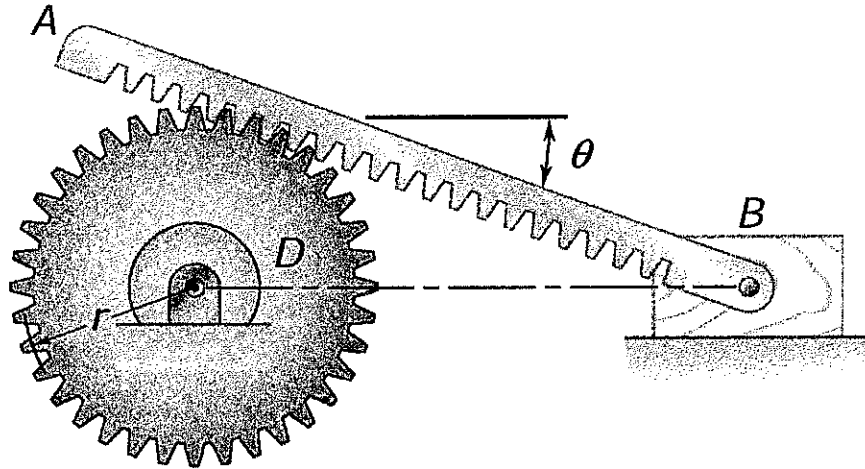
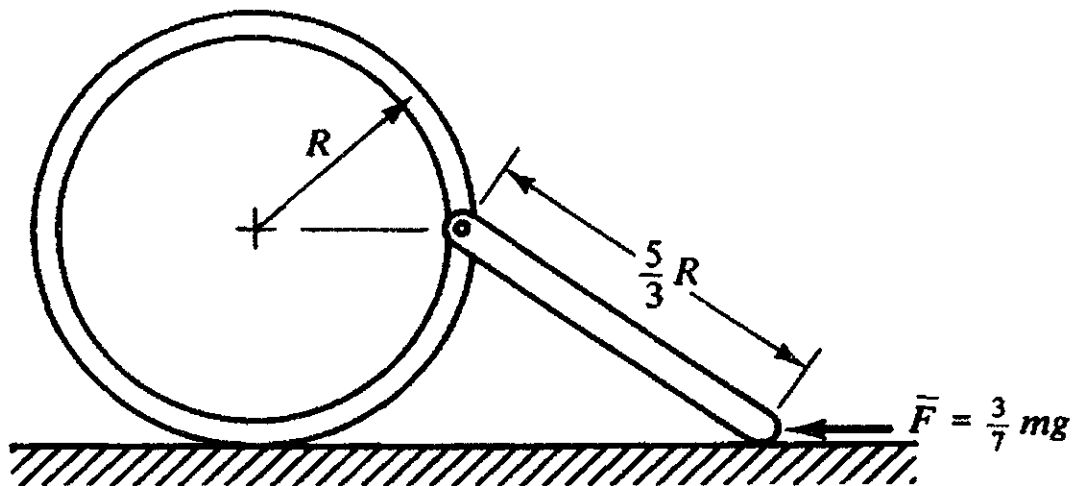


※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (25%) A straight rack rests on a gear of radius $r = 3$ cm and is attached to a block B as shown. Knowing that at the instant shown $\theta = 20^\circ$, the angular velocity of gear D is 3 rad/s clockwise, and it is speeding up at a rate of 2 rad/s^2 , determine (a) the angular velocity of the rack, (b) the velocity of block B , (c) the angular acceleration of the rack, and (d) the acceleration of block B .



2. (25%) The massless bar is pinned at its left end to a ring of mass m . The system is initially at rest at the position shown, when a horizontal force F of magnitude $3mg/7$ is applied to the right end of the bar. The ring rolls over the ground, and the friction between the bar and the ground is negligible. Determine (a) the normal contact force from the ground to the bar, (b) the acceleration of the center of the ring at the instant the force is applied, and (c) the minimum value of the coefficient of static friction required to prevent slippage at this position.



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3. (25%) The gear is defined as a toothed member designed to transmit motion to or receive motion from another toothed member, by means of successively engaged teeth. The two gears are rotatable around axes whose relative positions are fixed, and they form a gear pair. The torque from the driving shaft to the driven one in a gear drive is transmitted due to the pressure of the teeth of the pinion (the gear in a pair which has the smaller number of teeth) on those of the wheel (the gear in a pair which has the greater number of teeth). To preserve a constant transmission ratio, the teeth of both pinion and wheel should have conjugate profiles.

Parallel and co-planer shafts connected by gears are called spur gears. Spur gears have straight teeth and are parallel to the axis of the wheel. The advantages of spur gears are their simplicity in design, and economy of manufacture and maintenance. Spur gears are known as slow speed gears. If noise is not a serious design problem, spur gears can be used at almost any speed. Helical gears have their teeth inclined to the axis of the shafts in the form of a helix. These gears are usually thought of as high speed gears. Helical gears can take higher loads than similarly sized spur gears. The motion of helical gears is smoother and quieter than the motion of spur gears. Intersecting but coplanar shafts connected by gears are called bevel gears. Straight bevel gears can be used on shafts at any angle, but right angle is the most common. Bevel gears can be used to change the direction of drive in a gear system by 90 degrees.

(a) Translate the first paragraph into **Chinese**.

(b) Based on the information provided, use your own words (**in English**) to explain the differences between the three types of gears in terms of shaft arrangement, teeth meshing and design considerations.

4. (25%) A 2-kg mass of putty D strikes the uniform 10-kg plank ABC with a velocity of 10 m/s. If the putty remains attached to the plank, determine (a) the angular velocity of rod AC at the time when the putty initially contacts the plank (b) the kinetic energy of the system at the time when the putty initially contacts the plank, and (c) the maximum angle θ of swing before the plank momentarily stops. Neglect the size of the putty.

