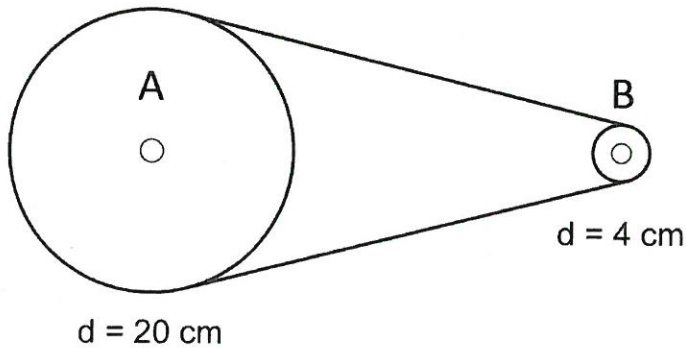


**Test: Mechanical Engineering**

Each question is worth 4 marks.

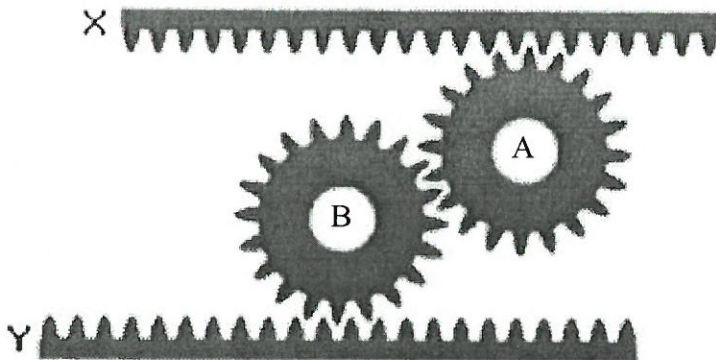
**Part A: Multiple Choice Questions**

- 1) Consider the belt and pulley system illustrated below.



Which statement correctly describes the rotation of the two pulleys?

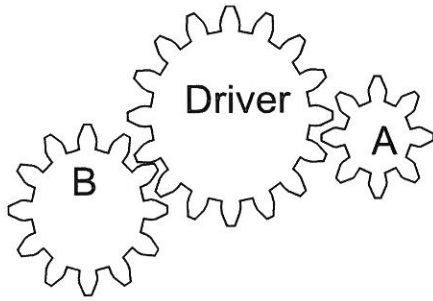
- a) Pulley A rotates faster than pulley B and they rotate in the same direction.
  - b) Pulley B rotates faster than pulley A and they rotate in the same direction.
  - c) Pulley A rotates faster than pulley B and they rotate in opposite directions.
  - d) Pulley B rotates faster than pulley A and they rotate in opposite directions.
- 2) Consider the motion system illustrated below. Component X slides to the right.



Which statement correctly describes the motion of components B and Y?

- a) Component B rotates clockwise and component Y moves to the left.
- b) Component B rotates counterclockwise and component Y moves to the left.
- c) Component B rotates clockwise and component Y moves to the right.
- d) Component B rotates counterclockwise and component Y moves to the right.

- 3) Consider the gear train illustrated below.



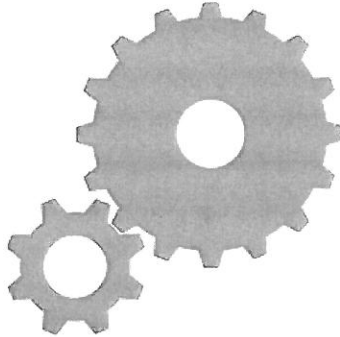
The driver gear rotates at a speed of 600 RPM.

Which of the following statements is correct?

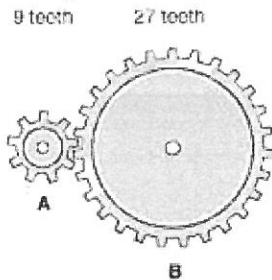
- a) The speed of gear A is 1200 RPM and the speed of gear B is 800 RPM.
- b) The speed of gear A is 300 RPM and the speed of gear B is 800 RPM.
- c) The speed of gear A is 1200 RPM and the speed of gear B is 450 RPM.
- d) The speed of gear A is 300 RPM and the speed of gear B is 450 RPM.

**Part B: Extended Answers**

- 4) What is the speed ratio of the gears below? (The gear on the bottom left is the driver gear)

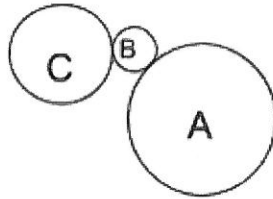


- 5) What is the speed ratio of the gears below? (Gear B is the driver gear.)



6) Consider the gears below:

Gear B is the driver gear.  
Gear B rotates at a speed of 200 RPM.  
Gear C rotates at a rate of 150 RPM.  
Gear A rotates at a rate of 80 RPM.



- a. What is the speed ratio of gear A?
- b. What is the gear ratio of gear C?

7) Many cell phones have a “slide and click” cover for the phone battery. Give the characteristics of the link between the cover and the cell phone.

