

Skill 32: Work done against friction

111. A 15 kg bucket is lifted to a height of 5m by 900J of work using a pulley. How much work was done against friction?

$$Q = E_T - PE$$

$$Q = 900J - mgh$$

$$Q = 900J - (15kg)(9.8m/s^2)(5m)$$

$$Q = 165J$$

112. A 60 kg child slides down a ramp with a vertical height of 4m. The child has a velocity of 3m/s when they reach the bottom. How much work was done to overcome friction?

$$Q = E_T - KE$$

$$Q = PE_{\text{top}} - KE_{\text{bottom}}$$

$$Q = 2354.4J - 270J$$

$$= 2084.4J$$

	E_T	KE	PE	Q
Top	2354.4J	0	mgh 2354.4J	0
Bottom	2354.4J	$\frac{1}{2}mv^2$ 270J	0	?

113. Otto, a 5kg otter slides from the top of a 10m muddy slope. Otto reaches the bottom of the hill with a velocity of 10 m/s. How much work was done against friction?

$$Q = E_T - KE$$

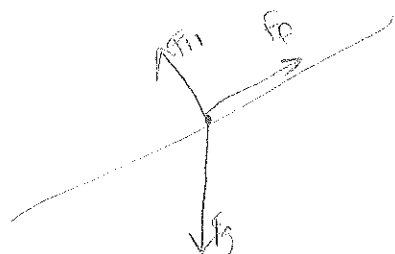
$$Q = 490J - 250J$$

$$= 240J$$

	E_T	KE	PE	Q
Top	490J	0	mgh 490J	0
Bottom	490J	$\frac{1}{2}mv^2$ 250J	0	?

Challenge Question (Review Skills)

A 20 kg object accelerates down a ramp inclined at 35 degrees with an acceleration of 4 m/s² for a distance of 3m. What is the work done against friction?



$$\begin{aligned} \Sigma F &= F_{g\parallel} + F_f \\ ma &= mg \sin \theta + F_f \\ (20kg)(4m/s^2) &= (20kg)(9.8m/s^2) \sin 35 + F_f \\ -80N &= -112.5N + F_f \\ F_f &= 32.5N \end{aligned}$$

$$\begin{aligned} W &= Fd \\ W &= (32.5N)(3m) \\ W &= 97.6J \end{aligned}$$

Topic 4B: Skill 32

Work against friction (Internal Energy)

114. A 25-gram paper cup falls from rest off the edge of a tabletop 0.90 meter above the floor. If the cup has 0.20 joule of kinetic energy when it hits the floor, what is the total amount of energy converted into internal (thermal) energy during the cup's fall?

- (A) 0.02 J B) 0.22 J
C) 2.2 J D) 220 J

$$m = 25g = 0.025kg$$

$$h = .9m$$

$$KE = .2J$$

$$Q = E_T - KE$$

$$Q = mgh - .2J$$

$$Q = .22J - .2J$$

$$Q = .02J$$

115. Two pieces of flint rock produce a visible spark when they are struck together. During this process, mechanical energy is converted into

- A) ~~nuclear energy and electromagnetic energy~~
B) ~~internal energy and nuclear energy~~
C) electromagnetic energy and internal energy
D) ~~elastic potential energy and nuclear energy~~

116. A car uses its brakes to stop on a level road. During this process, there must be a conversion of kinetic energy into

- A) light energy
B) nuclear energy
C) gravitational potential energy
D) internal energy

117. A 0.2 kg mouse runs up a clock to a height of 1.5 m and slides down a piece of wood back to the base. The mouse has 2J of kinetic energy when he reaches the base. How much work was done against friction during the slide?

