- **Runway End Lights.** Rows of lights on each side of the runway that extend along the full width of the runway. These lights show green when viewed by approaching aircraft and red when seen from the runway.
- **Runway Edge Lights.** These are white elevated lights that run the length of the runway on either side. Taxiways are differentiated by being bordered by blue lights.
- **Runway Centreline Lighting System (RCLS).** These are lights embedded into the surface of the runway at 50 foot intervals along the runway centreline on some precision instrument runways. The lights are white except for the last 3000 feet, which alternate white and red for 2000 feet and red for the last 1000 feet.
- **Touchdown Zone Lights (TDZL).** This consists of rows of white light bars (with three in each row) on either side of the centreline over the first 3000 feet of the runway.
- **Taxiway Centreline Lead-off Lights.** They are alternating green and yellow lights that are embedded into the runway pavement. They start with green lights branching off the runway centreline to the position of the first centreline light beyond the holding position on the taxiway.
- **Taxiway Centreline Lead-on Lights.** These are installed the same way as the taxiway centreline leadoff lights.
- **Land and Hold Short Lights.** These are a row of white blinking lights installed across the runway to indicate the hold short position on some runways.
- **Approach Lighting System (ALS).** A lighting system installed on the approach end of an airport runway, it consists of a series of light bars, strobe lights, or a combination of the two that extend outward from the end of the runway.

Baggage Handling: Baggage handlers work both indoors and outdoors at an aerodrome. They are responsible for making sure that not only does the mail, freight and luggage get onto the right aircraft but also that it gets there on time.

Fuel Storage Systems: Most of the large airports that service transport category aircraft have underground storage tanks and buried fuel lines. This arrangement allows the aircraft to be fuelled without having to carry the fuel to the aircraft in fuel trucks. Most aircraft that are fuelled from this type of system use under-wing fuelling.

De-Icing & Anti-Icing: The successful treatment of ice and snow deposits on airplanes on the ground is an absolute necessity for safe winter operations. A flight that is expected to operate in known ground icing conditions shall not takeoff unless the aircraft has been inspected for icing and, if necessary, has been given the appropriate de-icing/anti-icing treatment.

Answer the following questions on a separate piece of paper, using the information above.

1. What three categories are basic operations divided into at a civilian aerodrome?
2. What is the goal of ground controllers?
3. What are five ground services or facilities that assist aircraft during arrivals and departures?
4. What lights may a particular runway have?
5. What is an absolute necessity for airplanes on the ground in winter operations?

PO 270 – Aircraft Maintenance

Part 1 – Aircraft Systems & Components

The following are just a few aircraft systems and components that are manufactured to be used in assembling aircraft.

Instrument Systems: The development of efficient flight instruments is one of the most important factors that contributed to the growth of the present air transportation system. Prior to World War II, few airplanes were equipped for flight without using ground reference navigation. Aircraft instrument systems include flight instruments that depict the attitude, airspeed, and altitude of the aircraft, making up the aircraft instrument systems. Other instruments provide information about the engine or electrical system.

Electrical Systems: These systems generate and route electricity to various aircraft components such as generators, motors and inverters. There are many manufacturers of these components that make up the airframe electrical systems. Because of the expense of the tools, test equipment and current technical publications, component manufacturers or certified repair stations service many of the electrical components.

Power Systems: Early aircraft were equipped with flight controls and systems that were connected directly to the cockpit controls. As aircraft became more complex, it became necessary to operate systems remotely and the first of these was the brake system. Instead of cables or pushrods operating the brakes, hydraulic pressure was used. While small aircraft continue to use cables or pushrods for operating flight controls, aircraft manufacturers equip larger aircraft with hydraulic or pneumatic control systems for their primary system.

Landing Gear Systems: The landing gear of the very first airplanes was not very complex. The Wright Flyer, for instance, took off from a rail and landed on skids. However, soon after the basic problems of flight were solved, attention was turned to providing better control and stability of the aircraft while it was operated on the ground. Retraction systems, shock absorbing and non-shock absorbing systems, aircraft wheels, nose wheel steering systems and aircraft brakes are some of the other components involved in manufacturing the landing gear.

