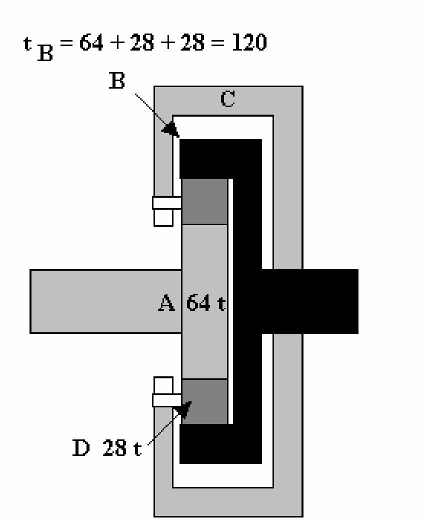
D25 1999 Q3

EPICYCLIC GEAR BOX

(a) The ring C is held stationary and A rotated at 200 rev/min. Calculate the speed of shaft B.
(b) The input A transmits 5 kW at 200 rev/min. Assuming no friction in the transmission, find the torque on C to hold it stationary.
(c) C is now rotated at 100 rev/min in the same direction as A which continues to rotate at 200rev/min. Determine the output speed of B.



(a) With C stationary it not an epicyclic gear box but a simple gear train.

A	D	B	C
1	-64/28	-64/120	0

Gear Ratio B/A = -64/120
Speed of A = 200 rev/min   Speed of B = 200 x 64/120 = 106.67 rev/min in opposite direction.

(b) Input power = 5 kW = $2\pi N_A T_A/60$ T_A = (5000 x 60)/(2π x 200) = 238.7 Nm ACW
Output Power = Input Power (no friction)
T_B = (5000 x 60)/(2π x 106.67) = 447.6 Nm CW
The torque on the case = T_C
$T_A + T_B + T_C = 0$ 238.7 – 447.6 + T_C = 0 T_C = 208.9 Nm (ACW)

(c) The gear box is now epicyclic.

	A	D	B	C
Keep C stationary give B 1 rev	-120/64	120/28	1	0
Multiply by x (revs of B)	-120x/64	120x/28	x	0
Lock the gears and rotate all y times	(-120x/64)+ y	(120x/28)+ y	x + y	y

Speed of C = y = 100 rev/min
Speed of A = (-120x/64)+ y = 200   -120x/64 + 100 = 200   x = -53.33 rev/min

Speed of B is -53.33 rev/min. (opposite direction)