- A) 3 J (B) 1 J
C) 2 J D) 0.3 J

$$m = .2kg$$

$$h = 1.5m$$

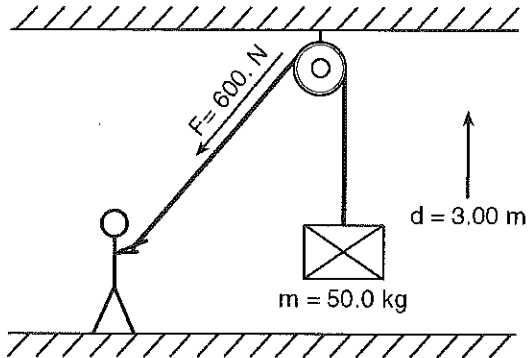
$$KE = 2J$$

$$W = ?$$

E_T	$PE + KE + Q$
mgh	0 0
2.9J	2.9J
Base 2.9J	0 2J (1.9J)

Topic 4B: Skill 32

118. As shown in the diagram below, a student exerts an average force of 600. newtons on a rope to lift a 50.0-kilogram crate a vertical distance of 3.00 meters.



Compared to the work done by the student, the gravitational potential energy gained by the crate is

- A) exactly the same
 B) 330 J less
 C) 330 J more
 D) 150 J more

$$W = (600\text{ N})(3\text{ m})$$

$$W = 1800\text{ J}$$

$$PE = mgh$$

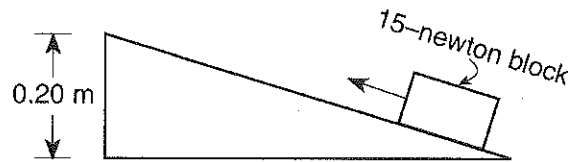
$$= (50\text{ kg})(9.8\text{ m/s}^2)(3\text{ m})$$

$$= 1471.5\text{ J}$$

119. When a force moves an object over a rough, horizontal surface at a constant velocity, the work done against friction produces an increase in the object's

- A) weight
 B) momentum
 C) potential energy
 D) internal energy

120. A block weighing 15 Newtons is pulled to the top of an incline that is 0.20 meter above the ground, as shown below.



If 4.0 joules of work are needed to pull the block the full length of the incline, how much work is done against friction?

- A) 1.0 J
 B) 0.0 J
 C) 3.0 J
 D) 7.0 J

$$W = E_T = 4\text{ J}$$

$$PE = (F_g)(d)$$

$$PE = (15\text{ N})(0.2\text{ m}) = 3\text{ J}$$

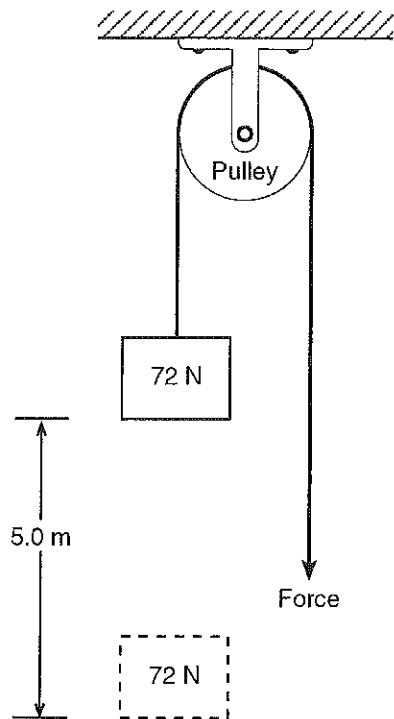
$$E_T = PE + KE + Q$$

$$4\text{ J} = 3\text{ J} + 0 + Q$$

$$Q = 1\text{ J}$$

Topic 4B: Skill 32

121. In the diagram below, 400. joules of work is done raising a 72-newton weight a vertical distance of 5.0 meters.



How much work is done to overcome friction as the weight is raised?

- (A) 40. J B) 360 J
C) 400. J D) 760 J

$$Q = E_T - PE$$

$$Q = 400J - 360J$$

$$Q = 40J$$

122. Work energy is completely converted to heat energy when all of the work done on an object is used to overcome

- A) momentum B) gravity
C) inertia D) friction

123. A force causes an object on a horizontal surface to overcome friction and begin to move. As this happens, the object's internal energy will

- A) decrease
B) increase
C) remain the same

Unit 4: Energy, Work and Power - Practice Test

2pt - Fact and Vocab Questions

124. Dumbo rides a skate board down a hill. As this happens the his potential energy

- A) Increases
- B) Decreases
- C) Remains the same

$h \downarrow$ so $PE \downarrow$

Vertical

125. The work done to accelerate a hovercraft down a hallway becomes.... [assume frictionless]

- A) potential energy (gravitational)
- B) elastic potential energy
- C) internal energy
- D) kinetic energy

(horizontal frictionless)

126. Buzz Lightyear uses a force " F_s " to stretch Slinky Dog distance " x ". Which equation could be used to determine the energy stored in the spring?

