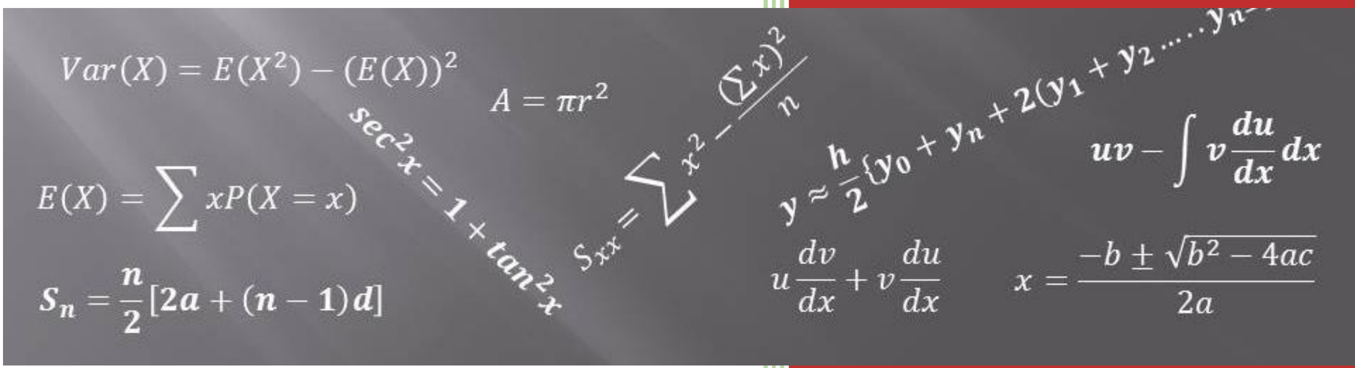
MathsGeeks

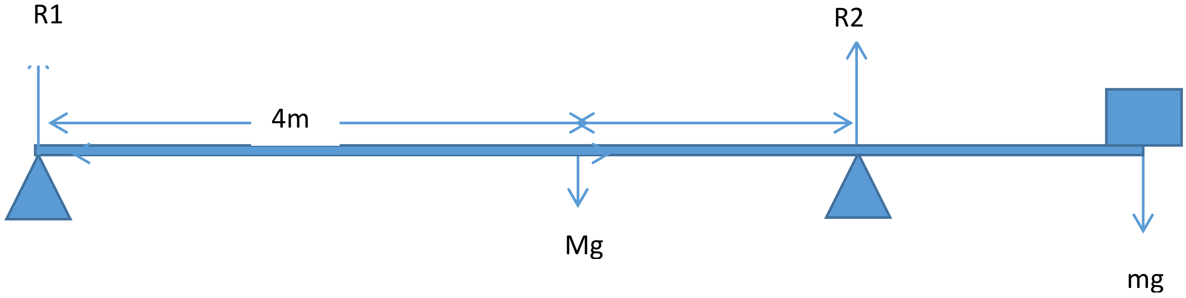
'Everything You Need to Know'
A Level – Edexcel – M1



September 2013

MathsGeeks

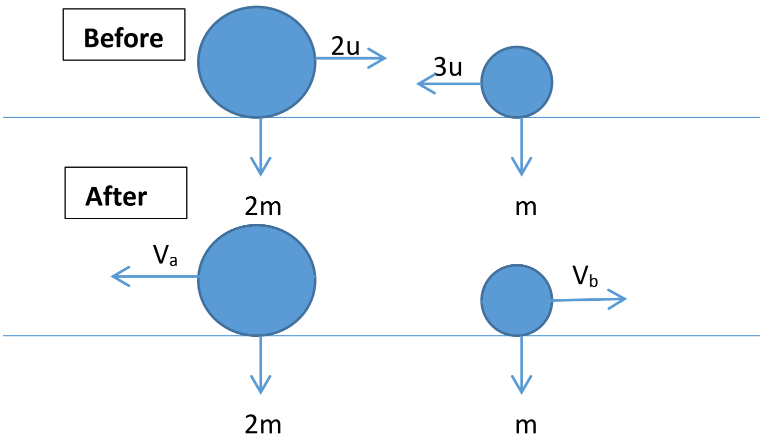
Planks/Beams



Draw diagram with a Reaction force on each support and the weight (Mg) of the beam (assuming uniform) acting in the middle of the beam. There are only two things that can be done to solve these problems.
1) **Resolve forces vertically**: forces up = forces down (Mg+mg = R1+R2)
2) **Take moments** about a point. Always choose a point to take moments around that has one of the unknowns. Clock wise moments = Anti-clockwise moments (e.g resolving around A 4Mg + 8mg = 6R2).

