AST 406
September 27, 2012 Practice

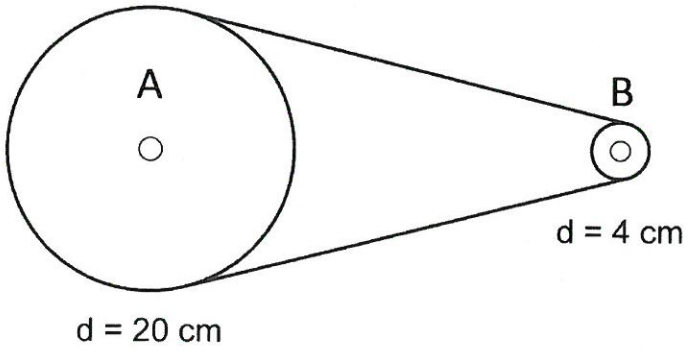
Name: Answers

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?

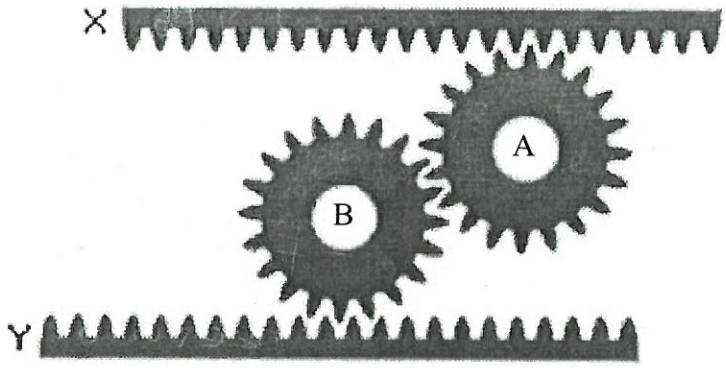
a) Pulley A rotates faster than pulley B and they rotate in the same direction.

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?

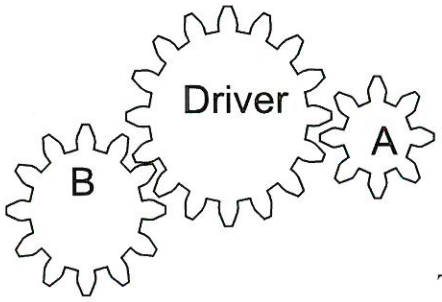
a) Component B rotates clockwise and component Y moves to the left.

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.

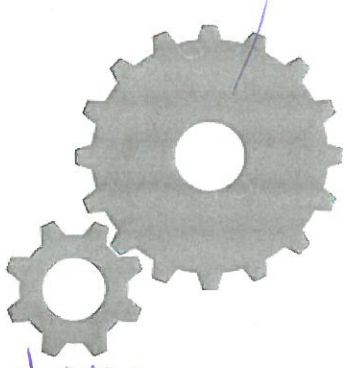
b) The speed of gear A is 300 RPM and the speed of gear B is 800 RPM.

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)

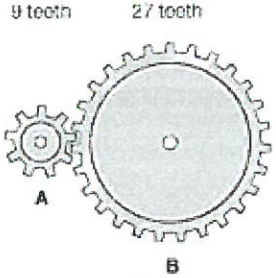


driver

$$S.R. = \frac{\text{teeth dr}}{\text{teeth dn}}$$

$$S.R. = \frac{4}{16} = \frac{1}{4}$$

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



driver

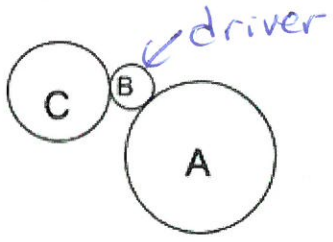
$$S.R. = \frac{\text{teeth dr}}{\text{teeth dn}}$$

$$= \frac{27}{9}$$

$$= 3$$

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? 0.4
b. What is the gear ratio of gear C? 0.8

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.

☒ Direct	☐ Indirect
☒ Rigid	☐ Flexible
☒ Removable	☐ Non-removable
☐ Partial	☒ 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.

- increase
- presence of adhesive

b) A piece of wood is sanded so that it can easily slide along the floor.

- decrease
- condition (state) of surface

c) When a motor operates in colder weather, it makes less noise.

- decrease
- temperature

9) Consider the bicycle pump illustrated below.

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

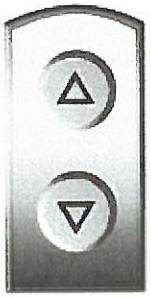
2

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

Rotation y

Translation y

10) Consider the button used to call an elevator.



