

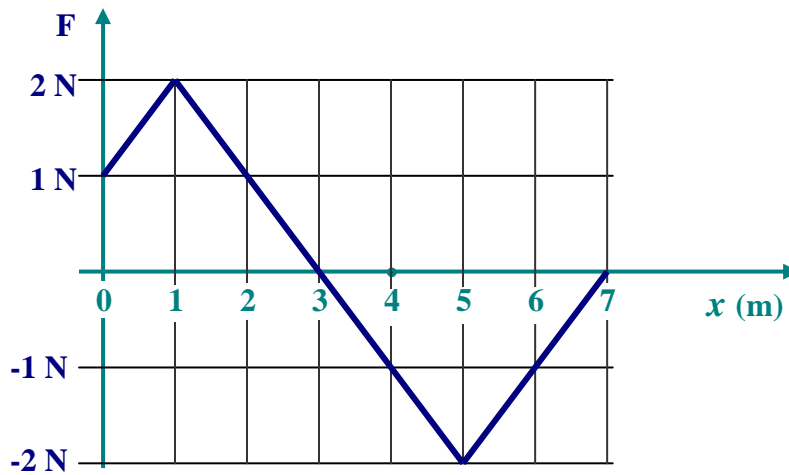
1. The figure gives how the force varies as a function of the position. Such force is acting on a particle, which undergoes one-dimensional motion. If the particle begins at rest at $x=0$,

1A Find the x coordinate at which the particle has the greatest kinetic energy

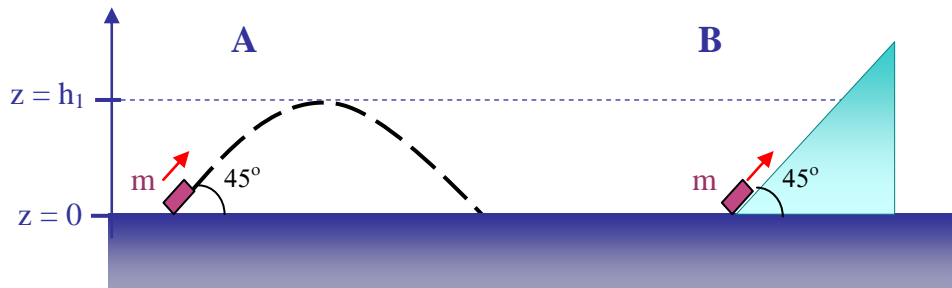
ANSWER $x = 3 \text{ m}$

1B Find the x coordinate at which the particle has zero speed

ANSWER $x = 6 \text{ m}$



2. At $t=0$ two small objects A and B of the same mass “m” are thrown simultaneously from the level $z=0$ and with the same initial speed of 10 m/s (the initial velocity makes 45° with the horizontal.) Object-A travels free in the air (its trajectory is indicated in the graph) while object-B moves along a frictionless surface of a 45° ramp.



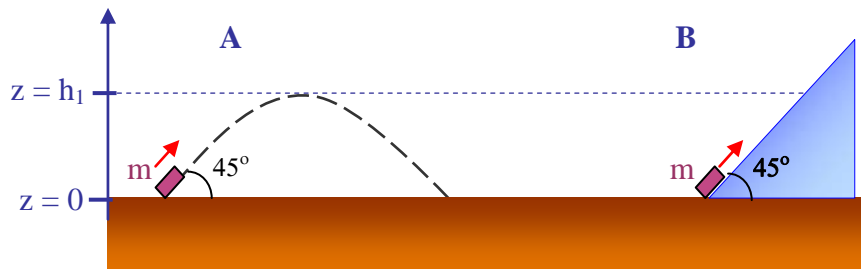
2A Let's call h_1 the maximum height reached by the object-A. Calculate the horizontal component of the velocity of the object-A when it passes by the maximum height h_1 .

ANSWER 7.1 m/s

2B Calculate the x-component of the velocity of the object-B when it passes by the height level $z = h_1$.

ANSWER 5 m/s

3. At $t=0$ two small objects A and B of the same mass "m" are thrown simultaneously from the level $z=0$ and with the same initial speed of 10 m/s (the initial velocity makes 45° with the horizontal.) Object-A travels free in the air (its trajectory is indicated in the graph) while object-B moves along a frictionless surface of a 45° ramp.



3A How long does it take for the object-A to reach the maximum height h_1 ?

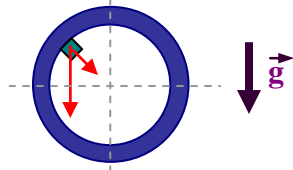
ANSWER 0.7 s

3B How long does it take for the object-B to reach (or pass by) the level of height $z = h_1$.

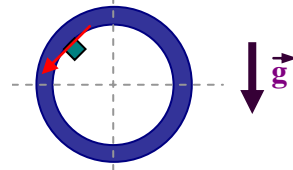
ANSWER 0.42 s

4. A ball slides counter-clockwise in a frictionless vertical circular path in a uniform gravitational field directed downwards.

4A When the block is at the position indicated in the figure, draw both all the forces acting on the block, as well as the corresponding vector velocity.