[HINT: 2nd part of question often adds a weight (moves a support etc) therefore you must recalculated the Reaction forces.]

Colliding Particles on a Smooth Horizontal Plane.



Draw the set up **Before** and **After** the collision clearly defining the direction of travel and ensuring the directions of the velocities are correct. Then use

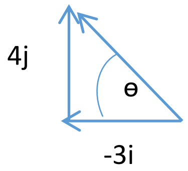
- Momentum before= Momentum after $(\mathrm{e.g.}\, 2\mathrm{m}(2\mathrm{u}) + (-3\mathrm{u})\mathrm{m} = 2\mathrm{m}(-v_a) + m(v_b)$
- Impulse **ON** particle P is the change in moment of P $(mv_p - mu_p)$.

Distance/time/velocity/acceleration:

- Velocity/time graph: - Distance = Total Area Under. Acceleration = gradient.
- Acceleration/time graph – For M1 it's constant acc/dec therefore this is a straight horizontal line above and below and parallel to x-axis, respectively.
- Learn Suvat equations

$v = u + at$	$s = (\frac{u+v}{2})t$
$s = ut + \frac{1}{2}at^2$	$v^2 = u^2 + 2as$

Vectors: If $v = ai + bj$ then speed is $= \sqrt{a^2 + b^2}$. To find the angle plot the velocity e.g. $v = -3i + 4j$. The angle with the horizontal is $\theta = tan^{-1}\frac{4}{3}$. Recall that the bearing is the angle



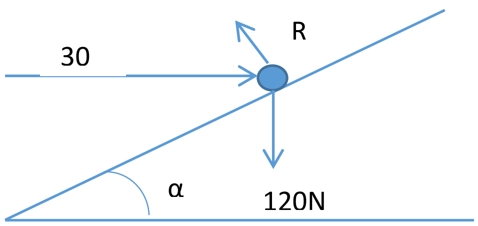
from North so in this example is $270° + \theta$. They may ask for angle with *j* or *i* instead, ensure you get the correct angle.
Learn that the general position vector is given by initial vector (i.e. position at t=0 + vector velocity *t $[P = (ai + bj) + (v_a i + v_b j)t]$.

Recall that

- Velocity = change in position over time
- Acceleration = change in velocity over time
- Resultant Force is the forces added together
- Use F=ma
- Distance between two points is given by $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

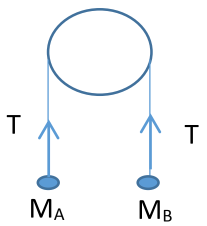
[HINT the last bit of question might ask parallel to the *i* axis then the *j* component is 0. So in example above $b + v_b t = 0$. Due North/South then *i* component is zero and due East/West then *j* component is zero. Or if say P is due west of Q then then the j components are equal.]

Particles moving up/down a plane:



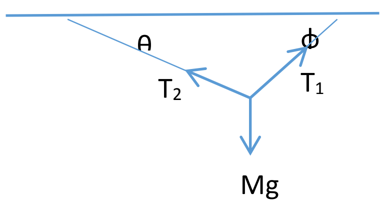
- Resolve Forces perpendicular (usually to find R) and then parallel to the plane.
- Rough surface frictional force $F_r = \mu R$ (opposite direction to travel) where μ is the coefficient of friction.
- Limiting equilibrium - forces are balanced.
- If the particle is moving then resultant Force $(F = ma)$

Strings:



Resolve F=ma for each particle (i.e. $M_A g - T = M_A a$ and $T - M_B g = M_B a$)
[As string is inextensible – tension remains the same for both and acc remains the same.]
If string breaks then tension goes and the only force is due to gravity.

Resolve horizontally $T_2 cos\theta = T_1 cos\varphi$ and then resolve vertically $T_2 sin\theta + T_1 sin\varphi = Mg$ to find unknowns.



Upward Projectiles: Use suvat where a=-9.8 (in upward direction). Greatest height is when v=0. Careful to define distance (s) carefully.

[NOTE: If $tan\theta = \frac{3}{4}$ then $sin\theta = \frac{3}{5}$ and $cos\theta = \frac{4}{5}$. If $tan\theta = \frac{5}{12}$ then $sin\theta = \frac{5}{13}$ and $cos\theta = \frac{12}{13}$]