- |                                    |  |
|------------------------------------|--|
| <input type="checkbox"/> Direct    | <input type="checkbox"/> Indirect      |
| <input type="checkbox"/> Rigid     | <input type="checkbox"/> Flexible      |
| <input type="checkbox"/> Removable | <input type="checkbox"/> Non-removable |
| <input type="checkbox"/> Partial   | <input type="checkbox"/> Complete      |

8) In each situation below, indicate whether adhesion increases or decreases, and name the factor involved.

- a) Baseball players use a kind of tar to make sure that their bat will not slide from their hands.
- b) A piece of wood is sanded so that it can easily slide along the floor.
- c) When a motor operates in colder weather, it makes less noise.

9) Consider the bicycle pump illustrated below.

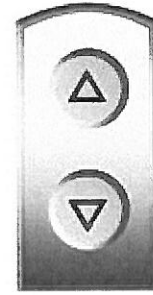


- a) How many degrees of freedom does the handle have?
- b) Give the type and direction of the motion that can be performed by the handle.

10) Consider the button used to call an elevator.

a) How many degrees of freedom does the button have?

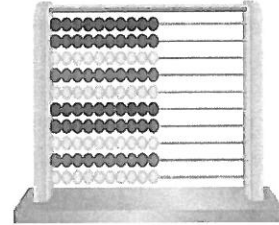
b) What type of motion can the button perform?



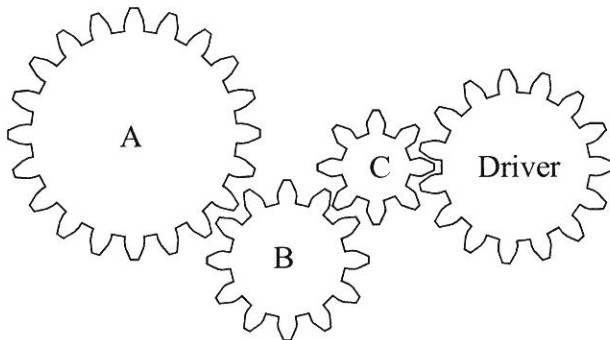
11) Consider the abacus illustrated on the right.

a) How many degrees of freedom do the beads have?

b) Give the type and direction of the motion that can be performed by beads.



Consider the gear train below. Questions 12 and 13 refer to this gear train.

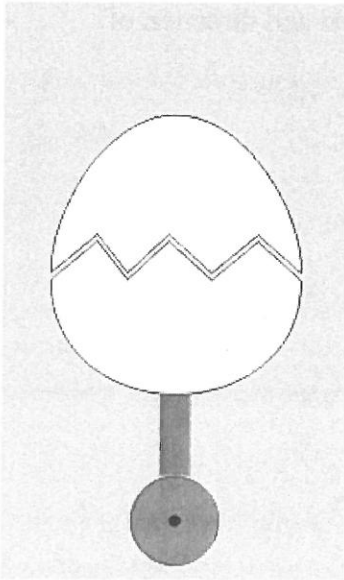


The driver gear rotates in the counterclockwise direction at a speed of 800 RPM.

12) What is the speed and direction of rotation of gear A?

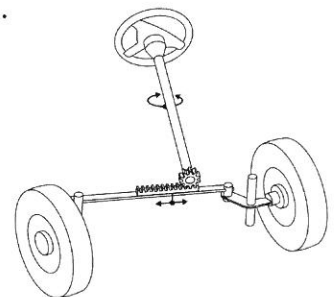
13) What is the speed and direction of rotation of gear C?

14) Consider the toy illustrated below. (You may also look at the animation on the overhead or at [http://cormierscience.weebly.com/uploads/1/2/1/5/12155919/egg\\_and\\_chick.gif](http://cormierscience.weebly.com/uploads/1/2/1/5/12155919/egg_and_chick.gif).)



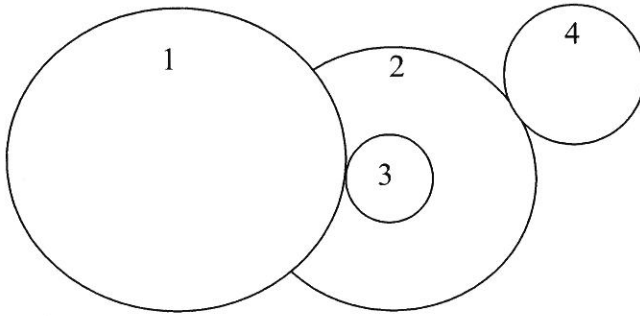
- a) What is the name of the system used in this toy?
- b) What kind of guiding is provided by the pat labeled “x”?
- c) Why must there be a complete link between the follower and the top of the egg shell?

15) The illustration below shows the basic principle of a car’s steering system..



- a) What type of system is illustrated here?
- b) Describe the steering system works. (Include the motion of all the parts.)

16) Consider the friction gears below.



Diameter of gear 1 = 40 cm  
Diameter of gear 2 = 30 cm  
Diameter of gear 3 = 10 cm  
Diameter of gear 4 = 20 cm

Gear #4 spins at a rate of 400 RPM clockwise. What is the speed and direction of rotation of gear #1? Show all your work.

- 17) Draw a motion transmission system that meets the following requirements.
- components A and B rotate at the same speed but in opposite directions.
  - component C rotates at half the speed of component B
  - component D rotates 4 times as fast as component A

(Your diagram does not need to be to scale, but it must include all dimensions.)