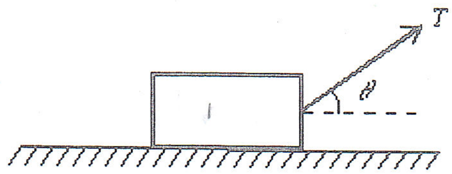
23. A block of mass m is pulled at constant velocity along a rough horizonatl floor by and applied force $\vec{T}$ as shown. The magnitude of frictional force is:



A) $T \cos \theta$
B) $T \sin \theta$
C) zero
D) mg
E) $mg \cos \theta$

$T \cos \theta + F_f = 0$

$F_f = -T \cos \theta$

24. For a block of mass m to slide without friction up the rise of height h shown, it must have a minimum initial speed of:

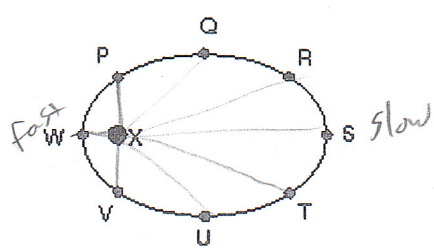
A) $1/2\sqrt{gh}$
B) $\sqrt{gh/2}$
C) $\sqrt{2gh}$
D) $2\sqrt{2gh}$
E) $2\sqrt{gh}$

KE → PE

$\frac{1}{2} m v^2 = mgh$

$v = \sqrt{2gh}$

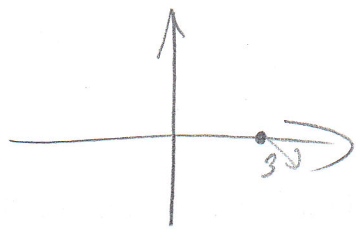
25. A planet travels in an elliptical orbit about a star X as shown. The magnitude of the acceleration of the planet is:



A) greatest at point Q
B) greatest at point S
C) greatest at point U
D) greatest at point W
E) the same at all points

29. A 2.0-kg block starts from rest on the positive x axis 3.0 m from the origin and thereafter has an acceleration given by $\vec{a} = 4.0\hat{i} - 3.0\hat{j}$ in m/s². The torque, relative to the origin, acting on it at the end of 2.0 s is:

A) 0
B) $(-18\ \text{N} \cdot \text{m})\hat{k}$
C) $(+24\ \text{N} \cdot \text{m})\hat{k}$
D) $(-144\ \text{N} \cdot \text{m})\hat{k}$
E) $(+144\ \text{N} \cdot \text{m})\hat{k}$

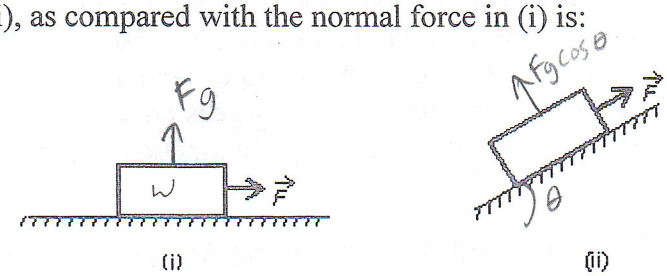


$\tau = F \times r$
$= m(a \times r)$
$= 2 \cdot -9 = (-18\ \text{N}\cdot\text{m})\hat{k}$

30. For a planet in orbit around a star the perihelion distance is r_p and its speed at perihelion is v_p. The aphelion distance is r_a and its speed at aphelion is v_a. Which of following is true?

A) $v_a = v_p$
B) $v_a / r_a = v_p / r_p$
C) $v_a r_a = v_p r_p$
D) $v_a / r^2_a = v_p / r^2_p$
E) $v_a r^2_a = v_p / r^2_p$

31. A heavy wooden block is dragged by a force $\vec{F}$ along a rough steel plate, as shown below for two cases. The magnitude of the applied force $\vec{F}$ is the same for both cases. The normal force in (ii), as compared with the normal force in (i) is:



A) the same
B) greater
C) less
D) less for some angles of the incline and greater for others
E) less or greater, depending on the magnitude of the applied force $\vec{F}$.

32. A 2.0-kg block starts from rest on the positive x axis 3.0 m from the origin and thereafter has an acceleration given by $\vec{a} = 4.0\hat{i} - 3.0\hat{j}$ in m/s². At the end of 2.0 s its angular momentum about the origin is:

A) 0
B) $(-36\ \text{kg} \cdot \text{m}^2/\text{s})\hat{k}$
C) $(+48\ \text{kg} \cdot \text{m}^2/\text{s})\hat{k}$
D) $(-96\ \text{kg} \cdot \text{m}^2/\text{s})\hat{k}$
E) $(+96\ \text{kg} \cdot \text{m}^2/\text{s})\hat{k}$

L=

at t=2

$a = \langle 4, -3 \rangle$

$v = \langle 4t, -3t \rangle \longrightarrow \langle 8, -6 \rangle$

$\cancel{d = \langle 3 + 2t^2, -\tfrac{3}{2}t^2 \rangle \longrightarrow \langle 11, -6 \rangle}$

$L = I \cdot \omega$ $= MRV$
$MR^2 \cdot \frac{V}{R}$ $= 2 \cdot \langle 8, -6 \rangle \times \langle 11, -6 \rangle$
$= -36\hat{k}$