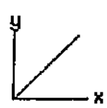
Name ____________________

Stage One of Regents Review is focused on knowing your variables, units, and the skills that transfer across all 6 units. This packet contains the following types of problems

A. Quantitative Problem Solving (List, Match, Solve)

Remember to list both your givens and your unknown (what you are trying to solve for)
Be careful with your algebraic rearrangement

B. Identifying direct, direct square, inverse and inverse square

Direct Relationship	**Direct Square Relationship**	**Inverse Relationship**	**Inverse Square Relationship**
In "direct" relationships the x and y go in the same direction. Apply any other function on the "x" to the "y"		In "inverse" relationships the x and y go in opposite directions. Apply any other function on the "x" to the "y"	
y=mx If x is halved, y is halved. If x is tripled, y is tripled	y=mx^2 If x is halved, y is quartered. If x is tripled, y is multiplied by 9	$y=\frac{m}{x}$ If x is halved, y is doubled. If x is tripled, y is divided by 3	$y=\frac{m}{x^2}$ If x is halved, y is quadrupled. If x is tripled, y is divided by 9
		The graphs of all inverse are the same basic shape. The curve gets more severe with each power	

C. Matching variables and acceptable units of measurement (combinations and derived)

Base Units – Values that can be measured directly	**Derived Units – Terms that replace a combination of units**	**Combined Units based on substituting into equations**
Mass = kilogram	Power = Watts also a J/s	speed or velocity = m/s from v=d/t
Time = second	Energy or Work = Joules also a $kg\frac{m^2}{s^2}$ or a Nm	Acceleration = m/s^2 from a=v/t (or N/kg for gravitational field strength)
Meter = distance, displacement, etc	Force = Newton Also a $kg\frac{m}{s^2}$	Spring constant is N/m from k=Fs/x
Coulomb = charge	Current = Ampere also a c/s	Use the reference table to practice all of these unit combinations. See "2 page table" for practice
	Resistance = Ohms V/A	

D. Estimating values – Exponents express "orders of magnitude". These orders of magnitude can also be expressed using metric prefixes. Each metric prefix is exchangeable with an exponent.

E. Identifying Scalar vs vector

Scalars – Values without Direction	Vectors – Values requiring magnitude (size) and direction
Distance, wavelength, height etc Speed Mass Time Work Energy, work, power (mechanical and electrical) Current, Resistance, Potential Difference, Charge	Displacement Velocity Acceleration Field Strength (gravitational and electric) Force (Including Weight) ie all values in Newtons Momentum Impulse

F. Slope vs. Area of a graph

Significance of Slope	Significance of Area
Slope is equal to rise (y) over run (x) To find the significance of slope: 1. Find the equation that relates the variable on the axes of the given graph. 2. Rearrange the equation in the form of $\frac{y}{x} = m$	Area is equal to the product of two values. To find the significance of area: 1. Find the equation that relates the two variables on the axes of a given graph 2. Rearrange the equation in the form of (y)(x)=area for a triangle 1/2yx=area

Examples:

y	x	So Equation Match is	m (slope)
distance	Time	$\frac{d}{t} = v$	Speed or velocity
Potential difference	Current	$\frac{V}{I} = R$	Resistance
E_{photon}	frequency	$\frac{E_{photon}}{f} = h$	Planck's Constant
Frictional Force	Normal Force	$\frac{F_f}{F_N} = \mu$	Coefficient of friction

Examples:

y	x	So Equation Match is	Area
Velocity or speed	Time	$vt = d$	Distance or displacement
Potential difference	Current	VI= P	Power
Force	distance	Fd=W	Work
Wavelength	frequency	fλ=v	Velocity (area under point)

G. Finding components of vectors (or vice versa)

For perpendicular velocity vectors the general equations listed below can be re-written with "v" in place of A, Ax or Ay

$A_x = A\cos\Theta$ $A_y = A\sin\Theta$ $\Theta = \tan^{-1}(\frac{A_y}{A_x})$ $A^2 = A_x^2 + A_y^2$ or $A = \sqrt{A_x^2 + A_y^2}$

$v_x = v\cos\Theta$ $v_y = v\sin\Theta$ $\Theta = \tan^{-1}(\frac{v_y}{v_x})$ $v^2 = v_x^2 + v_y^2$ or $v = \sqrt{v_x^2 + v_y^2}$

These equations can be used to split a vector with a direction that is not East, West, North or South into horizontal and vertical components. Or to determine the resultant velocity of an object with two perpendicular components.

The sum of two vectors is called the resultant. The equilibrant is equal in magnitude and opposite in direction (180 degrees different) from the resultant.

The maximum resultant of 2 vectors occurs when the angle between them is 0 degrees (or smallest choice option)

The minimum resultant of 2 vectors occurs when the angle between them is 180 degrees (or the closest choice option).

Note that only a very small portion of Physics Regents exam problems are at this basic level. You should be getting 85% of these questions correct if you expect to pass the Regents Exam in Physics. If you are having trouble with questions in this packet please be sure you are using your Physics Reference Table in problem solving. Use resources such as flashcards from my Edline page to learn the terms, variables and units. Ask for help if you are struggling with math skills, calculator skills or a specific physics skill listed above. It is strongly recommended that you master "Stage One Problems" before you move on to the average "Stage Two" or advanced "Stage Three" questions.

PART A: Quantitative Problem Solving (List, Match, Solve)

For these problems, make a list of "givens" with units, state equation and show solution.

1. How much time does it take for a bike moving with a speed of 15m/s to cover a distance of 3500m?

   $t = ?$
   $v = 15\,m/s$
   $d = 3500\,m$

   $v = d/t \quad t = d/v = \frac{3500m}{15 m/s} = \boxed{233.3s = 3.9 \text{ minutes}}$

2. How much distance is covered by an ant moving at $2x10^{-2}$m/s for 60 seconds?

   $d = ?$
   $v = 2\times10^{-2} m/s$
   $t = 60s$

   $d = vt = (2\times10^{-2} m/s)(60s) = 120\times10^{-2} m = \boxed{1.2m}$

3. What is the acceleration of an object that speeds up from 15m/s to 35 m/s in a time of 4 seconds?

   $a = ?$
   $v_i = 15 m/s$
   $v_f = 35 m/s$ } $\Delta v = 20 m/s$
   $t = 4s$

   $a = \frac{\Delta v}{t} = \frac{20 m/s}{4s} = \boxed{5 m/s^2}$

4. What is the acceleration of a toy rocket that covers a distance of 20m in a time of 0.4 seconds if it experiences a uniform net force?

   $a = ?$
   $d = 20m$
   $t = .4s$
   $F_{net} = \text{constant}$

   $d = \frac{1}{2}at^2$
   $20m = \frac{1}{2}a(.4s)^2$
   $\boxed{a = 250 m/s^2}$

5. What is the final velocity of a ball that starts from rest and rolls down a hill with an acceleration of 3.5 m/s² for a distance of 30m?

   $v_f = ?$
   $v_i = 0$
   $a = 3.5 m/s^2$
   $d = 30m$

   $v_f^2 = v_i^2 + 2ad$
   $v_f^2 = 0 + 2(3.5 m/s^2)(30m)$
   $v_f = \sqrt{210 m^2/s^2}$
   $\boxed{v_f = 14.5 m/s}$

6. What is the acceleration due to gravity on a planet where a ball falls a distance of 30m in 6 seconds?

   $a = ?$
   $d = 30m$
   $t = 6s$

   $d = \frac{1}{2}at^2$
   $\frac{2d}{t^2} = a$
   $\boxed{a = \frac{2(30m)}{(6s)^2} = \frac{60m}{6s^2} = 10 m/s^2}$

7. What is the mass of cart if a net force of 30N causes it to accelerate at 4 m/s²?

   $m = ?$
   $F_{net} = 30N$
   $a = 4 m/s^2$

   $F_{net} = ma$
   $30N = m(4 m/s^2)$
   $\boxed{m = 7.5 Kg}$

8. What is the weight of a rock with a mass of 5kg on a planet with a gravitational field strength of 12N/kg?

$F_g = ?$
$m = 5kg$
$g = 12N/kg$

$F_g = mg$
$= (5kg)(12N/kg) = \boxed{60N}$

9. A phone is thrown at a wall with a momentum of 4kg m/s and hits a wall with a speed of 20m/s. What is the mass of the phone?