- A) $\frac{x}{F_s}$
- B) $\frac{F_s}{x}$
- C) $F_s x$
- D) $\frac{F_s}{2} x$

127. A monkey drops a banana off a cliff. At what point in the fall are the kinetic and potential energy equal?

- A) At the top
- B) At the bottom
- C) One quarter of the way down
- D) Half way down

128. As Superman flies upward at a **constant speed** of 30m/s his

- A) Kinetic energy remains the same and the potential energy increases
- B) Kinetic energy decreases and the potential energy increases
- C) Both potential and kinetic energy remains the same
- D) Both potential and kinetic energy decrease

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129. Ski lift A carries a group of snowboarders with a collective mass of 250kg to an elevation of 500m in a time of 4 minutes. Ski lift B carries a mass of 500kg in skiers to an elevation of 250m in a time of 2 minutes. Compared to Ski lift A, Ski lift B

- A) Does the same work, but consumes twice the power
- B) Does the same work, but consumes half the power
- C) Does more work and consumes the same power
- D) Does more work and consumes half the power

A	B
$m = 250\text{kg}$	$m = 500\text{kg}$
$h = 500\text{m}$	$h = 250\text{m}$
$t = 4\text{min}$	$t = 2\text{min}$
	more powerful \rightarrow less time

130. Energy and work are classified as

- A) Vector quantities
- B) Scalar quantities
- C) Energy is scalar and work is a vector

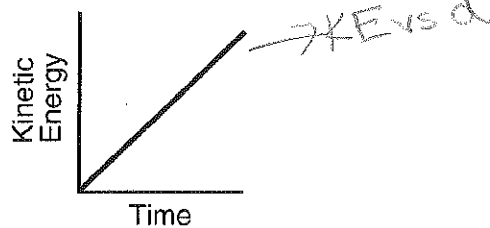
131. Which of the following is an appropriate unit for measuring kinetic energy?

- A) J/s
- B) $\text{kg} \frac{\text{m}}{\text{s}^2}$
- C) Nm
- D) N/m

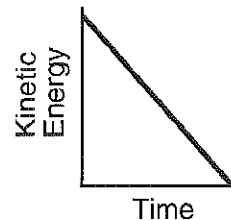
132. An object falls freely near Earth's surface.

Which graph best represents the relationship between the object's kinetic energy and its time of fall

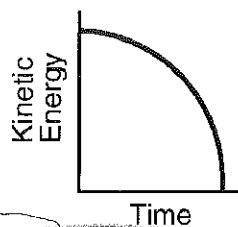
A)



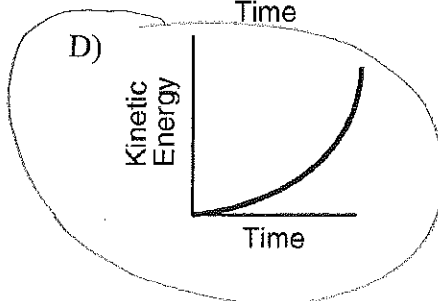
B)



C)



D)



$$KE = \frac{1}{2}mv^2$$

$$v = at$$

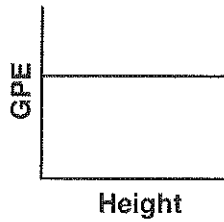
so

$$KE = \frac{1}{2}m(at)^2$$

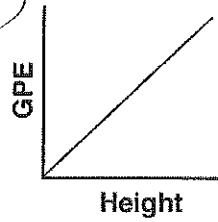
Unit 4: Energy, Work and Power - Practice Test

133. Which graph represents the relationship between the gravitational potential energy (GPE) of an object near the surface of Earth and its height above the surface of Earth?

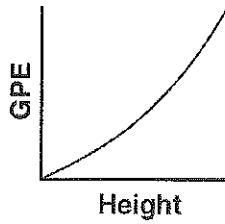
A)



B)



C)



D)

