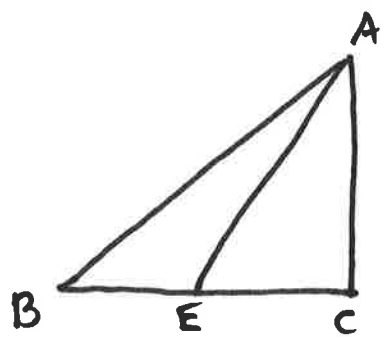


ASG v2

Ex 10.1

(Inclined plane) (4 pages)



distance from A to C = $d_c = 1$

" " A to E = $d_e = \sqrt{3}$

" " A to B = $d_b = 2$

Suppose it takes 1 unit of time to travel (falling) from A to C. First, let's compare the forces.

a) Since the force acting on the block can be written as F_B (along AB), F_E (along AE) and F_c (along AC), we have

$$\frac{F_B}{F_c} = \frac{1}{2}, \quad \frac{F_E}{F_c} = \frac{1}{\sqrt{3}}$$

The ratios follow from Galileo's argument on page 138, where he says the forces pulling a body down ~~equal~~ equal altitude ramps having different slopes are inversely proportional to the slope lengths.

Now, since along AC, the body moves 1 unit of distance in 1 unit of time, its average speed must be 1. If it undergoes uniform acceleration, then its final speed must be 2. So its acceleration must be 2. Thus

$$a_c = 2, \quad a_E = \frac{2}{\sqrt{3}}, \quad a_B = 1$$

This is because the bodies' accelerations are proportional to the force causing the acceleration.

b) Since for an object undergoing uniform acceleration, $d = \frac{1}{2} at^2$, the time of descent along AC, AE & AB are

$$d_c = \frac{1}{2} \cdot 2 (t_c)^2 = 1$$

$$d_E = \frac{1}{2} \cdot \frac{2}{\sqrt{3}} (t_E)^2 \Rightarrow t_E = \sqrt{3}$$

$$d_B = \frac{1}{2} \cdot 1 (t_B)^2 \Rightarrow t_B = 2$$

So $t_c = 1, t_E = \sqrt{3}, t_B = 2$

c) Since for an object undergoing uniform acceleration $v = at$, the speeds at points C, E & B are

$$v_c = 2 \cdot 1 = 2$$

$$v_E = \frac{2}{\sqrt{3}} \cdot \sqrt{3} = 2$$

$$v_B = 1 \cdot 2 = 2$$

The speeds are identical!

$$v_c = v_E = v_B = 2$$

d)

$$\frac{F_c d_c}{F_E d_E} = \frac{a_c d_c}{a_E d_E} = \frac{2 \cdot 1}{\frac{2}{\sqrt{3}} \cdot \sqrt{3}} = \frac{2}{2} = 1$$

$$\frac{F_c d_c}{F_B d_B} = \frac{a_c d_c}{a_B d_B} = \frac{2 \cdot 1}{1 \cdot 2} = \frac{2}{2} = 1$$

So the product of the forces and distances traveled are all equal! Incidentally, this product of force and distance is called the work done on the body by the force in moving down the ramp.