編號： 80

國立成功大學 105 學年度碩士班招生考試試題

系　　所：機械工程學系

考試科目：動力學

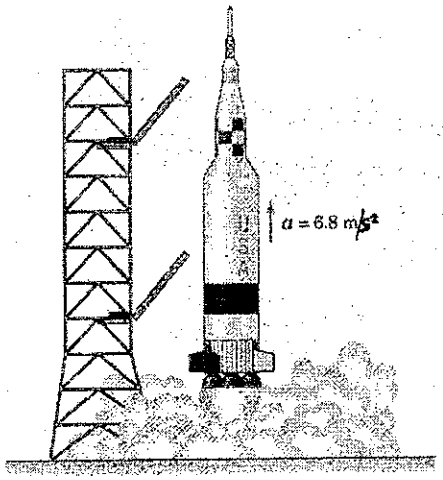
考試日期：0227，節次：2

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

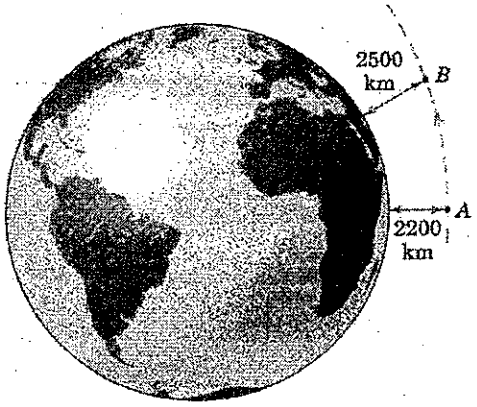
1. Please answer the following problem within a space mission.

(1) At the instant of vertical launch, the rocket expels exhaust at the rate of *220 kg/s* with an exhaust velocity of *820 m/s*. If the initial vertical acceleration is *6.80 m/s*^{2}, calculate the total mass of the rocket and fuel at launch. **(10%)**

(2) The spacecraft moving in an elliptical orbit has a velocity of *25000 km/h* at an altitude of *2200 km* at Point A. Determine its velocity v_B at Point B where the altitude is *2500 km*. Treat the earth as a sphere of radius *R=6371 km*, and use *g=9.825 m/s*^{2} for the acceleration of gravity at the earth's surface. **(10%)**

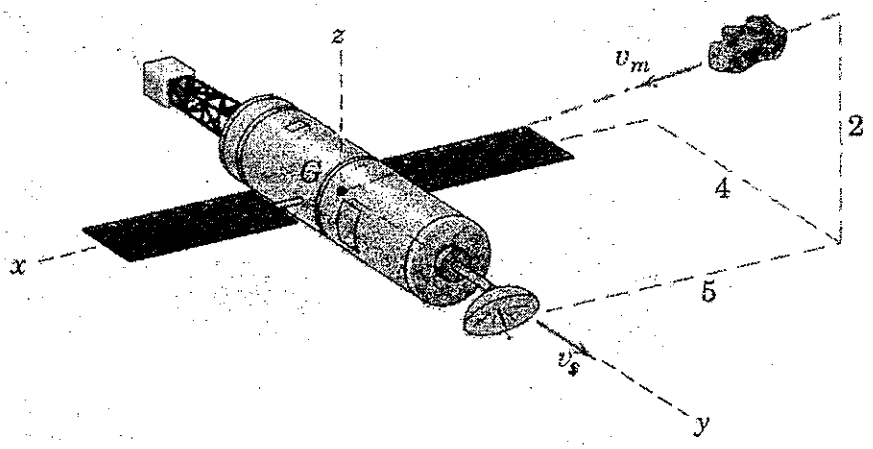


Problem 1-(1)



Problem 1-(2)

(3) A *1000 kg* spacecraft is traveling in deep space with a speed of v_s=*2000 m/s* when a *10 kg* meteor moving with a velocity v_m of magnitude *5000 m/s* in the direction shown strikes and becomes embedded in the spacecraft. Determine the final velocity *v* of the mass center *G* of the spacecraft. Calculate the angle β between *v* and the initial velocity v_s of the spacecraft. **(10%)**



Problem 1-(3)

