**OALCF Task Cover Sheet**

**Task Title:** Understanding Gears and Calculating Gear Ratios

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| **Learner Name:** | |
| **Date Started: Date Completed:**  **Successful Completion: Yes\_\_\_ No\_\_\_** | |
| **Goal Path:** Employment\_\_\_ Apprenticeship**✓** Secondary School\_\_\_ Post Secondary\_\_\_ Independence\_\_\_ | |
| **Task Description:**  Understanding various gears used in industry and calculations for installing correct gears into machinery. | |
| **Competency:**  A: Find and Use Information  B: Communicate Ideas and Information  C: Understand and Use Numbers | **Task Group(s):**  A1: Read Continuous Text  A2: Interpret Documents  B2: Write Continuous Text  C4: Manage Data |
| **Level Indicators:**  A1.2: Read texts to locate and connect ideas and information  A2.2: Interpret simple documents to locate and connect information  B2.2: Write texts to explain and describe information and ideas  C4.3: Find, integrate and analyze data; identify trends in data | |
| **Performance Descriptors:** see chart on last page | |
| **Materials Required:**   * Attached document - Understanding Gears and Calculating Gear Ratios * Pen and paper | |

**Task Title:** Understanding Gears and Calculating Gear Ratios

**Learner Information and Tasks**

Millwrights must have a general knowledge of drive train systems and the components that make up those systems to effectively troubleshoot and repair. Repairing these systems may include gear replacement and therefore understanding gear ratios is vital to the proper operation of the system.

Use the attached document **Understanding Gears and Calculating Gear Ratios**to complete the following tasks*.*

**Task 1:** Which is the most common gear?

**Task 2:** Name the typical angle of application for a Bevel Gear.

**Task 3:** Explain the difference between a Helical Gear and a Spur Gear.

**Task 4:** List two reasons that Intermediate or Idler gears are used.

**Task 5:** In your own words explain the difference between the *Driver* and *Driven.*

**Task 6:** Calculate the ratio for the following gears:

* + - Input movement (Driver) - 25 teeth
    - Output movement (Driven) - 75 teeth

**Task 7:** In the following diagram, the smaller gear is the Input movement and the larger gear is the Output movement. Count the number of teeth on each of the gears to calculate the gear ratio.



**Task 8:** Use the following diagram to count the number of teeth on each gear and calculate the gear ratio.

Input

Output

Idler Gear

**Understanding Gears and Calculating Gear Ratios**

The spur gear might be called the basic gear, as all other types have been developed from it. Its teeth are straight and parallel to the bore centre line. Spur gears may run together with other spur gears on parallel shafts; with internal gears on parallel shafts; and with a rack.

Many types and designs of gears have been developed from the spur gear. While they are commonly used in industry, many are complex in design and manufacture.

**Types of gears include:**

|  |  |
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| **Bevel gears**  [Image Of Bevel Gears](http://www.gearsandstuff.com/images/gear_types/gear-bevel.jpg) | Bevel gears are used mostly in situations that require power to be transmitted at right angles (or applications that are not parallel). Bevel gears can have different angles of application but tend to be 90° |
| **Helical gears**  [Image Of A Helical Gear](http://www.gearsandstuff.com/images/gear_types/HELICAL-GEAR-2.jpg) | Helical gears are very similar to spur gears except the teeth are not perpendicular to the face. The teeth are at an angle to the face giving helical gears more tooth contact in the same area.  Helical gears can also be used on non-parallel shafts to transmit motion.  Helical gears tend to run quieter and smoother than spur gears due to the increased number of teeth in constant contact at any one period of time |
| **Herringbone gears**  [Image Of A Herringbone Gear](http://www.gearsandstuff.com/images/gear_types/herringbones.gif) | Herringbone gears resemble two helical gears that have been placed side by side. They are often referred to as "double helicals".  One benefit of herringbone gears is that it helps to avoid issues related to side thrust created with the use of helical gears |
| **Worm Gears**  [Image Of Worm Gears](http://www.gearsandstuff.com/images/gear_types/gear-worm.jpg) | Worm gears are used to transmit power at 90° and where high reductions are required. The worm resembles a thread that rides in concaved or helical teeth |
| **Spur Gears**  Image Of A Spur Gear | Spur gears are by far the most common type of gear and with the exceptions of the "cog" the type of gear that has been around the longest.  Spur gears have teeth that run perpendicular to the face of the gear |
| **Internal Gears**  Image Of Internal Gears | Internal gears typically resemble inverted spur gears but are occasionally cut as helical gears |
| **Racks**  Image Of AGear Rack | A rack is basically a straight gear used to transmit power and motion in a linear movement. |
| **Face Gears**  Image Of A Face Gear | Face gears transmit power at (usually) right angles in a circular motion. Face gears are not very common in industrial application |
| **Sprockets**  Image Of A Gear Sprocket | Sprockets are used to run chains or belts. They are typically used in conveyor systems |