$p = 4 kg\,m/s$
$v = 20 m/s$
$m = ?$

$p = mv$
$4 kg\,m/s = m(20 m/s)$
$\boxed{m = .2 kg}$

10. A force of 30N acts on a book for a time of 0.4 seconds. What is the impulse acting on the book?

$F = 30N$
$t = .4s$
$J = ?$

$J = Ft$
$J = (30N)(.4s)$
$\boxed{J = 12Ns}$

11. A force of 50N is applied to stretch a spring by 0.75m. What is the spring constant of the spring?

$F_s = 50N$
$x = .75m$
$k = ?$

$F_s = kx$
$50N = k(.75m)$
$\boxed{k = 66.7 N/m}$

12. A force of 60N is applied at an angle of 45 degrees to pull a sled. What is the horizontal component of the force?

$F = 60N$
$\theta = 45°$
$F_x = ?$

$F_x = F\cos\theta$
$F_x = 60N\cos 45°$
$\boxed{F_x = 42.4N}$

13. A horizontal force of 30N is applied concurrently with a vertical force of 45N. What is the magnitude and direction of the resultant force?

$F_x = 30N$
$F_y = 45N$
$F_x = ?$

$F = \sqrt{F_x^2 + F_y^2}$
$F = \sqrt{(30N)^2 + (45N)^2}$
$\boxed{F = 54N}$

$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right) = 56.3°$

14. A yo-yo with a mass of 1 x 10^2 kg being spun in a circle experiences a centripetal acceleration of 2m/s^2. What is the centripetal force acting on yo-yo?

$m = 1 \times 10^2 kg$
$a = 2 m/s^2$
$F_c = ?$

$F_c = ma_c$
$F_c = (1 \times 10^2 kg)(2 m/s^2)$
$\boxed{F_c = 200N}$

15. Find the kinetic energy of a 3kg ball moving with a velocity of 4m/s.

$KE = ?$
$m = 3kg$
$v = 4m/s$

$KE = \frac{1}{2}mv^2$
$KE = \frac{1}{2}(3kg)(4m/s)^2$
$\boxed{KE = 24J}$

16. Find the elastic potential energy stored when a spring with a spring constant of 2N/m is stretched 0.4m.

$PE_s = ?$
$K = 2N/m$
$x = .4m$

$PE_s = \frac{1}{2}kx^2$
$PE_s = \frac{1}{2}(2N/m)(.4m)^2$
$\boxed{PE_s = .16J}$

17. What is the work done if a force of 40N east is applied to move a box 4m east?

$W = ?$
$F = 40N$
$d = 4m$

$W = Fd$
$W = (40N)(4m)$
$\boxed{W = 160Nm = 160J}$

18. A crane with a power rating of 2000W lifts a piano for a time of 4 seconds. How much mechanical work was done by the crane?

$P = 2000W$
$t = 4s$
$W = ?$

$P = W/t$
$W = Pt$
$W = (2000W)(4s)$
$\boxed{W = 8000J}$

19. What is the electric field strength acting between two parallel plates if a charge of 2C is experiencing a electrostatic force of 5N?

$E = ?$
$q = 2C$
$F_e = 6N$

$E = \frac{F_e}{q} = \frac{6N}{2C} = \boxed{3N/C}$

20. How much work is done to move a 4C charge through a potential difference of 9V?

$W = ?$
$q = 4C$
$V = 9V$

$W = Vq$
$= (9V)(4C)$
$\boxed{= 36J}$

21. How much time is required for a current of 1.5 x 10^{-2} A to move a charge of 3 C?

$t = ?$

$I = 1.5\times10^{-2}A$

$q = 3C$

$I = q/t$

$t = q/I = \frac{3C}{1.5\times10^{-2}A} = \boxed{2\times10^{2}s}$

22. What is the current in a wire with an applied potential difference of 20V and a resistance of 60Ω?

$I = ?$

$V = 20V$

$R = 60\Omega$

$V = IR$

$I = V/R = \frac{20V}{60\Omega} = \boxed{.33A}$

23. What is the potential difference in a wire if 30 Ω of resistance allows a current of 0.2A?

$V = ?$

$R = 30\Omega$

$I = .2A$

$V = IR$

$= (.2A)(30\Omega) = \boxed{6V}$

24. What is the power rating of device that allows a current of 2A when a resistance of 4 Ω is present?

$P = ?$

$I = 2A$

$R = 4\Omega$

$P = I^2R$

$P = (2A)^2 4\Omega$

$\boxed{P = 16W}$

25. A wave moving with a speed of 30m/s has a wavelength of 5m. What is the frequency of the wave?

$v = 30m/s$

$\lambda = 5m$

$f = ?$

$v = f\lambda$

$f = v/\lambda = \frac{30m/s}{5m} = \boxed{6Hz}$

26. What is the period of a wave if it has a frequency of 2.5 x 10^6 Hz?

$T = ?$

$f = 2.5\times10^6Hz$

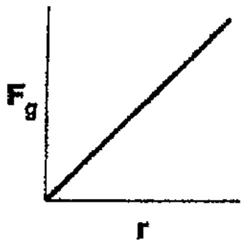
$T = 1/f = \frac{1}{2.5\times10^6Hz} = .4\times10^{-6}s = \boxed{4\times10^{-7}s}$

Level One Review

PART B: Direct, Direct square, Inverse and Inverse Square Relationships.

27. Which graph represents the relationship between the magnitude of the gravitational force, F_g, between two masses and the distance, r, between the centers of the masses?

A)



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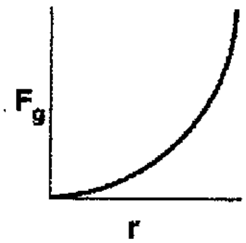

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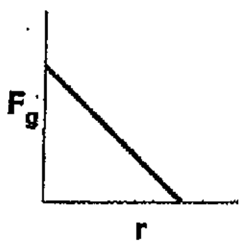
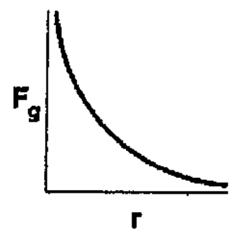


D)



$F_g = \frac{Gm_1m_2}{r^2}$

$y = \frac{(m)}{x^2}$

28. A distance of 1.0 meter separates the centers of two small charged spheres. The spheres exert gravitational force F_g and electrostatic force F_e on each other. If the distance between the spheres' centers is increased to 3.0 meters, the gravitational force and electrostatic force, respectively, may be represented as

A) $\frac{F_g}{9}$ and $\frac{F_e}{9}$ B) $\frac{F_g}{3}$ and $\frac{F_e}{3}$

C) $3F_g$ and $3F_e$ D) $9F_g$ and $9F_e$

F_e & F_g	r
F_g	1m $\times 3$
$\div 3^2$ $\frac{F_g}{9}$	3m

29. If the speed of a moving object is doubled, the kinetic energy of the object is

A) halved B) doubled

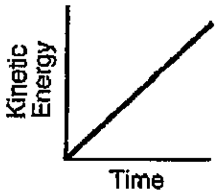
C) unchanged D) quadrupled

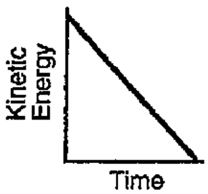
V, KE

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

KE	v
$\times 2^2$	$\times 2$

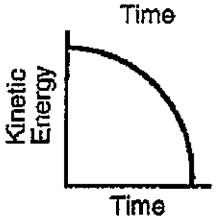
30. An object falls freely near Earth's surface. Which graph best represents the relationship between the object's kinetic energy and its time of fall

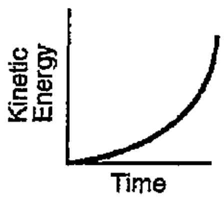
A)


B)


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

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

C)


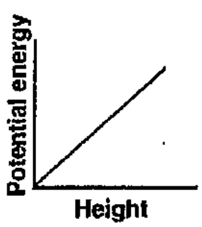
D)


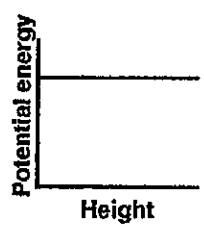
KE & V direct^2

V & t direct

So KE & t is also direct^2

31. Which graph best represents the relationship between the gravitational potential energy of an object near the surface of Earth and its height above Earth's surface?