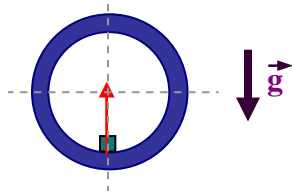


Draw here the forces.

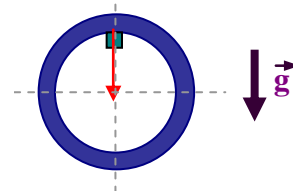


Draw here the vector velocity.

4B Using the corresponding graphs given below, draw the vector acceleration when the ball is at the lowest point of its path, as well as when the ball is at the highest point of its path.

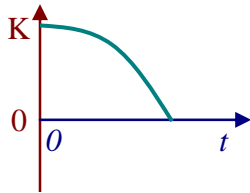


Draw here the vector acceleration.

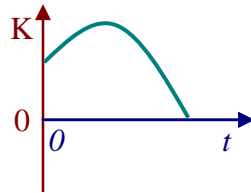


Draw here the vector acceleration.

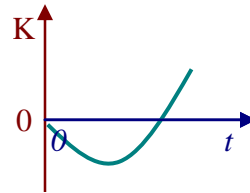
5. 5A. A glob of slime is launched or dropped from the edge of a cliff. Circle the graphs that could possibly show how the kinetic energy of the glob changes during its flight.



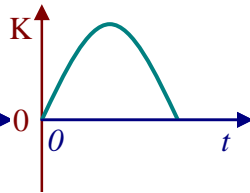
a)



b)



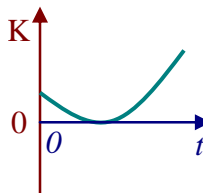
c)



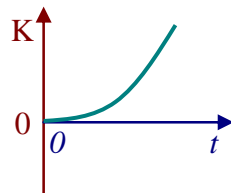
d)

e) All the graphs above are incorrect

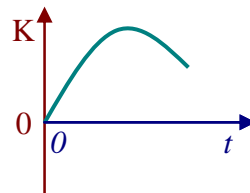
5B. A glob of slime is dropped from the edge of a cliff. Circle the graphs that could possibly show how the kinetic energy of the glob changes during its flight.



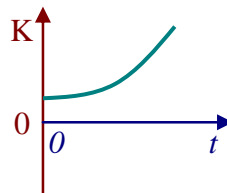
a)



b)



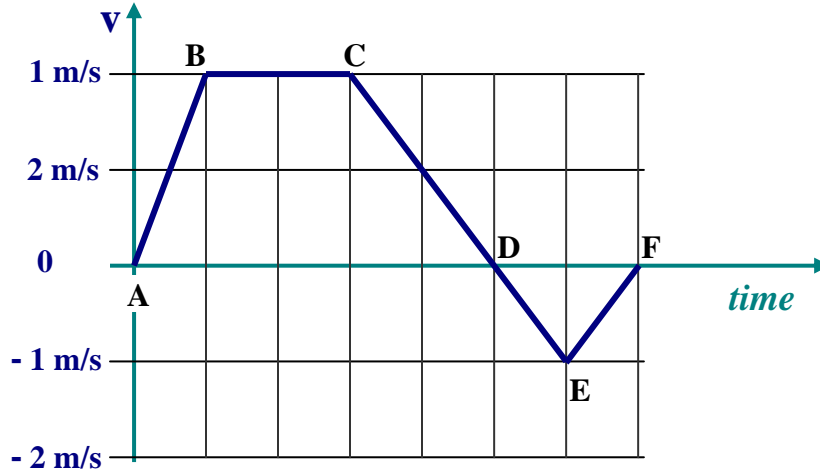
c)



d)

e) All the graphs above are incorrect

6. 6A The motion of a particle is described by a velocity vs time graph (as shown in the figure below). For each of the intervals indicated in the figure, indicate whether the change in the kinetic energy of the particle (caused by a variable total force acting on the particle) is positive, zero, or negative.

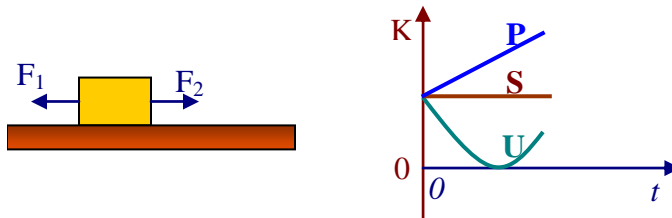


ANSWER $W(A \rightarrow B)$ Positive $W(B \rightarrow C)$ Zero

$W(C \rightarrow D)$ negative $W(D \rightarrow E)$ positive

$W(E \rightarrow F)$ negative

- 6B. The figure below shows two horizontal forces that act on a block that, at $t=0$, is sliding to the right across a frictionless floor. The figure also shows three plots of the block's kinetic energy K versus time t .