**Revolution -** one complete turn of a gear.

*For example, if the ratio is 2 or “2 to 1,” this usually means that the smaller gear or pinion makes two revolutions to one revolution of the larger mating gear.*

**Pinion** - The smaller of a pair of gears

**Bullgear** - The larger of a pair of gears on large heavy-duty drives

**Pressure Angle -** The sides of each tooth incline toward the centre top at an angle

*It is extremely important that the pressure angle be known when gears are mated, as all gears that run together must have the same pressure angle.*

**Gear** **Train** - In a gear train, the *input gear*, or *drive gear*, transmits power to the *output gear*, also known as the *driven gear*. The input gear, which is usually connected to a power source, such as a motor or engine, transmits power through any other gears that may be in the gear train to the output gear.

**Driver** - Gear that is providing the effort of movement or input movement

**Driven** - Gear that is the load that the driver is moving or output movement

**Gear Ratio -** The **gear ratio** of a gear train, also known as its **speed ratio**, is the ratio of the angular velocity of the input gear to the angular velocity of the output gear.

**Calculating Gear Ratio** - Calculated directly from the numbers of teeth on the gears in the gear train. The ratio is found by dividing the number of teeth on the larger gear by the number of teeth on the smaller gear or pinion. Only the first and last gears are used to calculate the ratio.

**Idler or Intermediate Gear -** In a sequence of gears chained together, the ratio depends only on the number of teeth on the first and last gear. The intermediate gears, regardless of their size, do not alter the overall gear ratio of the chain. However, the addition of each intermediate gear reverses the direction of rotation of the final gear.

An intermediate gear which does not drive a shaft to perform any work is called an idler gear. Sometimes, a single idler gear is used to reverse the direction, in which case it may be referred to as a *reverse idler*. For instance, the typical automobile manual transmission engages reverse gear by means of inserting a reverse idler between two gears.

Idler gears can also transmit rotation among distant shafts in situations where it would be impractical to simply make the distant gears larger to bring them together. Not only do larger gears occupy more space, the mass and rotational inertia of a gear is proportional to the square of its radius. Instead of idler gears, a toothed belt or chain can be used to transmit torque over distance.

**Idler or intermediate gears are used to assist with the transfer of power or for directional force.**

***Note:*** *If the driver is smaller than the output this reduces speed*

***Note:*** *If the driver is larger than the output this increases speed*

*The driver is not necessarily always the smaller gear.*

*The application dictates the configuration of the gears*

**Gear Ratio Equation**

The following equation uses 60 teeth for the driver (Input) and 30 teeth for the driven (Output)

Driven (Output Movement) = 30 - Number of teeth on Gear A

Driver (Input Movement) 60 - Number of teeth on Gear B

Find the common factor for 30 and 60

The common factor is 30. 30 goes into 60 2 times

Therefore

30 goes into 30 1 time - the output is 1

30 goes into 60 2 times - the input is 2

= 1 = Output movement

2 Input movement

= Driven(Output) : Driver (Input)

1:2

Driven (Output Movement) = 60 - Number of teeth on Gear A

Driver (Input Movement) 30 - Number of teeth on Gear B

Find the common factor for 30 and 60

The common factor is 30. 30 goes into 60 2 times

Therefore

30 goes into 30 1 time - the input is 1

30 goes into 60 2 times - the output is 2

= 2 = Input movement

1 Output movement

Driven (Output) : Driver (Input)