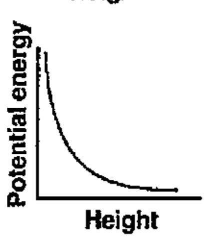
A)


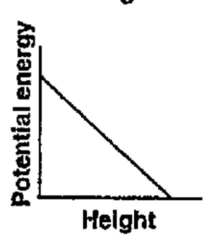
B)


y x

$\boxed{PE = mgh}$

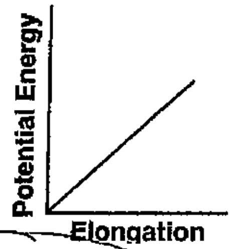
direct

C)


D)


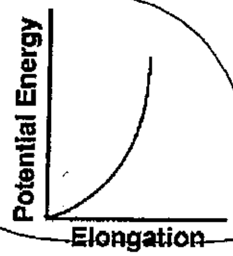
32. Which graph best represents the relationship between the elastic potential energy stored in a spring and its elongation from equilibrium?

A)

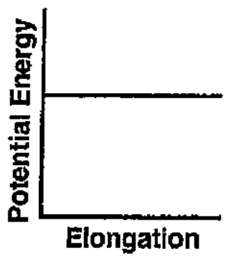


$PE_s = \frac{1}{2}kx^2$

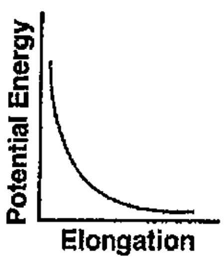
B)



C)

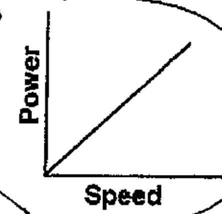


D)



33. 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?

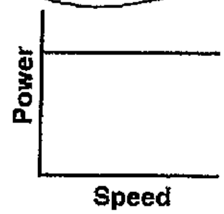
A)



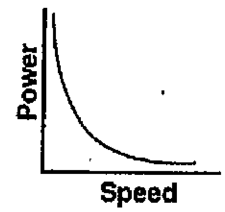
$P = Fv$

$y \propto x$

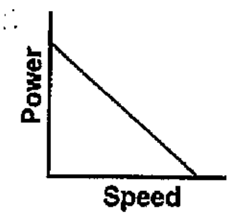
B)



C)



D)



34. A 110-kilogram bodybuilder and his 55-kilogram friend run up identical flights of stairs. The bodybuilder reaches the top in 4.0 seconds while his friend takes 2.0 seconds. Compared to the power developed by the bodybuilder while running up the stairs, the power developed by his friend is

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

m=110kg	m=55kg
h	h
t=4s	t=2s
$P=\frac{2mgh}{2t}$	$P=\frac{mgh}{t}$

Same

35. If the resistance of a circuit is doubled and the voltage remains unchanged, the current flowing in the circuit will be

A) one-half as much
B) twice as much
C) one-fourth as much
D) four times as much

$\div 2 \; I = \frac{V}{R} \times 2$

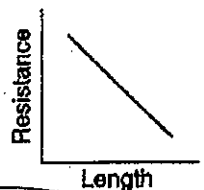
Inverse

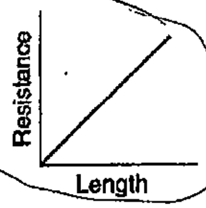
36. When the total resistance of a simple electrical circuit is decreased while keeping the voltage constant, the current in the electrical circuit will

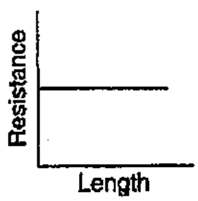
A) decrease
B) increase
C) remain the same

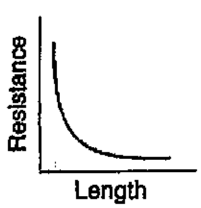
$I = V/R$

37. A copper wire is part of a complete circuit through which current flows. Which graph best represents the relationship between the wire's length and its resistance?

A)


B)


C)


D)


y x

$R = \frac{\rho L}{A}$

direct

38. If the length of a copper wire is reduced by half, then the resistance of the wire will be

A) halved
B) doubled
C) quartered
D) quadrupled

$R = \frac{\rho L}{A}$ direct

39. The electrical resistance of a metallic conductor is inversely proportional to its

A) temperature
B) length
C) cross-sectional area
D) resistivity

$R = \frac{\rho L}{A}$

Inverse

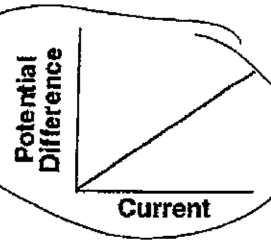
40. An electric circuit consists of a variable resistor connected to a source of constant potential difference. If the resistance of the resistor is doubled, the current through the resistor is

A) halved
B) doubled
C) quartered
D) quadrupled

$\div 2 \; I = \frac{V}{R} \times 2$

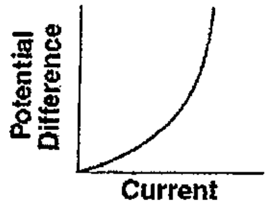
41. Which graph represents the relationship between the potential difference applied to a copper wire and the resulting current in the wire at constant temperature?

A)

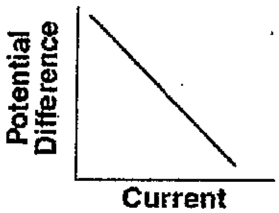


$V = IR$

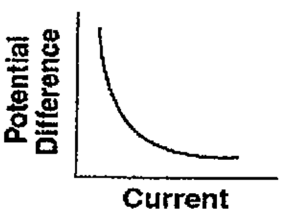
B)



C)

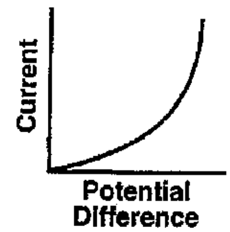


D)

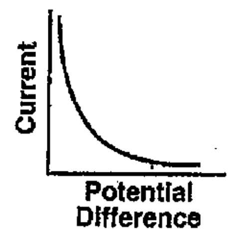


42. The resistance of a circuit remains constant. Which graph best represents the relationship between the current in the circuit and the potential difference provided by the battery?

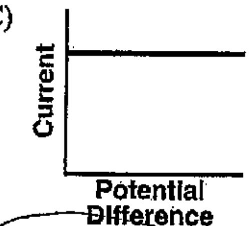
A)



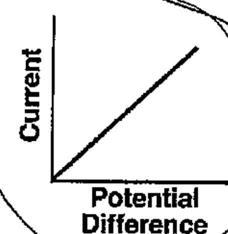
B)



C)



D)

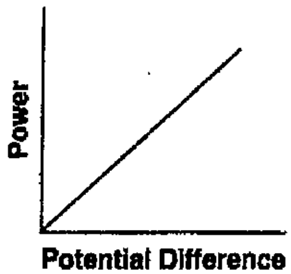


$I = \frac{V}{R}$

43. Which graph best represents the relationship between the power expended by a resistor that obeys Ohm's Law and the potential difference applied to the resistor?

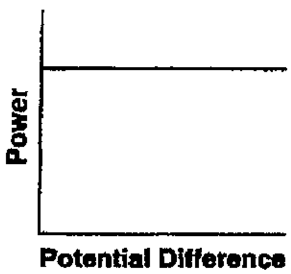
R

A)

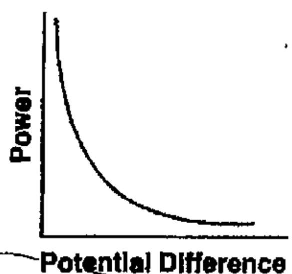


$P = \frac{V^2}{R}$

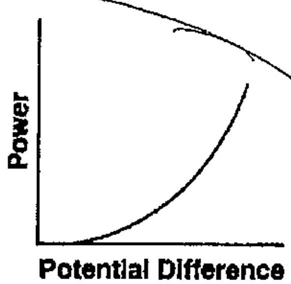
B)



C)

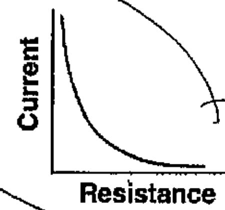


D)



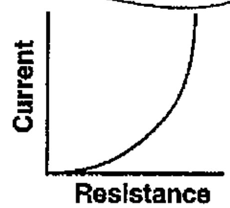
44. An electric circuit contains a variable resistor connected to a source of constant potential difference. Which graph best represents the relationship between current and resistance in this circuit?