Fuel Systems: All fuel systems share many of the same common components. Every system has one or more fuel tanks, tubing to carry the fuel from the tank(s) to the engine(s), valves to control the flow of fuel, provisions for trapping water and contaminants and a method for indicating the fuel quantity.

Answer the following questions on a separate piece of paper, using the information above.

1. List the aircraft systems manufactured to be used in assembling an aircraft.
2. What are some of the other components involved in manufacturing landing gear?

Part 2 – Materials Used in Aircraft Manufacturing

Non-Ferrous Metals

Much of the metal used on today's aircraft contains no iron. The term that describes metals which have elements other than iron as their base is non-ferrous. Aluminum, titanium, nickel and copper are some of the more common non-ferrous metals used in aircraft manufacturing and repair.

Aluminum and Its Alloys. Pure aluminum lacks strength to be used for aircraft construction. However, its strength increases considerably when it is alloyed, or mixed with other compatible metals.

Titanium. Titanium and its alloys are lightweight metals with very high strength. Pure titanium is about 50 percent lighter than stainless steel, yet it is approximately equal in strength to iron. Pure titanium is soft and flexible with a density between that of aluminum and iron.

Nickel. Aircraft technicians need to be familiar with two nickel alloys. They are monel and inconel.

- **Monel.** Monel contains about 68 percent nickel and 29 percent copper, along with small amounts of iron and manganese. Monel works well in gears and parts that require high strength and toughness, as well as for parts in exhaust systems that require high strength and corrosion resistance at elevated temperatures.
- **Inconel.** Inconel contains about 80 percent nickel and 14 percent chromium, and small amounts of iron and other elements. Inconel is frequently used in turbine engines because of their ability to maintain their strength and corrosion resistance under extremely high temperatures.

Copper. Neither copper nor its alloys find much use as structural materials in aircraft construction. However, due to its excellent electrical and thermal conductivity, copper is the primary metal used for electrical wiring.

Composites

Graphite Fibres. Graphite fibres are manufactured by heating and stretching rayon fibres. This produces a change in the fibres' molecular structure that makes it extremely lightweight, strong, and tough.

Kevlar Fibre. Kevlar fibre is one of the most commonly used cloth-reinforcing fabrics. In its cloth form, Kevlar is a soft yellow organic fibre that is extremely light, strong and tough. Its great impact resistance makes it useful in areas where damage from sand or other debris can occur. These areas include around landing gear and behind propellers. Kevlar is rather difficult to work with however, and does not perform well under compressive loads.

Glass Fibre/Fibreglass. Fibreglass greatly enhances the strength and durability of thermosetting resin, which is a material that hardens when heated. For high strength requirements, the glass fibres are woven into a cloth. On the other hand, where cost is of greater importance than strength, the fibres are gathered into a loose mat which is saturated with resin and moulded into a desired shape.

Answer the following questions on a separate piece of paper, using the information above.

1. What was the breakthrough that occurred in the aircraft aluminium industry?
2. What are some of the more common non-ferrous metals used in aircraft manufacturing and repair?

Part 3 – Aircraft Manufacturing Careers

An **aircraft interior technician**'s primary responsibilities include the removal, disassembly, cleaning, inspection, repair and re-installation of aircraft cabin furnishings. The technicians work both in an aircraft cabin and in a shop, and are familiar with the function, operation and safety requirements of aircraft passenger support systems. They maintain oxygen, water, waste, entertainment, and emergency systems and equipment. In addition, they refurbish seats, seat belts, carpets, interior panelling, windows, and galley and washroom modules.

Students prepare for a career in aircraft maintenance and begin to qualify for an **aircraft maintenance engineer (AME) – Category "E" license (Avionics).** Aircraft avionics technicians are responsible for the servicing, repair and modification of aircraft electronic systems and components. The job includes removing and installing components, bench testing and troubleshooting complex electronic aircraft systems.

Students prepare for a career in aircraft maintenance and begin to qualify for an **aircraft maintenance engineer (AME) – Category "M" license (Maintenance)**. AMEs are responsible for the release (certification) of an aeronautical product (aircraft), after maintenance or inspection. The job responsibilities include a variety of tasks including removing and installing components and troubleshooting complex systems. A qualified AME is able to maintain small aircraft, helicopters, and large transport category aircraft. Larger aircraft are quite sophisticated as they possess many different electrical, electronic, pneumatic, hydraulic, mechanical and propulsion systems, and the AME must understand and maintain them.