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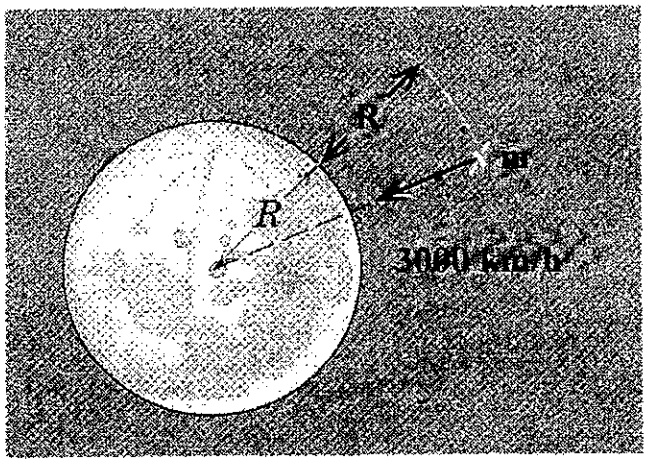
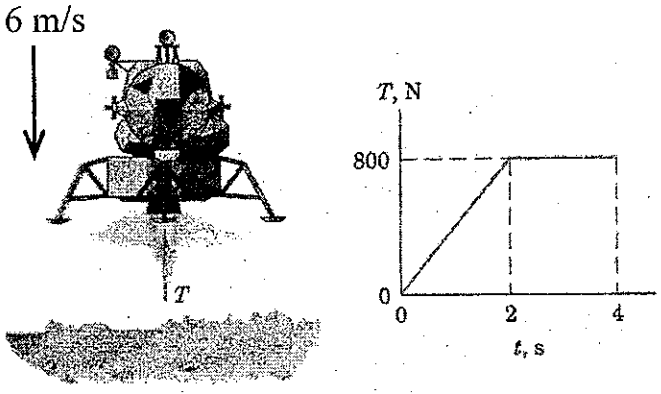
(4) The space craft *m* is heading toward the center of the moon with a velocity of *3000 km/h* at a distance from the moon's surface equal to the radius *R* of the moon. Compute the impact velocity *v* with the surface of the moon if the spacecraft is unable to fire its retro-rockets. Consider the moon fixed in space. The radius *R* of the moon is *1738 km*, and the acceleration due to gravity at its surface is *1.62 m/s*^{2}. **(10%)**

(5) The *200 kg* lunar lander is descending onto the moon's surface with a velocity of *6 m/s* when its retro-engine is fired. If the engine produces a thrust *T* for *4 s* which varies with the time as shown and then cuts off, calculate the velocity of the lander when *t=5 s*, assuming that it has not yet landed. Gravitational acceleration at the moon's surface is *1.62 m/s*^{2}. **(10%)**

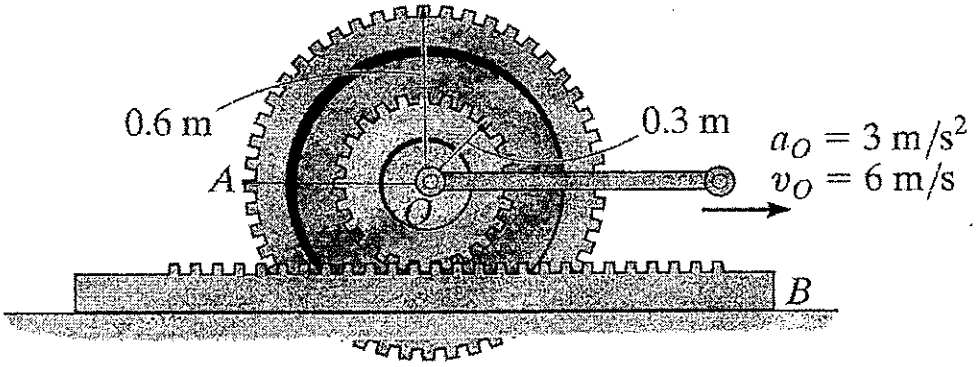


Problem 1-(4)



Problem 1-(5)

2. The gear rolls on the fixed rack *B*. At the instant shown, the center *O* of the gear moves with a velocity of $v_o = 6m/s$ and acceleration of $a_o = 3\frac{m}{s^2}$. Determine the angular acceleration of the gear and acceleration of point *A* at this instant. **(15%)**



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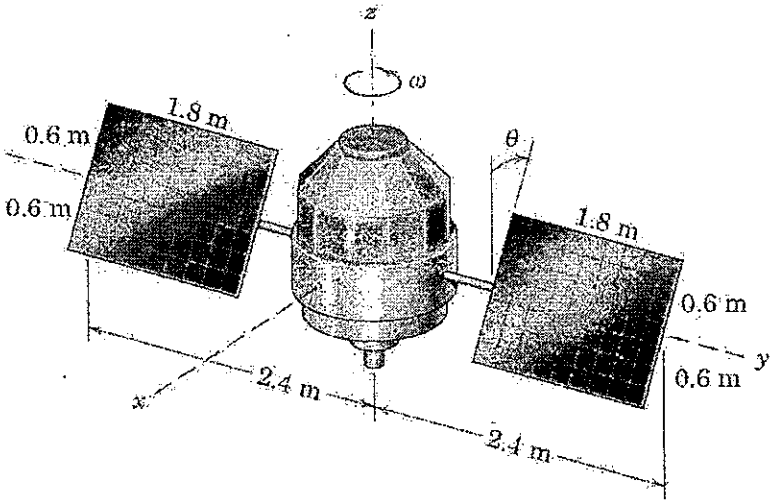
3. The body of the spacecraft has a mass of 160 kg and has a radius of gyration about its z-axis of 0.45 m. Each of the two solar panels may be treated as a uniform flat plate of 8 kg mass. If the spacecraft is rotating about its z-axis at the angular rate of $1\frac{rad}{s}$ with $\theta = 0$, determine the angular rate ω after the panels are rotated to the position $\theta = \pi/2$ by an internal mechanism. Neglect the small momentum change of the body about the y-axis. **(15%)**



4. The lightweight turbine consists of a rotor which is powered from a torque applied at its center. At the instant the rotor is horizontal it has an angular velocity of 15 rad/s and a clockwise angular acceleration of 8 rad/s^2. Determine the internal normal force, shear force, and moment at a section through A. Assume the rotor is a 50 m long slender rod, having a mass of 3 kg/m. **(20%)**