A)

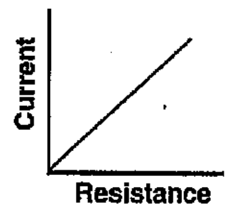


$I = V/R$

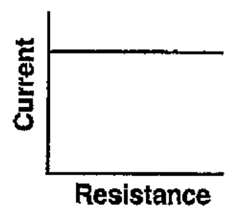
B)



C)

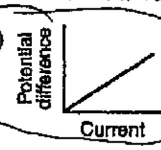


D)

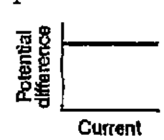


45. Which graph best represents the relationship between potential difference across a metallic conductor and the resulting current through the conductor at a constant temperature?

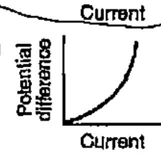
A)



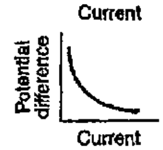
B)



C)



D)



46. An electric circuit contains a variable resistor connected to a source of constant voltage. As the resistance of the variable resistor is increased, the power dissipated in the circuit

A) decreases B) increases $P=\frac{V^2}{R}$
C) remains the same

47. If the velocity of a constant-frequency wave increases, the wavelength direct

$\lambda=\frac{v}{f}$

A) decreases B) increases
C) remains the same

48. If the frequency of a periodic wave is doubled, the period of the wave will be

$\frac{1}{2}T=\frac{1}{f}\times 2$

A) halved B) doubled
C) quartered D) quadrupled

Invers

49. If the speed of a wave doubles as it passes from shallow water into deeper water, its wavelength will be

$\lambda=\frac{v}{f}$

A) unchanged B) doubled
C) halved D) quadrupled

50. The absolute index of refraction of medium *Y* is twice as great as the absolute index of refraction of medium *X*. As a light ray travels from medium *X* into medium *Y*, the speed of the light ray is

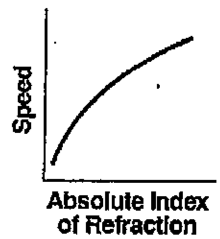
A) halved B) doubled
C) quartered D) quadrupled

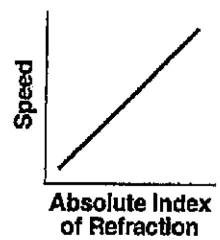
X	Y
n	2n

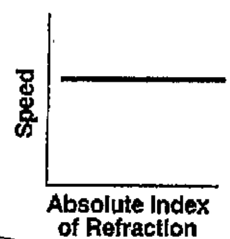
$V=\frac{c}{n}$

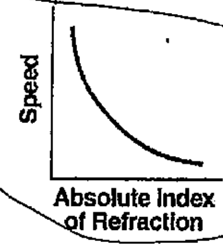
51. A ray of light ($f = 5.09 \times 10^{14}$ Hz) travels through various substances. Which graph best represents the relationship between the absolute index of refraction of these substances and the corresponding speed of light in these substances?

$V=\frac{c}{n}$

A)


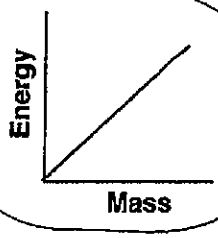
B)


C)


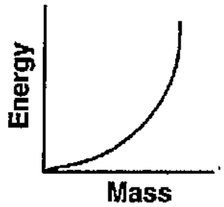
D)


52. Which graph best represents the relationship between energy and mass when matter is converted into energy?

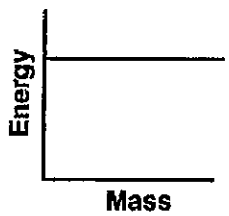
A)



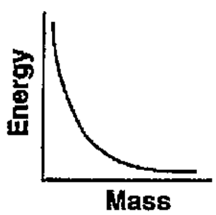
B)



C)



D)

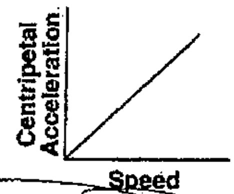


$E=mc^2$

$F_c = \frac{mV^2}{r}$

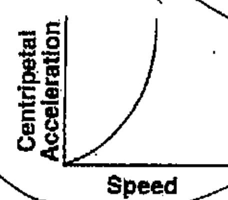
53. Which graph best represents the relationship between the magnitude of the centripetal acceleration and the speed of an object moving in a circle of constant radius?

A)

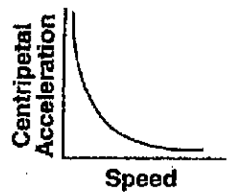


$a_c = \frac{V^2}{r}$

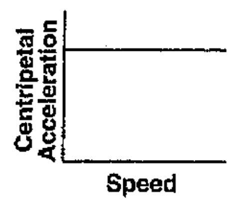
B)



C)



D)



54. The magnitude of the centripetal force acting on an object traveling in a horizontal, circular path will *decrease* if the

$\downarrow F_c = \frac{mv^2 \downarrow}{r \uparrow}$

A) radius of the path is increased
~~B) mass of the object is increased~~
~~C) direction of motion of the object is reversed~~
~~D) speed of the object is increased~~

55. Centripetal force F_c acts on a car going around a curve. If the speed of the car were twice as great, the magnitude of the centripetal force necessary to keep the car moving in the same path would be

A) F_c B) $2F_c$ C) $\frac{F_c}{2}$ D) $4F_c$

56. A ball of mass M at the end of a string is swinging in a horizontal circular path of radius R at constant speed V. Which combination of changes would require the greatest increase in the centripetal force acting on the ball?

$\uparrow F_c = \frac{mv^2\uparrow}{r\downarrow}$

A) doubling V and doubling R
B) doubling V and halving R
C) halving V and doubling R
D) halving V and halving R

57. A child is riding on a merry-go-round. As the speed of the merry-go-round is doubled, the magnitude of the centripetal force acting on the child

A) remains the same B) is doubled
C) is halved D) is quadrupled

$F_c = \frac{mv^2}{r}$

58. An electrostatic force of magnitude F exists between two metal spheres having identical charge q. The distance between their centers is r. Which combination of changes would produce *no* change in the electrostatic force between the spheres?

A) doubling q on one sphere while doubling r ×2 ÷4 = ÷2
B) doubling q on both spheres while doubling r ×2 ×2 ÷4 ×1
C) doubling q on one sphere while halving r ×2 ×4 ×8
D) doubling q on both spheres while halving r ×4 ×4 ×16

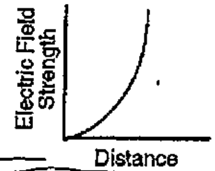
$F_e = \frac{kq_1q_2}{r^2}$

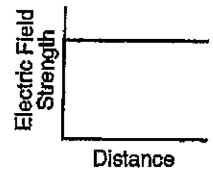
59. If the distance separating an electron and a proton is halved, the magnitude of the electrostatic force between these charged particles will be

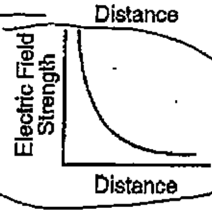
A) unchanged B) doubled
C) quartered D) quadrupled

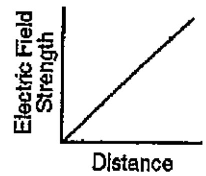
F_e	r
×4	÷2

60. Which graph best represents the relationship between the strength of an electric field and distance from a point charge?

A) 

B) 

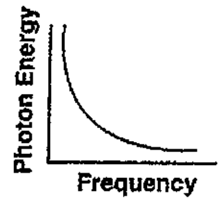
C) 

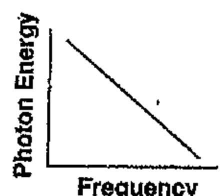
D) 

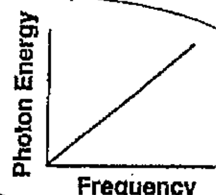
$F_e = \frac{kq_1q_2}{r^2}$

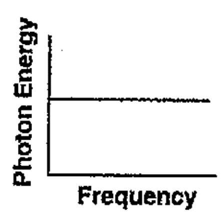
61. Which graph best represents the relationship between photon energy and photon frequency?

$E_{photon} = hf$

A) 

B) 

C) 

D) 

62. A variable-frequency light source emits a series of photons. As the frequency of the photon increases, what happens to the energy and wavelength of the photon?

