國立成功大學八十學年度礦冶及材料科學研究所考試(普通物理試題) 共 1 頁 第 1 頁

(1) A wedge of mass M rests on a frictionless horizontal
20% table top. A block of mass m is placed on the wedge as shown in Fig.1. There is no friction between the block and the wedge. The system is released from the rest. Calculate (a) the acceleration of the wedge. (b) the horizontal and vertical components of the acceleration of the block. (c) If the wedge is to remain rest on the table top, how much horizontal force F is required? (as shown in Fig. 2)

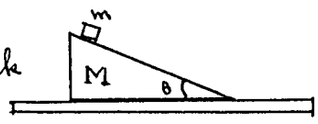

Fig. 1.

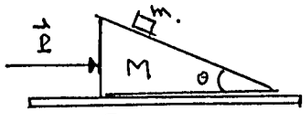

Fig. 2

(2). (a) What are isotopes of an element?
15% (b) Describe and explain the function of a mass spectrometer.

(3) (a) What is a Carnot engine?
15% (b) Explain why it is so important and verify your statements.

(4). (a) Describ the structure of a grating spectrometer.
15% (b) Derive an expression to explain the function of this device.

(5) A conducting spherical shell of inner radius a and outer radius b has a
15% positive point charge Q located at its center. The total charge on the shell is $-3Q$, and it is insulated from its surroundings.
(a) Find the electric field and potential for the regions $r<a$, $a<r<b$, and $r>b$.
(b) Find the surface charge density on the inner surface of the conducting shell.

(6) For the circuit as shown in Fig. 3.
20% (a) Find the expression for the current through switch S_1 at any time after the switch S_1 is closed.
(b) After the current has reached its final steady value, the switch S_2 is closed. Derive an expression for the currents through R_0, R and S_2 as function of time.

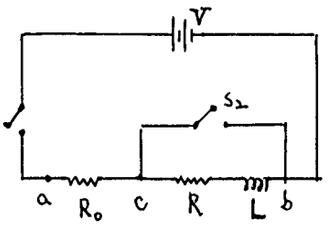

Fig. 3

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