Skill 30: Rate of Work = Power

40. Which quantity is a measure of the **rate at which work** is done?

A) energy
B) power
C) momentum
D) velocity

41. The rate at which work is done is measured in

A) Newtons
B) joules
C) calories
D) watts

42. Which unit is equivalent to a watt, the SI unit of power?

A) joule/second
B) joule/volt
C) joule/ohm
D) joule/coulomb

43. As the time required to do a given quantity of work decreases, the power developed

A) decreases
B) increases
C) remains the same

↑ $P = W/t$ ↓
inverse

44. What is the maximum amount of work that a 6000.-watt motor can do in 10. seconds?

A) 6.0×10^1 J
B) 6.0×10^2 J
C) 6.0×10^3 J
D) 6.0×10^4 J

$P = W/t$

$W = Pt$

45. Student *A* lifts a 50.-newton box from the floor to a height of 0.40 meter in 2.0 seconds. Student *B* lifts a 40.-newton box from the floor to a height of 0.50 meter in 1.0 second. Compared to student *A*, student *B* does

A) the same work but develops more power
B) the same work but develops less power
C) more work but develops less power
D) less work but develops more power

	A	B
W = 20 J	F_g 50 N	40 N
	d .4 m	.5 m
low	t = 2 s	1 s
		W = 20 J
		20 W

46. A 40.-kilogram student runs up a staircase to a floor that is 5.0 meters higher than her starting point in 7.0 seconds. The student's power output is

A) 29 W
B) 280 W
C) 1.4×10^3 W
D) 1.4×10^4 W

$P = \frac{\Delta PE}{t} = \frac{(40\text{kg})(9.8\text{m/s}^2)(5\text{m})}{7}$

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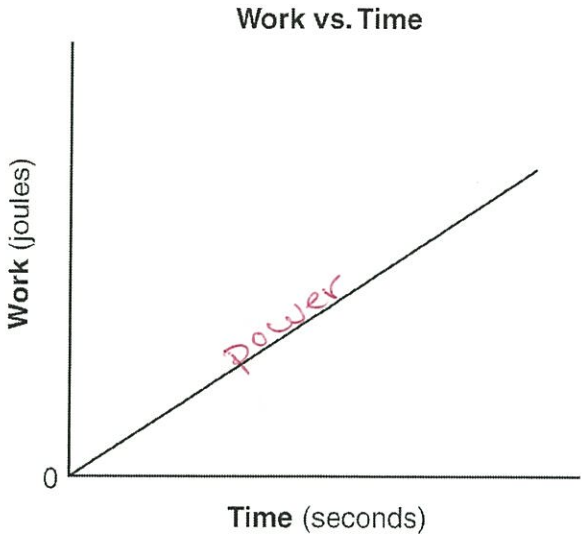
47. The graph below represents the relationship between the work done by a student running up a flight of stairs and the time of ascent.

What does the slope of this graph represent?



A) impulse
B) momentum
C) speed
D) power

$P = W/t$

48. If 20. joules of work is done in 4.0 seconds, the power developed is

A) 0.20 watt
B) 5.0 watts
C) 16 watts
D) 80. watts

$W = 20J$
$t = 4s$
$P = W/t = \frac{20J}{4s} = 5W$

49. One elevator lifts a mass a given height in 10 seconds and a second elevator does the same work in 5 seconds. Compared to the power developed by the first elevator, the power developed by the second elevator is

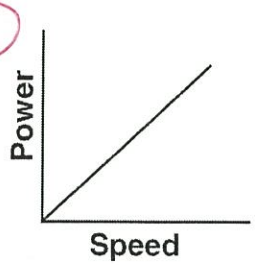
A) one-half as great
B) twice as great
C) the same
D) four times as great

P	P
W	W
10s	5s ÷2

$P = W/t$

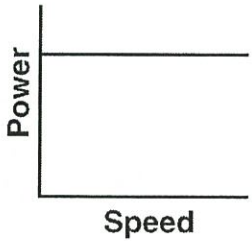
50. Zazu the Hornbill lifts coconut vertically. Which of the following represents the relationship between the power and the speed at which Zazu lifts the coconut?