$E_{photon} = hf$

$E_{photon} = \frac{hc}{\lambda}$

A) The energy decreases and the wavelength decreases.
B) The energy decreases and the wavelength increases.
C) The energy increases and the wavelength decreases.
D) The energy increases and the ~~wavelength increases.~~

63. The energy of a photon is inversely proportional to its

A) wavelength B) frequency
C) speed D) phase

$E_{photon} = \frac{hc}{\lambda}$

Level One Review

Part C: Units of measurement. Base Units, Derived Units, Combined Units (based on equations)

64. Which combination of fundamental units can be used to express energy? Energy = Joules

    A) kg•m/s
    B) kg•m²/s
    C) kg•m/s² m a
    D) kg•m²/s² m v²

65. A joule is equivalent to a Energy & Work = Joules

    A) N•m Fd = Work
    B) N•s Ft = Impulse
    C) N/m F/x = spring constant
    D) N/s F/t nothing

66. Which two quantities can be expressed using the same units?

    A) energy J and force N
    B) impulse Ns and force N
    C) momentum kg m/s and energy
    D) impulse and momentum

    Ns = kg m/s
    kg m/s² · s = kg m/s

67. Which combination of fundamental unit can be used to express the weight of an object? F_g = N = kg m/s²

    A) kilogram/second
    B) kilogram•meter
    C) kilogram•meter/second
    D) kilogram•meter/second²

68. One coulomb per second is equal to one $\frac{C}{s} = \frac{q}{t} = I$

    A) watt
    B) ohm
    C) volt
    D) ampere

69. One watt is equivalent to one Watt = Power

    A) N•m Fd
    B) N/m F/x
    C) J•s Wt
    D) J/s W/t = P

70. Which combination of units can be used to express electrical energy? $W = Vq$

    A) $\frac{\text{volt}}{\text{coulomb}}$
    B) $\frac{\text{coulomb}}{\text{volt}}$
    C) volt•coulomb
    D) volt•coulomb•second

71. The electronvolt is a unit of q V

    A) energy
    B) charge
    C) electric field strength
    D) electric potential difference

72. The hertz is a unit Frequency that describes the number of

    A) seconds it takes to complete one cycle of a wave
    B) cycles of a wave completed in one second
    C) points that are in phase along one meter of a wave
    D) points that are out of phase along one meter of a wave

73. Which is a unit of electrical power? $P = I^2R = V^2/R$

    A) volt/ampere
    B) ampere/ohm
    C) ampere²/ohm
    D) volt²/ohm

74. Which term is a unit of power?

    A) joule
    B) Newton
    C) watt
    D) hertz

75. The watt•second is a unit of $P = W/t$ $W = Pt$

    A) power
    B) energy
    C) potential difference
    D) electric field strength

76. Which two quantities are measured in the same units?

    A) velocity m/s and acceleration m/s²
    B) weight N and force N
    C) mass kg and weight N
    D) force N and momentum kg m/s

velocity

77. A meter/second could also be expressed as

A) m/Hz B) m Hz C) m/s^2 D) s/Hz

λ/f λf d/t^2 T/f

PART D: ESTIMATION (translating between standard notation, scientific notation, metric notation or in combination).

78. The approximate length of an unsharpened No. 2 pencil is

A) 2.0×10^{-2} m 2cm
B) 2.0×10^{-1} m 20×10^{-2} m = 20cm
~~C) 2.0×10^{0} m 2m~~
~~D) 2.0×10^{1} m 20m~~

79. The weight of a typical high school physics student is closest to

$F_g = mg$

$m = \frac{F_g}{g}$

A) 1500 N = 150kg
B) 600 N = 60kg
C) 120 N = 12kg
D) 60 N 6kg

80. What is the approximate mass of an automobile?

~~A) 10^{1} kg 10kg~~
~~B) 10^{2} kg 100kg~~
C) 10^{3} kg 1000kg
~~D) 10^{6} kg 1000,000kg~~

81. An egg is dropped from a $\boxed{\text{third-story window.}}$ The distance the egg falls from the window to the ground is closest to

1m = 3ft

$\boxed{\text{10m = 30ft}}$

3story

A) 10^{0} m 1m
B) 10^{1} m 10m
C) 10^{2} m 100m
D) 10^{3} m 100m

82. The thickness of one page of this test booklet is closest to

A) 10^{-4} m .1mm
B) 10^{-2} m cm
~~C) 10^{0} m 1m~~
D) 10^{2} m 100m

83. Which measurement is closest to 1×10^{-2} meter?

=1cm

~~A) diameter of an atom~~
B) width of a student's finger
C) length of a football field
D) height of a schoolteacher

PART E: Scalar and Vector Quantities (be able to identify by term, variable or unit of measurement).

84. Which quantity has both a magnitude and a direction? = Vector

A) inertia B) impulse
C) speed D) time

85. Which is a vector quantity?

A) speed B) distance
C) mass D) displacement

86. Which is a vector quantity?

A) gravitational field strength of Earth
B) mass of a jogger
C) gravitational potential energy
D) kinetic energy of a freely falling body

87. Which term identifies a scalar quantity?

A) displacement B) acceleration
C) velocity D) energy

88. Which term identifies a scalar quantity?

A) displacement B) acceleration
C) velocity D) time

89. Which terms represent a vector quantity and its respective unit?

A) weight – kilogram Weight is a force - measured in Newtons
B) mass – kilogram scalar
C) force – newton
D) acceleration – ~~meters per second~~

90. A unit used for a vector quantity is

A) watt Power B) newton
C) kilogram mass D) second time

91. Which quantity is a vector?

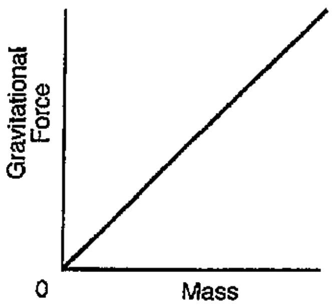
A) power B) kinetic energy
C) speed D) weight Fg Weight is a force

92. Scalar is to vector as

A) speed is to velocity
B) displacement is to distance
C) displacement is to velocity
D) speed is to distance

PART F: Significance of SLOPE or AREA (equation matching)

93. Base your answer to the following question on The graph below represents the relationship between gravitational force and mass for objects near the surface of Earth.



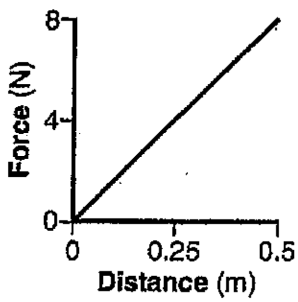
$\frac{F_g}{m} = g$

The slope of the graph represents the

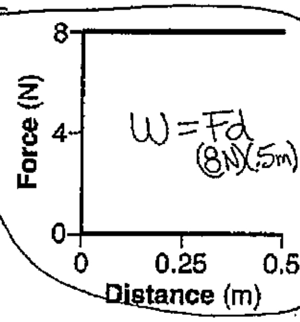
A) gravitational field strength g
B) universal gravitational constant G
C) momentum of objects p
D) weight of objects F_g

94. Which graph best represents the greatest amount of work?

A)

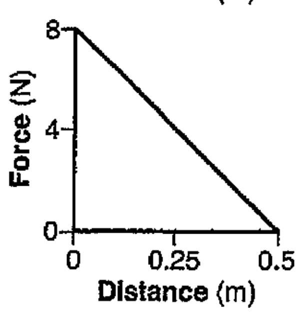


B)

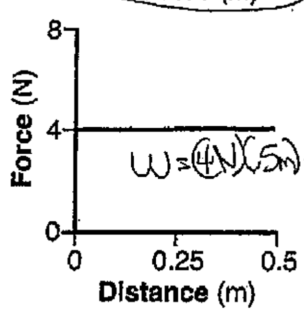


$W = Fd$
$(8N)(.5m) = 4J$

C)

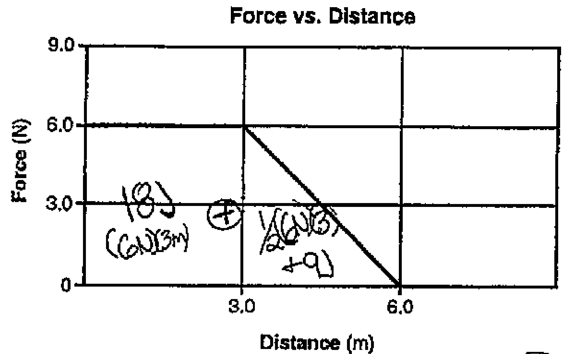


D)



$W = (4N)(.5m) = 2J$

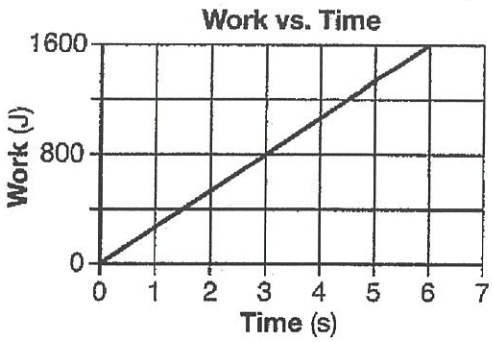
95. A box is pushed to the right with a varying horizontal force. The graph below represents the relationship between the applied force and the distance the box moves.



