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Continuing Education Course #239
What Every Engineer Should Know
About Drive Trains and Linkages

1. An automobile engine produces 100 pounds-feet of torque. It is coupled to a transmission with ratios of 3:1 in low gear, 2:1 in second gear, and 1:1 in high gear. If the engine is running at 2000 RPM and the transmission is in second gear, how fast is the output shaft turning?

- a. 2000 RPM
- b. 1000 RPM
- c. 4000 RPM

2. In a perfect world (100% efficiency) what is the maximum torque in any gear that the output of the transmission in Q1 will see?

- a. 100 pounds-feet
- b. 200 pounds-feet
- c. 300 pounds-feet

3. In the engine/transmission pair in Q1 above, the transmission efficiency is 95% (It is not a perfect world). What is the maximum torque in any gear at the output of the transmission?

- a. 195 pounds-feet
- b. 190 pounds-feet
- c. 285 pounds-feet

4. If the engine in the engine/transmission pair in Q3 above is producing 100 HP, what is the maximum heat that must be dissipated in the transmission? (Hint: 1 HP = 746 watts).

- a. 746 watts
- b. 3730 watts
- c. 7460 watts

5. Gears only have a few teeth in contact at a time.

- a. T
- b. F

6. A company makes Bevel Gear boxes (1:1) and Angle Gear boxes (2:1) for transmitting power around right angle corners. For the Bevel Gear set, both gears are 1" diameter, 16 DP. For the Angle Gear set, one gear is 1" diameter, 16 DP, and the other gear is 2" diameter, 16 DP. Are the cone angles the same for both sets of gears?

- a. Yes
- b. No.

7. A single-lead worm 1" in diameter drives a 60-tooth worm gear 6" in diameter. The drive ratio is?

- a. 6:1
- b. 60:1
- c. 30:1

8. A roller chain sprocket with 15 teeth drives an output sprocket with 45 teeth through a chain that when new was 60" long. But now, the chain has worn and is now 60.6" long. What is the ratio of this chain drive"

- a. 2.97:1
- b. 3.00:1
- c. 3.03:1

9. Timing belts must be kept lubricated.

- a. T
- b. F

10. You must design a cover for a timing belt drive. The cover must:

- a. retain the lubricant on the belt
- b. Keep foreign objects out of the drive
- c. Keep the belt from flapping

11. A 2" diameter V-belt pulley is set up to drive a 4" diameter V-belt pulley. At rest, there are ten pounds of tension in the belt. The bearings supporting each shaft must withstand a radial load of ___pounds?

- a. 10
- b. 20
- c. 40

12. Gear A is a 16-tooth, 8DP gear, and gear B is a 32-tooth, 8 DP gear. How far apart should the centers be to make the gears mate properly?

- a. centers should be adjustable
- b. 3.000 inches
- c. 4.000 inches

13. A 2", 8 DP gear drives a 2", 16 DP gear. What is the final ratio?

- a. 1:1
- b. 2:1
- c. gears will not mesh.

14. We know that a gear with 20 degree pressure angle teeth will have stronger teeth than one with a 14 1/2 degree pressure angle, because the teeth of the 20 degree pressure angle gear have thicker bases. Where in the Lewis Formula ($s=W_tP_d/FY$) is this taken into account?

- a. In the Y factor
- b. In the P_d
- c. In the W_t

15. A 13T, 24 DP pinion drives a 40T, 24 DP gear that is part of a compound gear. The other gear on the compound gear is a 17T, 10 DP gear, driving a 69T, 10 DP gear. What is the final drive ratio?

- a. The gears will not mesh because they have odd numbers of teeth
- b. The gears will not mesh because some of them are 24 DP and some of them are 10 DP.
- c. A little over 12:1

16. Engineer Tom Swift has designed an electric generating set with a gasoline engine and an alternator mounted side-by-side, driven with a timing belt. Tom has chosen the smallest center distance that he can, for compactness. But, that center distance requires the use of a 111 1/2 tooth belt, which cannot be made. What can Tom do?

- a. Increase the center distance
- b. Use a longer belt with an idler pulley
- c. Change the pulley sizes to a different ratio
- d. Any of the above

17. A taper-lock bushing is ...?
- a. A plain bearing with an adjustable bore
- b. A method to keep people from stealing pulleys
- c. A hub that clamps onto the shaft, eliminating both bore and keyway looseness

18. Cup point setscrews create their own flats on a shaft.
- a. T
- b. F

19. A pulley is clamped to a shaft by a nut threaded onto the shaft. If the nut is torqued to 20 pounds-feet, what is the approximate torque that will cause the pulley to slip?
- a. 10 pounds-feet
- b. 20 pounds-feet
- c. 40 pounds-feet

20. In the front wheel bearing assemblies of automobiles, the bearing outer cups are pressed into the wheel. Why?
- a. The press fit retains the cup
- b. The press fit prevents the cup from "walking" around the inside of the wheel
- c. The press fit keeps the wheel from spinning on the cup

21. In the front wheel bearing assemblies of automobiles, the bearing inner cones are an easy slip fit on the spindle. Why?
- a. To make the wheel easier to remove
- b. The cones are always forced up against the bottom of the spindle by the weight of the car, and the spindle never rotates.
- c. Both of the above

22. Plain bearings made from plastic:
- a. Do not need lubrication
- b. Do not form sludge from the mixing of dirt with the lubricant
- c. Both of the above

23. A crank arm 4" long drives a second crank arm 2" long through a pushrod. At the beginning of the stroke, both crank arms are perpendicular to the pushrod. If the the shaft that mounts the 4" arm is rotated through 10 degrees, how far will the shaft that mounts the 2" arm be rotated?
- a. about 10 degrees
- b. about 20 degrees
- c. about 40 degrees

24. A push-pull cable has to be bent 180 degrees into a "U" shape to move a link in the desired direction. If 10 pounds is applied to the cable, neglecting friction, how many pounds will be applied to the link?
- a. 5 pounds
- b. 10 pounds
- c. 20 pounds

25. In order to form the cable housing of Q24 above into a "U" shape, and to resist the load of the cable, both ends of the housing must be attached to the frame of the machine. How much load will the attachments at each end see?
- a. 10 pounds at the input end, 0 pounds at the output end
- b. 5 pounds at each end
- c. 10 pounds at each end