A)

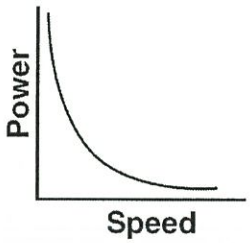


$P = Fv$

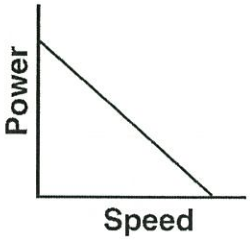
B)



C)



D)



Skill 30: Rate of Work = Power

51. Two elevators, *A* and *B*, move at constant speed. Elevator *B* moves with twice the speed of elevator *A*. Elevator *B* weighs twice as much as elevator *A*. Compared to the power needed to lift elevator *A*, the power needed to lift elevator *B* is

A) the same
B) twice as great
C) half as great
D) four times as great

A	B
v	2v
F_g	$2F_g$

$P = Fv$
$P = 2F2v$

52. A 70.-kilogram cyclist develops 210 watts of power while pedaling at a constant velocity of 7.0 meters per second east. What average force is exerted eastward on the bicycle to maintain this constant speed?

A) 490 N
B) 30. N
C) 3.0 N
D) 0 N

$P = 210W$
$v = 7m/s$
$F = ?$
$P = Fv$
$210w = F(7m/s)$
F_g

53. A boat weighing 9.0×10^2 Newtons requires a horizontal force of 6.0×10^2 Newtons to move it across the water at 1.5×10^1 meters per second. The boat's engine must provide energy at the rate of

A) 2.5×10^{-2} J
B) 4.0×10^1 W
C) 7.5×10^3 J
D) 9.0×10^3 W

$P = Fv = (6 \times 10^2 N)(1.5 \times 10^1 m/s)$

54. In raising an object vertically at a constant speed of 2.0 meters per second, 10. watts of power is developed. The weight of the object is

A) 5.0 N
B) 20. N
C) 40. N
D) 50. N

$P = 10W$
$v = 2m/s$
$P = Fv$
$10w = F(2)$
$F = 5N$

55. Car *A* and car *B* of equal mass travel up a hill. Car *A* moves up the hill at a constant speed that is twice the constant speed of car *B*. Compared to the power developed by car *B*, the power developed by car *A* is

A) the same
B) twice as much
C) half as much
D) four times as much

A	B
m	m
2v	v

56. If a motor lifts a 400.-kilogram mass a vertical distance of 10. meters in 8.0 seconds, the *minimum* power generated by the motor is

A) $3.2\ 10^2$ W
B) $5.0\ 10^2$ W
C) $4.9\ 10^3$ W
D) $3.2\ 10^4$ W

$P = \frac{Fd}{t} = \frac{F_g d}{t} = \frac{mgh}{t} = \frac{(400kg)(9.8m/s^2)(10m)}{8s}$

57. What is the maximum height to which a motor having a power rating of 20.4 watts can lift a 5.00-kilogram stone vertically in 10.0 seconds?

A) 0.0416 m
B) 0.408 m
C) 4.16 m
D) 40.8 m

$P = 20.4W$
$m = 5kg$
$t = 10s$
$P = \frac{mgh}{t}$
$20.4w = \frac{(5kg)(9.8m/s^2)(h)}{10s}$

58. What is the average power required to raise a 1.81×10^4-newton elevator 12.0 meters in 22.5 seconds?

A) 8.04×10^2 W
B) 9.65×10^3 W
C) 2.17×10^5 W
D) 4.89×10^6 W

$P = ?$
$F_g = 1.81 \times 10^4 N$
$d = 12m$
$t = 22.5s$
$P = \frac{F_g d}{t}$

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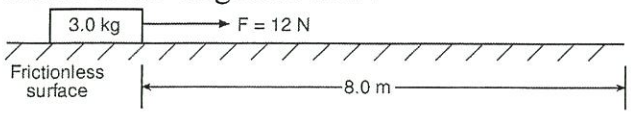
59. A 3.0-kilogram block is initially at rest on a frictionless, horizontal surface. The block is moved 8.0 meters in 2.0 seconds by the application of a 12-newton horizontal force, as shown in the diagram below.



$P = \frac{Fd}{t} = \frac{(12N)(8m)}{(2s)}$

What is the average power developed while moving the block?

A) 24 W
B) 32 W
C) 48 W
D) 96 W