Head Start to AS Physics Bridging Work

Task 1.

Logon to Isaac physics and create an account using this link. You will be added to a teaching group called Physics 2022-24 which has a number of assignments.

https://isaacphysics.org/account?authToken=W6RPVV

The assignments are called **GCSE - A level transition skills** and **Resultant Force and Acceleration**.

Task 2.

Complete these questions taken from CGP – Head Start to AS Physics. You may wish to buy and complete the whole book.

Balanced and Unbalanced Forces

Balanced and Unbalanced Forces

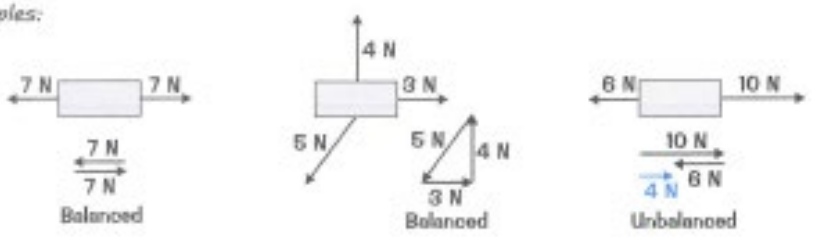
Force is a vector, just like displacement or velocity.

When more than one force acts on a body, you can add them together in just the same way as you add displacements or velocities.

You find the resultant force by putting the arrows "tip-to-tail".

If the resultant force is zero, the forces are balanced.

Examples:



If there's a resultant force, then the forces are unbalanced — there is a net force on the object.

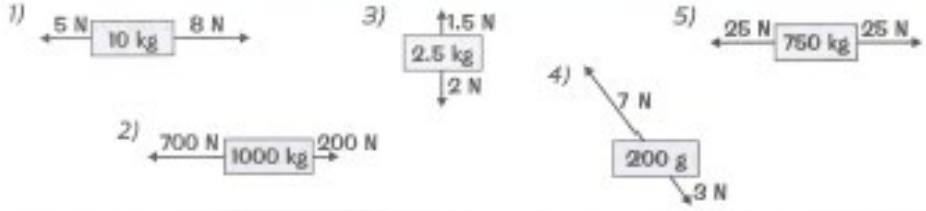
Example:

A force of 10 newtons to the right and a force of 6 newtons to the left result in a net force of 4 newtons to the right. If these forces acted on an object of mass 5 kilograms it would produce an acceleration given by:

$$a = F/m = 4\ N / 5\ kg = 0.8\ ms^{-2}$$

Have a go at these:

Work out the net forces on these objects and calculate the acceleration they would cause:



Answers

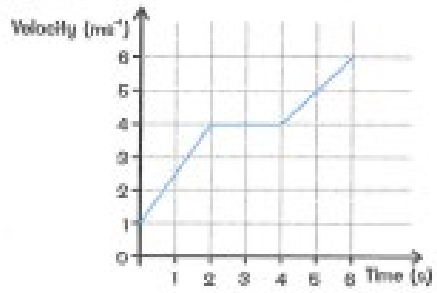
1) 3 N to the right, 0.3 ms^{-2} to the right.
2) 500 N to the left 0.5 ms^{-2} to the left.
3) 0.5 N down, 0.2 ms^{-2} down.
4) 4 N diagonally up and left, 20 ms^{-2} in the same direction.
5) No net force, no acceleration.

Velocity-Time Graphs

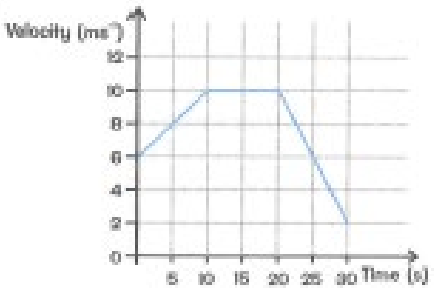
Try these:

1) *Calculate the accelerations in each of the three sections of each graph.*
2) *Calculate the distances travelled in each of the three sections of each graph and calculate the total distance travelled in each case.*

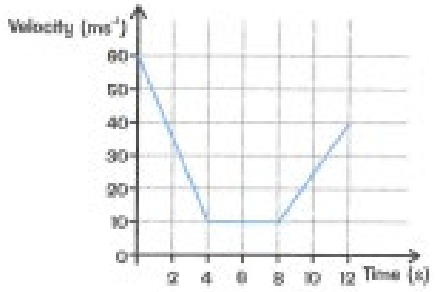
a)



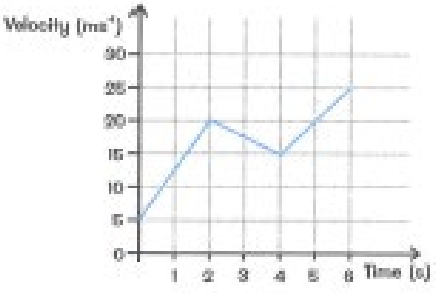
b)



c)



d)