What is the total work done in moving the box 6.0 meters?

A) 9.0 J B) 18 J C) 27 J D) 36 J

96. The graph below represents the work done against gravity by a student as she walks up a flight of stairs at constant speed.

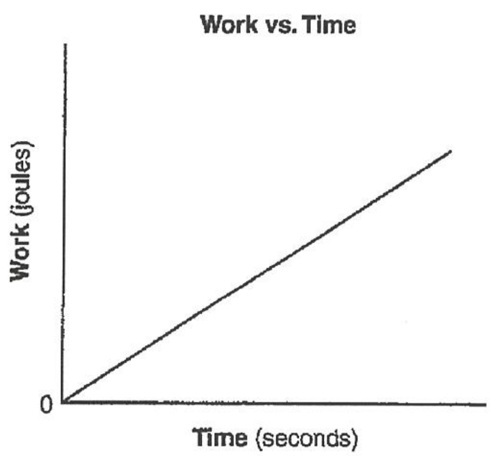


$P = W/t$

Compared to the power generated by the student after 2.0 seconds, the power generated by the student after 4.0 seconds is

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

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

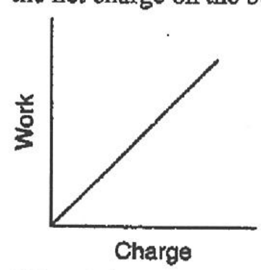


What does the slope of this graph represent?

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

$P = W/t$

98. The graph below shows the relationship between the work done on a charged body in an electric field and the net charge on the body.

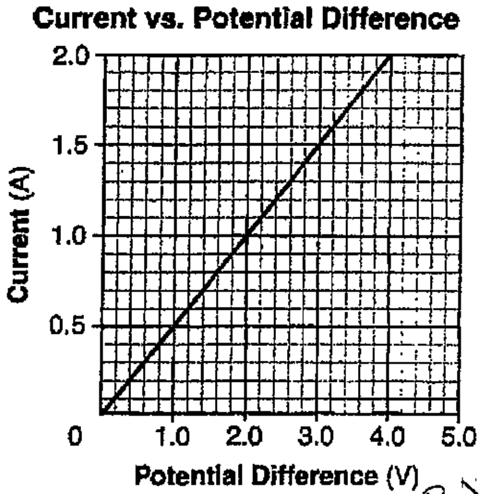


What does the slope of this graph represent?

A) power
B) potential difference
C) force
D) electric field intensity

$V = W/q$

99. The graph below represents the relationship between the current in a metallic conductor and the potential difference across the conductor at constant temperature.

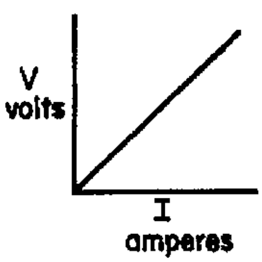


$R = \frac{V}{I} = \frac{4V}{2A} = 2\Omega$

The resistance of the conductor is

A) 1.0 Ω B) 2.0 Ω C) .50 Ω D) 4.0 Ω

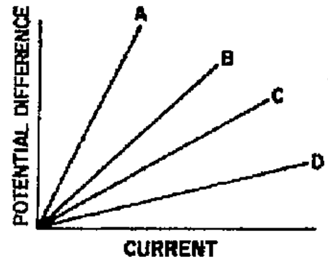
100. The graph below shows how the voltage and current are related in a simple electric circuit. For any point on the line, what does the ratio of V to I represent?



$R = \frac{V}{I}$

A) work in joules
B) power in watts
C) resistance in ohms
D) charge in coulombs

101. The graph below shows the relationship between current and potential difference for four resistors *A*, *B*, *C*, and *D*.

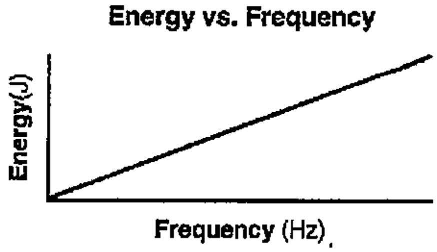


Which resistor has the greatest resistance?

A) *A* B) *B* C) *C* D) *D*

102. Base your answer to the following question on the data table and graph below. The data table lists the energy and corresponding frequency of five photons. The graph represents the relationship between the energy and the frequency of photons.

Photon	Energy (J)	Frequency (Hz)
A	6.63×10^{-15}	1.00×10^{19}
B	1.99×10^{-17}	3.00×10^{16}
C	3.49×10^{-19}	5.26×10^{14}
D	1.33×10^{-20}	2.00×10^{13}
E	6.63×10^{-26}	1.00×10^{8}



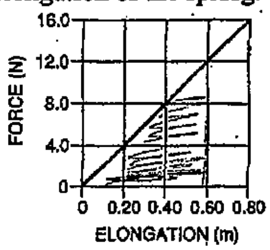
$\frac{E}{f} = h$

Planck's constant

The slope of the graph would be

A) 6.63×10^{-34} J•s
B) 6.67×10^{-11} N•m²/kg²
C) 1.60×10^{-19} J
D) 1.60×10^{-19} C

103. The graph below represents the relationship between the force applied to a spring and the elongation of the spring.



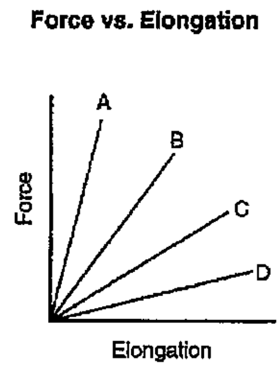
$W = (12N)(.6m)$
$= \frac{7.2Nm}{2} = 3.6Nm$

How much energy is stored in the spring if it is stretched 0.6m?

A) 3.6 J B) 7.3 J C) 20 J D) 10 J

$W = Fd = \frac{1}{2}Fx$

104. The graph below represents the relationship between the force applied to a spring and spring elongation for four different springs.

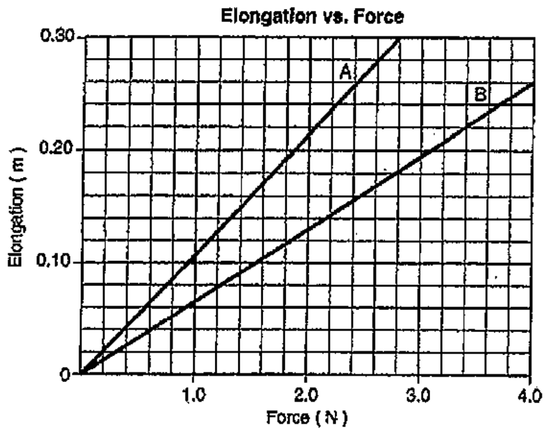


$K = \frac{F_s}{x}$

Which spring has the greatest spring constant?

A) *A* B) *B* C) *C* D) *D*

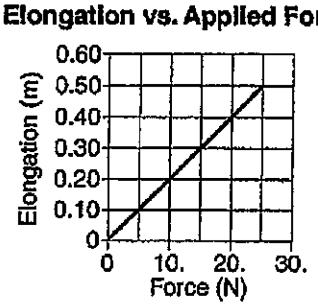
105. The graph below shows elongation as a function of the applied force for two springs, *A* and *B*.



Compared to the spring constant for spring *A*, the spring constant for spring *B* is

A) smaller
B) larger
C) the same

106. The graph below shows the relationship between the elongation of a spring and the force applied to the spring causing it to stretch.

