國立中央大學 110 學年度碩士班考試入學試題

所別： 地球科學學系地球物理 碩士班 不分組(一般生)　　
地球科學學系地球物理 碩士班 不分組(在職生)

科目： 普通物理學

本科考試禁用計算器　※計算題需計算過程，無計算過程者不予計分　＊請在答案卷(卡)內作答

1. The pair of pulleys shown in Fig. 1 is used to lift a 80 kg block 0.25 m. The constant acceleration of the block during the lift is 3 m/s^2, and the pulleys and rope have negligible inertia and negligible friction. What is the tension (a) in the pulling rope and (b) in the rope from which the block hangs ? (c) What force is exerted by the upper mount on the top pulley ? (d) How much work is done by the person pulling the rope in lifting the block 0.25 m? (e) By how much does the kinetic energy of the block change in this process ? (f) How much work does the ceiling do in this process ? (g) How much work does Earth do on the block ? (h) Draw energy diagrams for three systems during the lifting: block; block and Earth; block, Earth, pulleys, rope, and person (40 %).

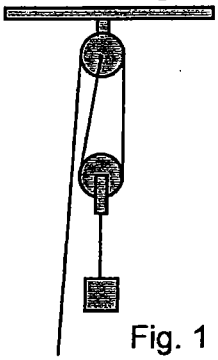
Fig. 1

2. A research vessel performs a river survey. The vessel moves downstream with a constant speed 6 m/s relative to the water. The river has a steady current of 1 m/s relative to the ground. Mary sits on the boat and his instrument falls into the river. Five minutes later, she notices that his instrument is missing and immediately turns the boat around, moves upriver with the same speed of 6 m/s relative to the water. How long does it take the man to row back upriver to reclaim his instrument ? (20 %)

3. A transverse wave pulse traveling along a rope is described by the time-dependent wave function $f(x,t) = Ae^{-(kx-wt)^3}$, with wave number $k = 2\pi\ s^{-1}$. (a) sketch the time-dependent wave function at $t = 0$ and $t = 5.00\ s$. (5 %) (b) sketch the pulse as a function of time at $x = 0$ and $x = 5.00\ m$. (5 %) (c) Shat that the function given above satisfies the wave equation. (5 %) (d) What is the wave speed of the pulse (5 %)? (total 20 %)

4. A palm tree sways back and forth with a period of 15 s, and Jack estimate the amplitude of the motion of the treetop to be 1.5 m. Jack begins timing at some instant after the treetop passes through the upright position, and after you have been watching this motion for 40 s, the treetop is 0.5 m to the left of the upright position of time. (a) Write the equation for the position of the treetop as a function of time. (b) What is the maximum speed of the threetop ? (c) At what instants does the treetop has this speed ? (d) What is the maximum acceleration of the treetop ? (e) What is acceleration at instant t = 40 s ? (20 %)