

類組：物理類 科目：普通物理(2002)

※請在答案卷內作答

- 一、 A cylindrical capacitor consists of two coaxial cylinders of radii  $a$  and  $b$  and length  $l$  as shown in Fig. 1. What is the capacitance of the structure? The dielectric constant of the air is  $\epsilon_0$ . Assume that the capacitor is very long (i.e.  $l \gg b$ ) so that we can ignore the fringing of the lines of force at the ends for the purpose of calculating of the capacitance. (15%)

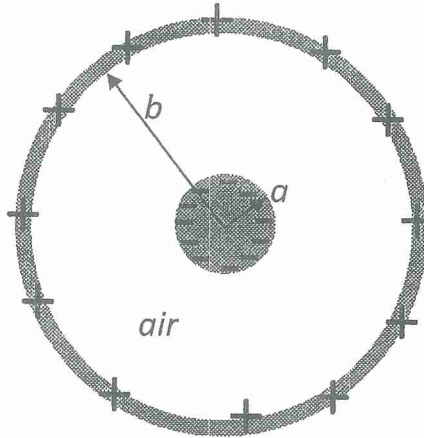


Figure 1 A cross section of a cylindrical capacitor.

- 二、 As the light propagates in a medium with refractive index larger than 1, the velocity of the light is slower or faster than that of the light propagating in vacuum? (10%)
- 三、 Assume that the batteries in Fig. 2 have negligible internal resistance. Find the current in the circuit. (10%)

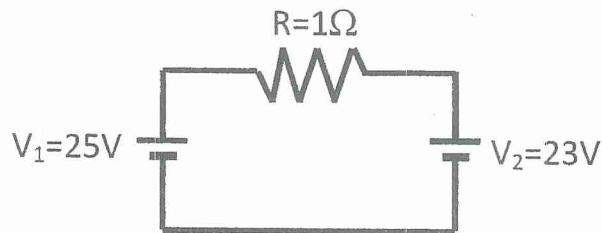


Figure 2

- 四、 Figure 3 shows a charge  $+q$  arranged as a uniform conducting sphere of radius  $a$  and placed at the center of the spherical conducting shell of inner radius  $b$  and outer radius  $c$ . The outer shell carries a charge of  $-q$ . Find the electric field inside the shell ( $b < r < c$ ). (15%)

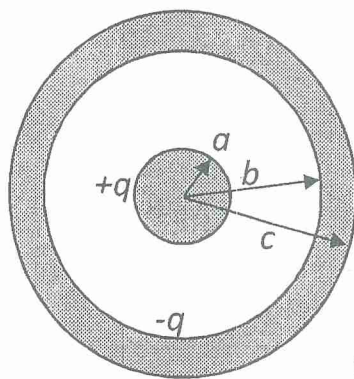


Figure 3

參考用

注意：背面有試題

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五、In the movie "Speed", the bus driver tried to fly a bus over a broken bridge. Two possible cases are shown in Figure 4. Assume the bus has 5000-kg weight and its length can be neglected. Please answer the following questions.

(一) Which case (1 or 2) can work in practice? (4%)

(二) Please provide brief explanation for your answer in (一). (4%)

(三) For the case you select, how much velocity at least should the bus have right before it leaves the bridge? Assume  $\Delta d$  is negligible. (10%)

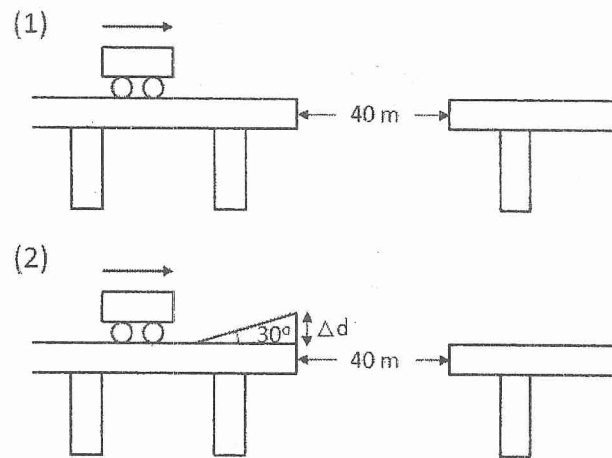


Figure 4

六、A safety net (安全網) has a spring constant of 80 N/m. It is designed to keep a 60-kg human falling from 10-m height from injured. Please find the minimum displacement of the safety net along the direction of gravity to achieve this safety requirement. (10%)

七、There are three objects. The first one is an iron ball with density of 7.87 g/cm<sup>3</sup> and diameter of 3 cm. The second one is an aluminum cylinder with density of 2.70 g/cm<sup>3</sup> and diameter of 5 cm. The third one is a gold ring with density of 19.32 g/cm<sup>3</sup> and diameter of 1 cm. When these three objects roll down from a hill without sliding, which one reaches the bottom of the hill the fastest? (6%)

八、When you stand in front of two mirrors at a 45° angle, how many images can you see in the mirrors? How many images are left-right reversal? If there is a mirror at the bottom, how many images can you see and how many of them are left-right reversal? (16%)

注意：背面有試題

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