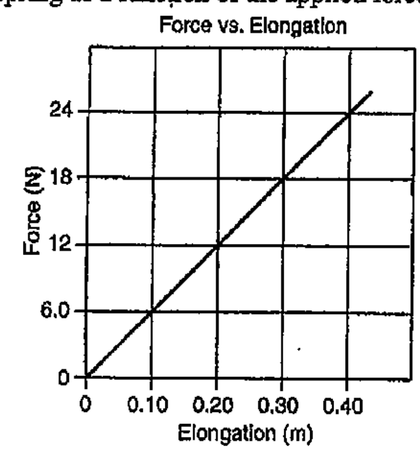


$K = \frac{25N}{.5m}$

What is the spring constant for this spring?

A) 0.020 N/m
B) 2.0 N/m
C) 25 N/m
D) 50. N/m

107. The graph below represents the elongation of a spring as a function of the applied force.



How much work must be done to stretch the spring 0.40 meter?

Area $\frac{1}{2}$(24N)(.4m)

A) 4.8 J
B) 6.0 J
C) 9.8 J
D) 24 J

Level One Review

PART G: Using Vector equations and Pythagorean Theorem

108. The components of a 15-meters-per-second velocity at an angle of 30.° above the horizontal are

30° x7y

A) 7.5 m/s vertical and 13 m/s horizontal
~~B) 13 m/s vertical and 7.5 m/s horizontal~~
C) 6.0 m/s vertical and 9.0 m/s horizontal
~~D) 9.0 m/s vertical and 6.0 m/s horizontal~~

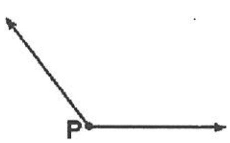
$A_x = A\cos\theta$ $\quad$ $A_y = A\sin\theta$

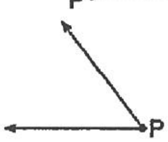
109. The vector below represents the resultant of two velocities acting concurrently on an object at point *P*.

Which pair of vectors best represents two concurrent velocities that combine to produce this resultant vector?

A)


B)


C)


D)


110. A displacement vector with a magnitude of 20. meters could have perpendicular components with magnitudes of

~~A) 10. m and 10. m~~ B) 12 m and 8.0 m
C) 12 m and 16 m D) 16 m and 8.0 m

111. The diagram below represents two concurrent velocities acting on an object. Which vector best represents their equilibrant?

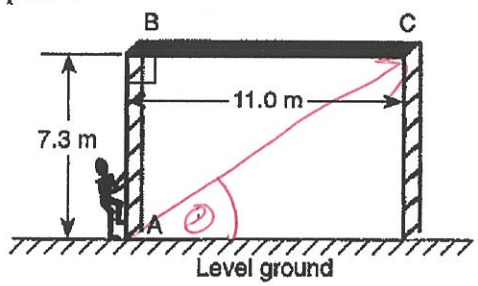
A)


B)


C)


D)


112. As shown in the diagram below, a painter climbs 7.3 meters up a vertical scaffold *A* to *B* and then walks 11.0 meters from *B* to *C* along a level platform



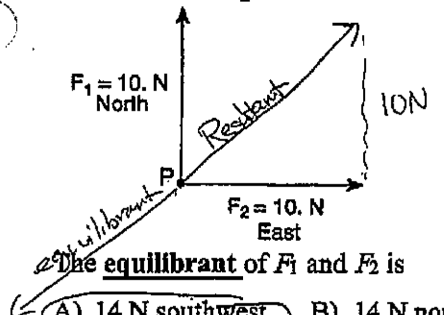
What is the angle of the painter's displacement relative to the horizontal as they move from *A* to *C*?

A) 13.2 degrees B) 33.6 degrees
C) 56.4 degrees D) 18.3 degrees

$A_x = 11m$
$A_y = 7.3m$

$\theta = \tan^{-1}\left(\frac{A_y}{A_x}\right) = \tan^{-1}\left(\frac{7.3m}{11m}\right)$
$= 33.6°$

113. Forces F_1 and F_2 act concurrently on point P, as shown in the diagram below.



$\sqrt{10N^2+10N^2}$
$\sqrt{200N^2}$
$=14N$

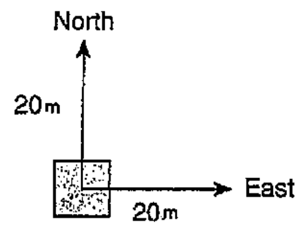
The **equilibrant** of F_1 and F_2 is

A) 14 N southwest B) 14 N northeast
C) 20. N southwest D) 20. N southeast

114. As the angle between two concurrent displacements increases from 45° to 90°, the magnitude of their resultant

A) decreases B) increases
C) remains the same

115. A 20 m displacement due north and a 20m displacement due east are experienced by an object, as shown in the diagram below.



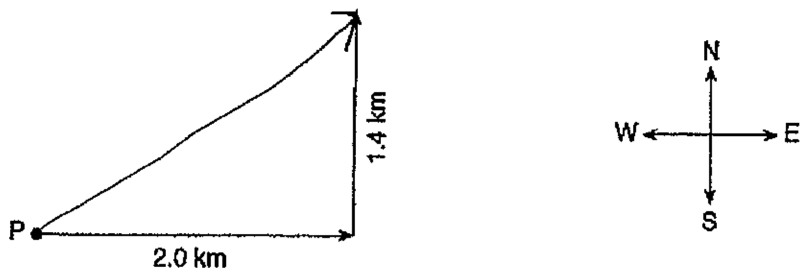
What is the magnitude of the resultant displacement?

A) 20m, northeast B) 20m, southwest
C) 28m, northeast D) 28m, southwest

greatest resultant
Smallest
angle

Base your answers to questions **116** through **119** on the information and vector diagram below and on your knowledge of physics.

A hiker starts at point *P* and walks 2.0 kilometers due east and then 1.4 kilometers due north. The vectors in the diagram below represent these two displacements.



116. Using a protractor, determine the angle between east and the hiker's resultant displacement. (1pt)

35°

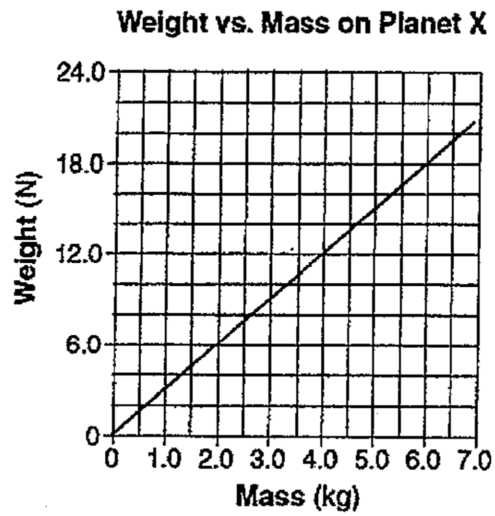
117. Using a metric ruler, determine the scale used in the vector diagram. (1 pt)

118. On the diagram above, use a ruler to construct the vector representing the hiker's resultant displacement. (1pt)

✓

119. ~~Using a protractor, determine the angle between east and the hiker's resultant displacement.~~

20. The graph below represents the relationship between weight and mass for objects on the surface of planet *X*.



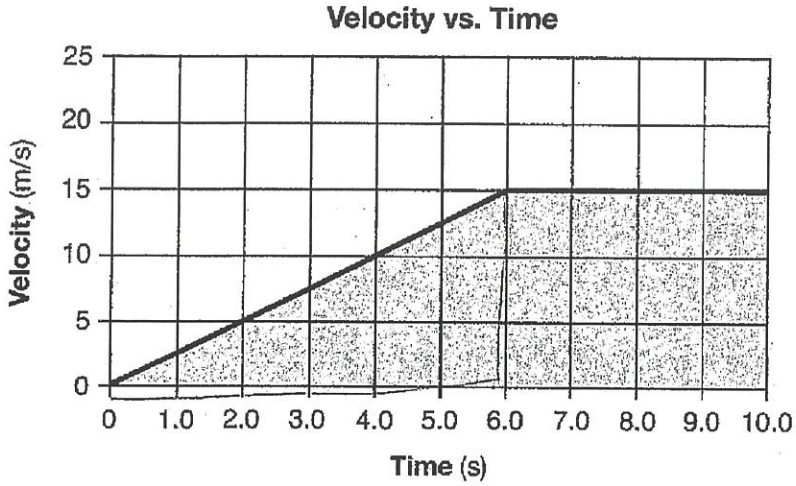
$g = \frac{F_g}{m}$

Determine the acceleration due to gravity on the surface of planet *X*.