Answers

1) (a) 1.5 ms^{-2}, 0 ms^{-2}, 1 ms^{-2}
(b) 0.4 ms^{-2}, 0 ms^{-2}, −0.8 ms^{-2}
(c) −12.5 ms^{-2}, 0 ms^{-2}, 7.5 ms^{-2}
(d) 7.5 ms^{-2}, −2.5 ms^{-2}, 5 ms^{-2}

2) (a) 5 m, 8 m, 10 m, total = 23 m
(b) 80 m, 100 m, 60 m, total = 240 m
(c) 140 m, 40 m, 100 m, total = 280 m
(d) 25 m, 35 m, 40 m, total = 100 m

Energy in Electrical Circuits

Conservation of Energy in Electrical Circuits

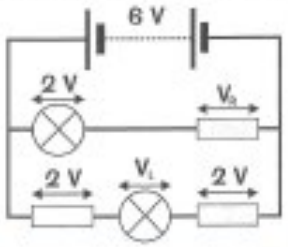
Energy is given to charged particles by the power supply and taken off them by the components in the circuit. Since energy is conserved, the amount of energy one coulomb of charge loses when going around the circuit must be equal to the energy it's given by the power supply.

And more than that, this must be true regardless of the route the charge takes around the circuit. So, you can say that:

> *For any closed loop in a circuit the sum of the potential differences across the components equals the voltage of the power supply.*

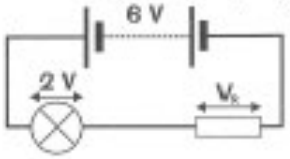
This is a case of Kirchhoff's second rule.

Have a look at this example:



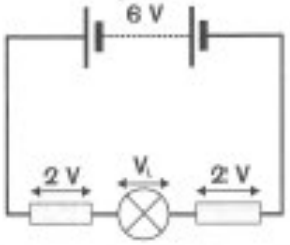
What are the voltages across the resistor, V_R, and the lamp, V_L?

First look at just the top loop:



$6\ V = 2\ V + V_R$
$6\ V - 2\ V = V_R$
$4\ V = V_R$

Now look at just the outside loop:



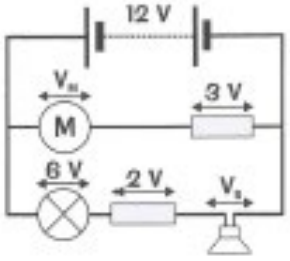
$6\ V = 2\ V + V_L + 2\ V$
$6\ V = 4\ V + V_L$
$6\ V - 4\ V = V_L$
$2\ V = V_L$

Now you do this one:

For the circuit on the right, calculate:

(a) the voltage across the motor, V_M

(b) the voltage across the loudspeaker, V_S



ANSWERS

(a) $V_M = 6\ V$

(b) $V_S = 4\ V$

Task 3.

Complete these questions on converting between Mathematical Prefixes.

Prefix	Symbol	Name	Multiplier
femto	f	quadrillionth	10^{-15}
pico	p	trillionth	10^{-12}
nano	n	billionth	10^{-9}
micro	μ	millionth	10^{-6}
milli	m	thousandth	10^{-3}
kilo	k	thousand	10^{3}
mega	M	million	10^{6}
giga	G	billion	10^{9}
tera	T	trillion	10^{12}
peta	P	quadrillion	10^{15}

When you are given a variable with a prefix you must convert it into its numerical equivalent in standard form before you use it in an equation.

Convert the following:

1.4 kW =

10 μC =

24 cm =

340 MW =

46 pF =

0.03 mA =

52 Gbytes =

43 kΩ =

0.03 MN =

83 Pm =

Now convert between different prefixes

5.46m to cm =

65mm to m =

3cm to m =

0.98m to mm =

34kW to GW =

76nN to kN =

Challenge Task

1. What is 5.2 mm^3 in m^3?
2. What is 24cm^2 in m^2?
3. What is 34 m^3 in μm^3?
4. What is 0.96 x 10^6 m^2 in km^2?

Convert the following:

1.4 kW = $1400\,W = 1.4 \times 10^{3}\,W$

24 cm = $0.24\,m = 2.4 \times 10^{-1}\,m$

46 pF = $46 \times 10^{-12}\,F = 4.6 \times 10^{-11}\,F$

52 Gbytes = $52 \times 10^{9}\,byte = 5.2 \times 10^{10}\,byte$

0.03 MN = $0.03 \times 10^{6}\,N = 3 \times 10^{4}\,N$

10 μC = $10 \times 10^{-6}\,C = 1 \times 10^{-5}\,C$

340 MW = $340 \times 10^{6}\,W = 3.4 \times 10^{3}\,W$

0.03 mA = $0.03 \times 10^{-3}\,A = 3 \times 10^{-5}\,A$

43 kΩ = $43 \times 10^{3}\,\Omega = 4.3 \times 10^{4}\,\Omega$

83 Pm = $83 \times 10^{15}\,m = 8.3 \times 10^{16}\,m$

Now convert between different prefixes

5.46m to cm = $546\,cm$

$5.46 \times 10^{2}\,cm$

65mm to m = $0.065\,m$

$= 6.5 \times 10^{-2}\,m$

3cm to m = $0.03\,m$

$3 \times 10^{-2}\,m$

0.98m to mm = $980\,mm$

$9.8 \times 10^{2}\,mm$

34kW to GW = $3.4 \times 10^{-5}\,GW$

$= 0.000034$

76nN to kN = $76 \times 10^{-12}\,kN$

$= 7.6 \times 10^{-11}\,kN$

Challenge Task

1. What is 5.2 mm^3 in m^3? $5.2\,mm^3 = 5.2 \times (10^{-3})^3\,m^3 = 5.2 \times 10^{-9}\,m^3$

2. What is 24cm^2 in m^2? $24\,cm^2 = 24 \times (10^{-2})^2\,m^2 = 2.4 \times 10^{-3}\,m^2$

3. What is 34 m^3 in μm^3? $34\,m^3 = 34 \times (10^{9})^3\,\mu m^3 = 34 \times 10^{27}\,\mu m^3 = 3.4 \times 10^{28}\,\mu m^3$

4. What is 0.96 x 10^6 m^2 in km^2? $0.96 \times 10^{6}\,m^2 = 0.96 \times 10^{6} \times (10^{-3})^2 = 0.96\,km^2 = 9.6 \times 10^{-1}\,km^2$

5. Convert 34 Mm^3 into pm^3. $34\,Mm^3 = 34 \times (10^{18})^3\,pm^3$

$= 34 \times 10^{54} = 3.4 \times 10^{55}\,pm^3$

Task 4.

Complete these questions on converting between units.

Many quantities are commonly represented by units other than their base units, for a variety of reasons. Some examples are displayed below:

Quantity	Quantity	Alternative Unit	Unit Symbol	Value in SI Units
Energy	E	electron volt	eV	1.6×10^{-19} J
Charge	Q	charge on electron	e	1.6×10^{-19} C
Mass	m	atomic mass unit	u	1.67×10^{-27} J
Mass	m	tonne	t	10^{3} kg
Time	t	hour	hr	3,600 s
Time	t	year	yr	3.16×10^{7} s
Distance	d	miles	miles	1,609 m
Distance	d	astronomical unit	AU	3.09×10^{11} m
Distance	d	light year	ly	9.46×10^{15} m
Distance	d	parsec	pc	3.09×10^{16} m

Convert the following quantities:

1. What is 13.6 eV expressed in joules?
2. What is a charge of 6e expressed in coulombs?
3. An atom of Lead-208 has a mass of 207.9766521 *u, convert this mass into kg.*
4. *What is 2.39* × 10^{8} *kg in tonnes?*
5. *It has been 49 years since England won the World Cup, how long is this in seconds?*
6. *A TV program lasts 2,560s, how many hours is this?*
7. *The semi-major axis of Pluto's orbit around the Sun is* 5.91×10^{12} m, what is this distance in AU?
8. Convert 0.023 kms^{-1} into ms^{-1}.
9. Express 3456 m hr^{-1} into km hr^{-1}
10. What is 30 miles hr^{-1} in ms^{-1}?
11. What is 50 ms^{-1} in miles hr^{-1}?
12. Convert 33 km hr^{-1} into ms^{-1}.
13. Express 234 miles hr^{-1} in km hr^{-1}.

Convert the following quantities:

1. What is 13.6 eV expressed in joules? 2.176×10^{-19} J = ~~2.2×10^{-18} J~~
2. What is a charge of 6e expressed in coulombs? 9.6×10^{-19} C
3. An atom of Lead-208 has a mass of 207.9766521 u, convert this mass into kg. $347 \times 10^{-27} = 3.47 \times 10^{-25}$ kg.
4. What is 2.39×10^{8} kg in tonnes? 2.39×10^{5} tonnes.
5. It has been 49 years since England won the World Cup, how long is this in seconds? $49 \times 3.16 \times 10^{7}$ = ~~154.84×10^{7}~~ 1.55×10^{9} s.
6. A TV program lasts 2,560s, how many hours is this? 0.711 hrs.
7. The semi-major axis of Pluto's orbit around the Sun is 5.91×10^{12} m, what is this distance in AU? ~~39.5 AU~~ 19.2 AU
8. Convert 0.023 kms^{-1} into ms^{-1}. = $23 ms^{-1}$.
9. Express 3456 m hr^{-1} into km hr^{-1} $3.456 km hr^{-1}$
10. What is 30 miles hr^{-1} in ms^{-1}? $30 miles hr^{-1} = 30 \times 1609 = 48270 m hr^{-1} = \frac{48270}{3600} = 13.4 ms^{-1}$.
11. What is 50 ms^{-1} in miles hr^{-1}? $50 ms^{-1}$ = ~~50 x 60 x 60 = 180000 m~~ $50 \times 60 \times 60 = 180000 m hr^{-1} = \frac{180000}{1609} = 111.9 miles hr^{-1}$ $\simeq 110$ miles hr^{-1}
12. Convert 33 km hr^{-1} into ms^{-1}. = $33000 m hr^{-1} = \frac{33000}{3600} = 9.2 ms^{-1}$
13. Express 234 miles hr^{-1} in km hr^{-1}.

$$234 miles hr^{-1} = \frac{234 \times 1609}{1000} = 377 km hr^{-1}$$