Which of the plots best corresponds to the following three situations?

i) $F_1 = F_2$ ANSWER S

ii) $F_1 > F_2$ ANSWER U

iii) $F_1 < F_2$ ANSWER P

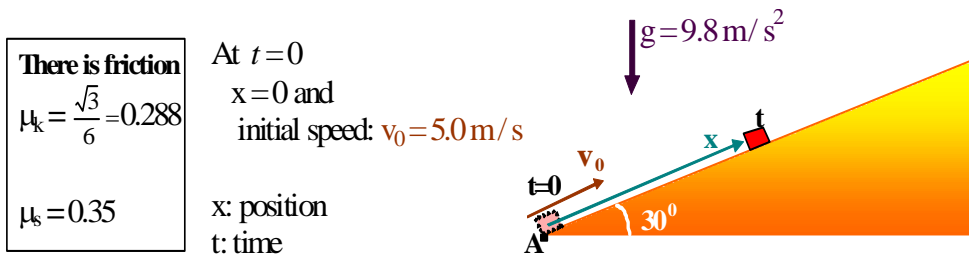
7 A block of mass $m = 0.8 \text{ Kg}$ slides up a rough ramp. At $t=0$ the block is at A (the bottom of the ramp) and its initial speed is 5.0 m/s . When the block reaches its highest position

7A what is the distance it has traveled along the ramp?

- a) 4.5 m b) 3.1 m c) 0.5 m **d) 1.7 m** e) NA

7B what is the work done by the gravitational force?

- a) -6.6 J** b) -12 J c) 3.1 J **d) -8.3 J** e) NA



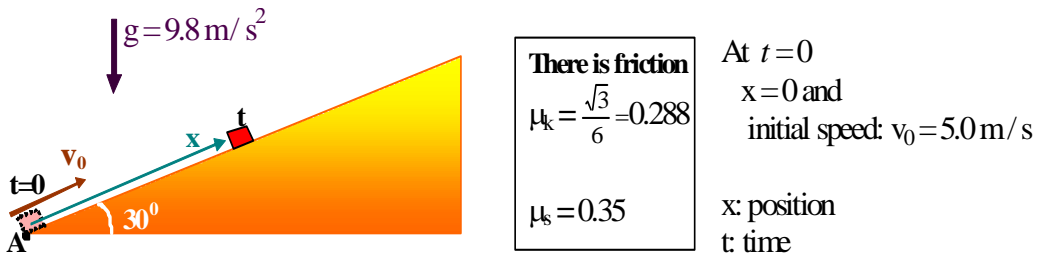
8 A block of mass $m = 0.8 \text{ Kg}$ slides up a rough ramp. At $t=0$ the block is at A (the bottom of the ramp) and its initial speed is 5.0 m/s .

8A When the block reaches its highest position what is the work done by the friction force?

- a) -4.2 J **b) -3.3 J** c) -17 J **d) -1.5 J** e) NA

8B When the ball returns to its initial position, what is its speed (in m/s)?

- a) 1.7 b) 5.8 c) 4.3 **d) 2.9** e) NA

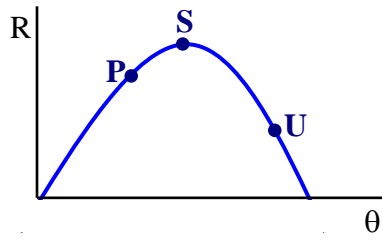


Bonus question (5 points)

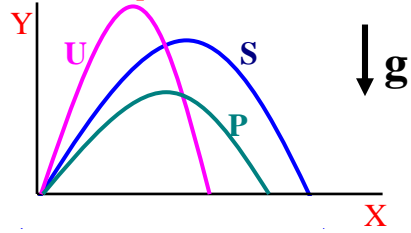
A ball is shot from ground level over level ground at a certain initial speed. The figure below gives the ranger of the ball versus its launch angle. Rank, from greatest to lowest, the three lettered points on the plot according to:

i) The total flight time of the ball ANSWER: U, S, P

ii) The ball's speed at maximum height ANSWER: P, S, U



Solution corresponds to



Helpful formulas

Average velocity = $\Delta \mathbf{x} / \Delta t$

instantaneous velocity $\mathbf{v} = d \mathbf{x} / dt$

Average acceleration = $\Delta \mathbf{v} / \Delta t$

instantaneous acceleration $\mathbf{a} = d \mathbf{v} / dt$

Motion under constant acceleration “a”

$$v = v_o + a t$$

$$x - x_o = v_o t + (1/2) a t^2$$

$$v^2 = v_o^2 + 2 a (x - x_o)$$

Free fall

$$v_y = v_{oy} - g t$$

$$g = 9.8 \text{ m/s}^2$$

$$y - y_o = v_{oy} t - (1/2) g t^2$$

$$x - x_o = v_{ox} t$$

$$g = 32 \text{ ft/s}^2$$

$$v_y^2 = v_{oy}^2 - 2 g (y - y_o)$$

Projectile motion

$$x = x_o + (v_o \cos \theta) t$$

$$y = y_o + (v_o \sin \theta) t - (1/2) g t^2$$

$$\text{Range } R = (v_o^2 / g) \sin 2\theta$$

Uniform circular motion $\mathbf{a} = v^2 / R$

Newton's second law $\mathbf{F} = m \mathbf{a}$

Work/Kinetic-energy theorem $\Delta K = W_{\text{total}}$