Students prepare for a career in aircraft maintenance and begin to qualify for an **aircraft maintenance engineer (AME) – Category "S" license (Structures)**. Category "S" structures technicians are responsible for the assessment, planning and implementation of aircraft structural fabrication and repairs. Structures technicians are often an integral part of repair crews including maintenance technicians, avionics technicians and professional engineers. They are expected to precisely follow aircraft fabrication and repair schemes for aluminium, titanium and stainless steel structures, as well as plastics and composites.

Aircraft mechanical component technicians are involved in the overhaul, repair, modification, inspection, testing and certification of aviation components of pneumatic, hydraulic, fuel, electrical, environmental and mechanical aircraft systems. Working in a shop environment, technicians are thoroughly familiar with the set-up and operation of tools and shop equipment as well as some semi-automatic processes.

Aircraft gas turbine technicians enjoy a challenging occupation requiring a high degree of responsibility and skill. Technicians perform the disassembly, inspection, repair, assembly and testing of gas turbine engines in a clean shop environment with regular working hours.

Answer the following questions on a separate piece of paper, using the information above.

1. What was the most interesting career to you? Why?
2. What are the primary responsibilities of the career that you found most interesting?

Part 4 – Aircraft Maintenance

In air operations, maintenance, overhaul, and repair are ongoing duties performed to maintain the performance and safety of the aircraft. In air operations, maintenance, overhaul and repair are defined as follows:

- **Maintenance.** Continuing repair work; work that is done regularly to keep a machine, building, or piece of equipment in good condition and working order.
- **Overhaul.** Checking for mechanical faults; to examine a piece of machinery thoroughly to identify faults and improve or repair as necessary.
- **Repair.** Fixing or mending something; to restore something broken or damaged to good condition.

Instrument Systems: Maintenance technicians must be familiar with the various types of instruments used to convey information to the pilot. The aircraft instrument systems group includes mechanics and technicians who install, adjust, repair and overhaul aircraft instruments and electrical or avionics systems on aircraft. This group also includes avionics inspectors who inspect instrument, electrical and avionics systems following assembly, modification, repair or overhaul. Workers in this group are employed by aircraft manufacturing, maintenance, repair and overhaul establishments and by airlines, the Canadian Forces and other aircraft operators.

Electrical Systems: An aviation maintenance technician must be familiar with aircraft electrical systems, including ways in which electricity is generated and routed to various aircraft components. By understanding the principles of electricity and electrical system designs, a technician can effectively diagnose, isolate and repair malfunctions.

Power Systems: Work performed by liquids is called 'hydraulic' whereas work performed by air is called "pneumatic". Today's aviation maintenance technician must be familiar with the principles of hydraulic and pneumatic systems as well as how the different aircraft systems utilize these principles.

Landing Gear Systems: Landing gear and wheels now absorb the extreme loads imparted during takeoffs and landings. In addition, braking systems were installed to provide safer and more efficient control of slowing an airplane after landing. In later years, as aircraft designs improved to increase speed and efficiency, retraction systems were provided to allow the landing gear to be stowed during flight to reduce aerodynamic loads or drag. With continued improvements in technology, landing gear systems on modern aircraft are highly reliable and capable of handling extreme conditions, enabling safe transitions between flight and ground mobility. The industry regulation requires the strictest performance of scheduled maintenance, repairs, and overhauls on aircraft landing gear systems.

Fuel Systems: Modern aircraft fuel is generally stored in the wings, and on ultra-long-range jetliners, extra fuel storage is located in the tail area. Volatile fuels are crucial to the performance of fuel systems in modern aircraft. Although the fuel systems are relatively simple, the safety and reliability of these systems is dependent on proper inspection and maintenance.

Answer the following questions on a separate piece of paper, using the information above.

1. Define maintenance.
2. What systems were installed, in addition to the landing gear, to provide safer and more efficient control of slowing an airplane after landing?
3. What are the safety and reliability of fuel systems dependent on?