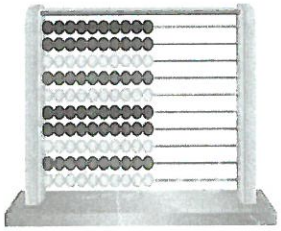
a) How many degrees of freedom does the button have?

1

b) What type of motion can the button perform?

translation Z

11) Consider the abacus illustrated on the right.



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

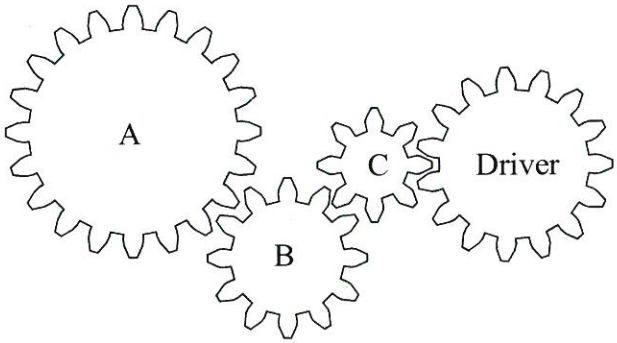
2

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

rotation X

translation X

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.

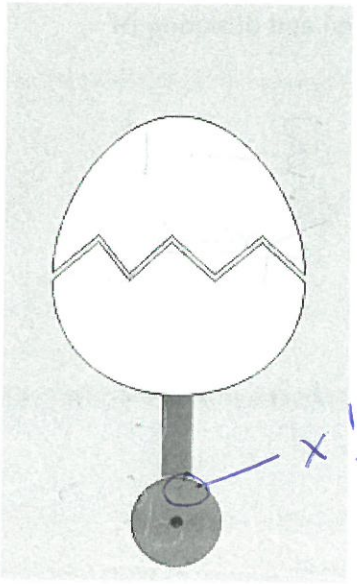
12) What is the speed and direction of rotation of gear A?

600 RPM, clockwise

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

1500 RPM, Clockwise

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.)



a) What is the name of the system used in this toy?

Cam and follower

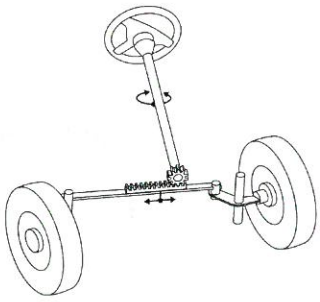
b) What kind of guiding is provided by the pat labeled "x"?

rotational

c) Why must there be a complete link between the follower and the top of the egg shell?

So that the top of egg shell will translate with the follower

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



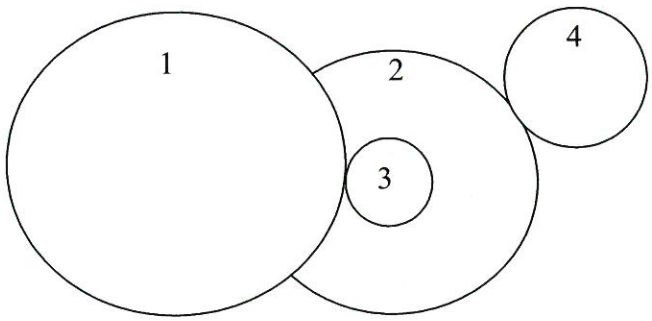
a) What type of system is illustrated here?

rack and pinion

b) Describe the steering system works. (Include the motion of all the parts.)

- rotating the steering rotates the axle and pinion
- the pinion's rotation causes the rack's translation
- this causes the wheels to rotate slightly

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.

① 4 → 2
Speed 2 = 267 RPM

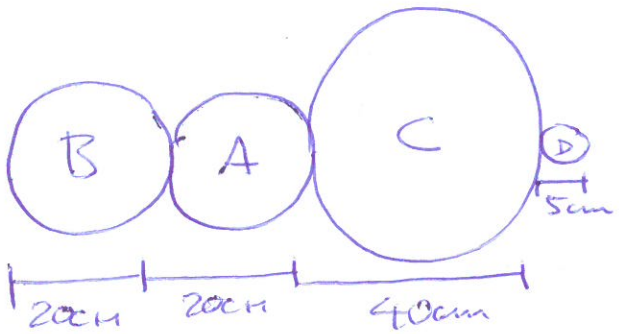
② Speed 3 = Speed 2
Speed 3 = 267 RPM

③ 3 → 1
Speed 1 = 67 RPM

Ans: 67 RPM Clockwise

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.)



other possible answers