$g = \frac{F_g}{m} = \frac{12N}{4kg} = \boxed{3 m/s^2}$

Level One Review

Base your answers to questions **121** and **122** on the graph below, which represents the relationship between velocity and time for a car moving along a straight line, and your knowledge of physics.



121. Identify the physical quantity represented by the shaded area on the graph.

$d = vt$ so area = distance

or

displacement

122. Determine the magnitude of the average velocity of the car from $t = 6.0$ seconds to $t = 10.$ seconds.

$\cancel{a = \frac{\Delta v}{t} = \frac{0\,m/s}{4s} = 0}$ $\quad \bar{v} = \frac{v_i + v_f}{2} = \frac{\overset{6s}{15\,m/s} + \overset{10s}{15\,m/s}}{2}$

$15\,m/s$

123. Base your answer to the following question on the information below and on your knowledge of physics.

A gas-powered model airplane has a mass of 2.50 kilograms. A student exerts a force on a cord to keep the airplane flying around her at a constant speed of 18.0 meters per second in a horizontal, circular path with a radius of 25.0 meters.

Calculate the kinetic energy of the moving airplane. [Show all work, including the equation and substitution with units.]

$KE = ?$
$m = 2.5 kg$
$v = 18 m/s$
$r = 25 m/s$

$KE = \frac{1}{2}mv^2$
$= \frac{1}{2}(2.5 kg)(18 m/s)^2$
$\boxed{= 405 J}$

124. Determine the amount of matter, in kilograms, that must be converted to energy to yield 1.0 gigajoule.

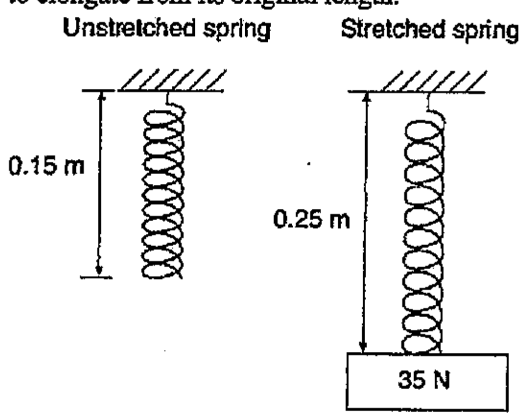
$E = 1\times10^9 J$
$m = ?$
$c = 3\times10^8 m/s$

$E = mc^2$

$m = \frac{E}{c^2} = \frac{1\times10^9 J}{(3\times10^8 m/s)^2} = \frac{1\times10^9 J}{9\times10^{16} m^2/s^2} = .11\times10^{-7} kg$

$\boxed{= 1.1\times10^{-8} kg}$

125. The diagram below represents a 35-newton block hanging from a vertical spring, causing the spring to elongate from its original length.



Determine the spring constant of the spring.

$F_s = 35 N$
$x = .1 m$
$K = ?$

$K = \frac{F_s}{x} = \frac{35 N}{.1 m} = \boxed{350 N/m}$

126. Calculate the average power required to lift a 490-newton object a vertical distance of 2.0 meters in 10. seconds. [Show all work, including the equation and substitution with units.]

$P = ?$

$F = 490N$

$d = 2m$

$t = 10s$

$P = \frac{Fd}{t} = \frac{(490N)(2m)}{10s} = \boxed{98W}$

127. A bolt of lightning transfers 28 coulombs of charge through an electric potential difference of 3.2 x 10^7 volts between a cloud and the ground in 1.5 x 10^{-3} second. Calculate the average electric current between the cloud and the ground during this transfer of charge. [Show all work, including the equation and substitution with units.]

$q = 28C$

$V = 3.2\times10^7 V$

$t = 1.5\times10^{-3}s$

$I = ?$

$I = q/t = \frac{28C}{1.5\times10^{-3}s} = 18.67\times10^3 A$

$\boxed{1.87\times10^4 A}$

128. The heating element in an automobile window has a resistance of 1.2 ohms when operated at 12 volts. Calculate the power dissipated in the heating element. [Show all work, including the equation and substitution with units.]

$R = 1.2\Omega$

$V = 12V$

$P = ?$

$P = \frac{V^2}{R} = \frac{(12V)^2}{1.2\Omega} = \boxed{120W}$

129. Base your answer to the following question on the information below.

A 3.50-meter length of wire with a crosssectional area of 3.14 x 10-6 meter2 is at 20° Celsius. The current in the wire is 24.0 amperes when connected to a 1.50-volt source of potential difference.

Calculate the resistivity of the wire. [Show all work, including the equation and substitution with units.]

$L = 3.5m$

$A = 3.14\times10^{-6}m^2$

$I = 24A$

$V = 1.5V$

ρ

$R = \frac{V}{I} = \frac{1.5V}{24A} = .0625\Omega$

$R = \frac{\rho L}{A}$ $\quad \rho = \frac{RA}{L}$

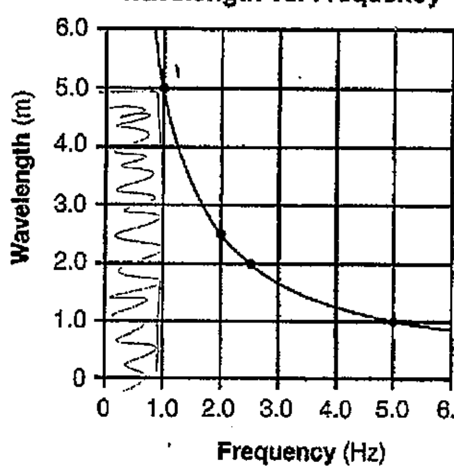
$\rho = \frac{(.0625\Omega)(3.14\times10^{-6}m^2)}{3.5m}$

$= .056\times10^{-6}\Omega m$

$\boxed{= 5.6\times10^{-8}\Omega m}$

130. The graph below represents the relationship between wavelength and frequency of waves created by two students shaking the ends of a loose spring.

Wavelength vs. Frequency



Calculate the speed of the waves generated in the spring. [Show all work, including the equation and substitution with units.]

Area under any point

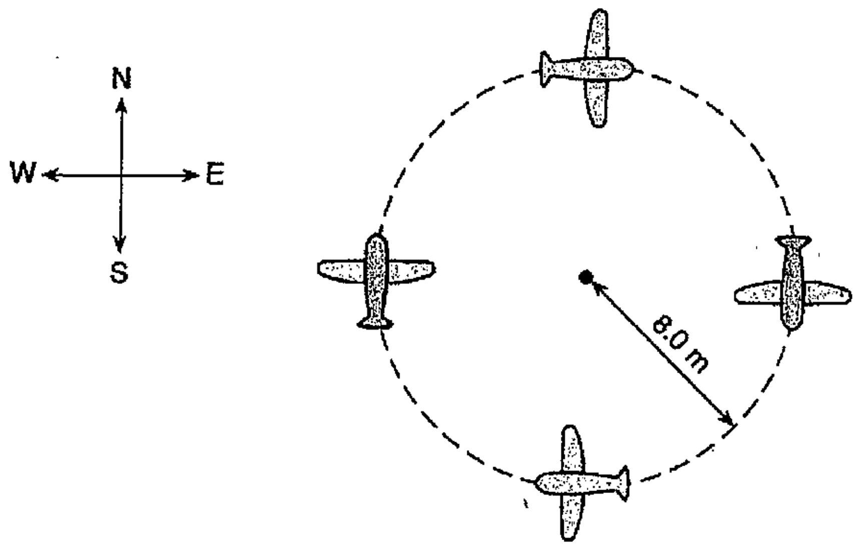
$\lambda = 5m$

$f = 1Hz$

$v = f\lambda = (1Hz)(5m) = \boxed{5 m/s}$

131. Base your answer to the following question on the information and diagram below and on your knowledge of physics.

A toy airplane flies clockwise at a constant speed in a horizontal circle of radius 8.0 meters. The magnitude of the acceleration of the airplane is 25 meters per second squared. The diagram shows the path of the airplane as it travels around the circle.



Calculate the speed of the airplane. [Show all work, including the equation and substitution with units.]

$v = ?$

$r = 8 m$

$a_c = 25 m/s^2$

$a_c = v^2/r$

$25 m/s^2 = \frac{v^2}{8m}$

$v^2 = 200 m^2/s^2$

$v = \sqrt{200 m^2/s^2}$

$\boxed{v = 14 m/s}$