2:1

**Task Title:** Understanding Gears and Calculating Gear Ratios

**Answer Sheet**

**Task 1:** Which gear is the most common gear?

**Spur Gear**

**Task 2:**  Name the typical angle of application for a Bevel Gear.

**90°**

**Task 3:** Explain the difference between a Helical Gear and a Spur Gear.

**Helical Gear teeth are not perpendicular to the face**

**Task 4:** List two reasons that Intermediate or Idler gears are used.

**Reverse direction of the rotation of the final gear**

**Transmit rotation in distant shafts where it is not practical to have large gears**

**Task 5:** In your own words explain the difference between the *Driver and Driven.*

**Driver is the first gear - input movement of gear**

**Driven is the last gear - output movement of gear**

**Task 6:** Calculate the ratio for the following gears Input movement (Driver) - 25 teeth

Output movement (Driven) - 75 teeth

Find the common factor for 25 and 75

The common factor is 25

75 = 3 = **3:1 ratio**

25 1

**Task 7:**  Use the **following** diagram to calculate the gear ratio. The smaller gear is the Input movement.

Count the number of teeth on each gear: Input gear has 19 teeth, Output gear has 38

Calculate ratio

Find the common factor for 38 and 19 (19)

19 = 2 **Ratio is 1:2**

38 1

**Task 8:**  Use the following diagram to calculate the gear ratio.

Count the number of teeth on each gear

All gears have 16 teeth

Calculate ratio using only the first and last gear, disregard the intermediate gear

Find the common factor for 16 and 16

The common factor is 16

16 = 1

16 1

**Ratio is 1:1**

## Task Title: Understanding Gears and Calculating Gear Ratios

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| Performance Descriptors | | **Needs Work** | **Completes task with support from practitioner** | **Completes task independently** |
| A1.2 | * scans text to locate information |  |  |  |
|  | * locates multiple pieces of information in simple texts |  |  |  |
|  | * makes low-level inferences |  |  |  |
|  | * makes connections between sentences and between paragraphs in a single text |  |  |  |
|  | * reads more complex texts to locate a single piece of information |  |  |  |
|  | * follows the main events of descriptive, narrative and informational texts |  |  |  |
|  | * obtains information from detailed reading |  |  |  |
| A2.2 | * performs limited searches using one or two search criteria |  |  |  |
|  | * extracts information from tables and forms |  |  |  |
|  | * uses layout to locate information |  |  |  |
|  | * makes connections between parts of documents |  |  |  |
|  | * makes low-level inferences |  |  |  |
| B2.2 | * writes texts to explain and describe |  |  |  |
|  | * conveys intended meaning on familiar topics for a limited range of purposes and audiences |  |  |  |
|  | * begins to sequence writing with some attention to organizing principles (e.g. time, importance) |  |  |  |
|  | * connects ideas using paragraph structure |  |  |  |
|  | * uses limited range of vocabulary and punctuation appropriate to the task |  |  |  |
|  | * begins to select words and tone appropriate to the task |  |  |  |
| C4.3 | * calculates using numbers expressed as whole numbers, fractions, decimals, percentages and integers |  |  |  |
|  | * manages unfamiliar elements (e.g. context, content) to complete tasks |  |  |  |
|  | * makes estimates involving many factors where precision is required |  |  |  |
|  | * chooses and performs required operations; makes inferences to identify required operations |  |  |  |
|  | * selects appropriate steps to solutions from among options |  |  |  |
|  | * interprets, represents and converts values using whole numbers, decimals, percentages, ratios and fractions |  |  |  |
|  | * identifies a variety of ways to complete tasks |  |  |  |
|  | * uses strategies to check accuracy (e.g. estimating, using a calculator, repeating a calculation, using the reverse operation) |  |  |  |

**This task:** was successfully completed\_\_\_ needs to be tried again\_\_\_

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| Learner Comments |
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#### Instructor (print) Learner Signature