Revision Questions

1. Find the magnitude of the resultant force on an object when two forces of 3.0 N and 4.0 N act:
    a. In the same direction
    b. In opposite directions
    c. At 90° to each other
    d. At 60° to each other

2. A cannon ball is fired at 150m/s at an angle of 50° to the horizontal.
    a. Calculate the vertical component of its velocity
    b. Calculate the horizontal component of its velocity

3. A child in a playground pulls a swing back and holds it stationary before letting go. The swing has a mass of 5.4kg and the child pulls with a force of 9.0 N.
    a. Draw a free body diagram for the forces acting on the swing when it is being held stationary by the child.
    b. Calculate the magnitude AND direction of the tension in the swing rope.

4. A 2.5m long plank of mass 12kg is placed on two bricks, each 30cm from the ends. A person of mass 84kg stands 70cm from one end of the plank. Calculate the force the plank exerts on each brick.

5. A ball is dropped from rest. It falls, then bounces off a table and rebounds to half the height it was released from. Sketch:
    a. A displacement-time graph
    b. A distance-time graph
    c. A velocity-time graph
    d. A speed-time graph

6. A uniform hollow cylinder has a radius of 4cm and a length of 30cm. It is stood on end on a piece of wood. The wood is tilted slowly until the cylinder topples.
    a. At what angle of tilt does it topple?
    b. A lump of plasticine is inserted into one end of the hollow cylinder, and the cylinder is stood on the opposite end. How will the angle it topples at compare with before?

7. A car driving at 10m/s accelerates uniformly at $5m/s^2$. How long does it take to cover a distance of 100m?

8. A ball is thrown horizontally at 10m/s from a cliff 30m high. Calculate the vertical and horizontal components of its velocity just before it hits the water below. Ignore air resistance.

9. Sketch a speed-time graph for a skydiver who jumps from a helicopter, falls for a long time, then opens her parachute, falls for a while, then lands.

10. A 1.2kg trolley moving to the right at 1.1m/s collides with a 0.8kg trolley moving to the left at 2.3m/s, and they stick together. Find the speed and direction they move in after the collision.

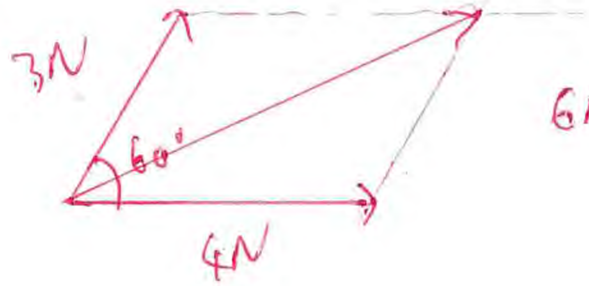
11. A water rocket ejects 2.0kg of water in 1.2 seconds, and the water is ejected at a relative speed of 5.0m/s.
    a. Calculate the thrust of the rocket.
    b. Describe the acceleration of the rocket from the instant the water starts to be ejected until just after all the water has left.

1. a) 7N

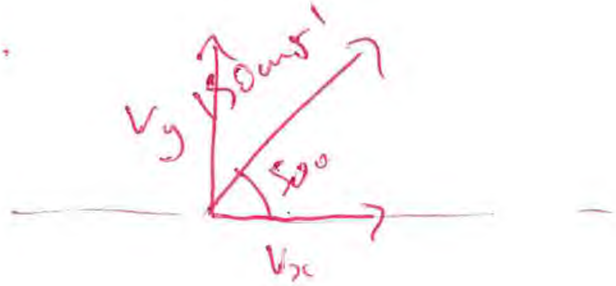
b) 1N

c) 

5N

d) 

6N

2. 

$\sin(50°) = \frac{V_y}{150}$

$V_y =$

$\cos(50°) = \frac{V_x}{150}$

$V_x =$

3. 

$w = mg = 5.4\text{kg} \times 9.8\text{N/kg}$

$= 52.9\text{N}$

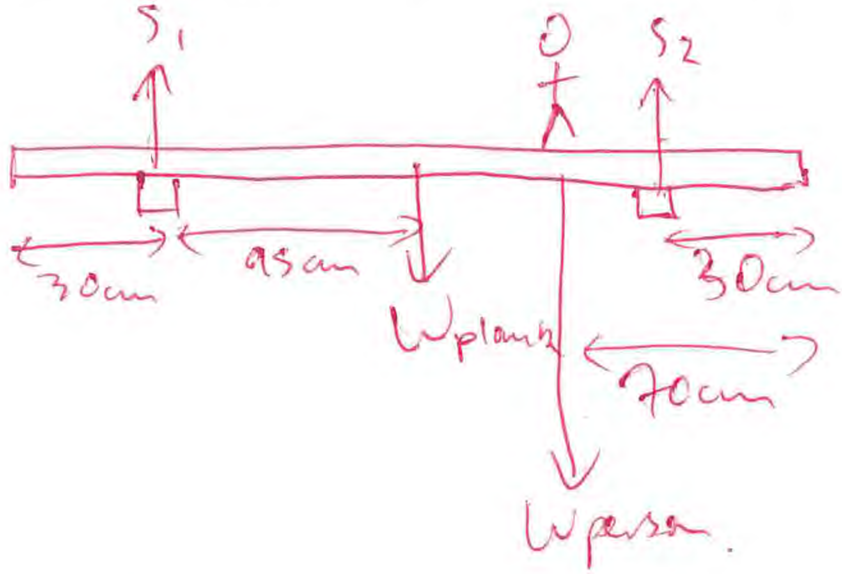
$9.0^2 + 52.9^2 = T^2$

$T = \sqrt{9^2 + 52.9^2}$

$=$

$\tan\theta = \frac{9}{52.9} \quad \theta =$

4.



moments about S_1:

$$12\,kg \times 9.8\,N/kg \times 0.95\,m + 84 \times 9.8 \times 1.5\,m$$

$$=$$

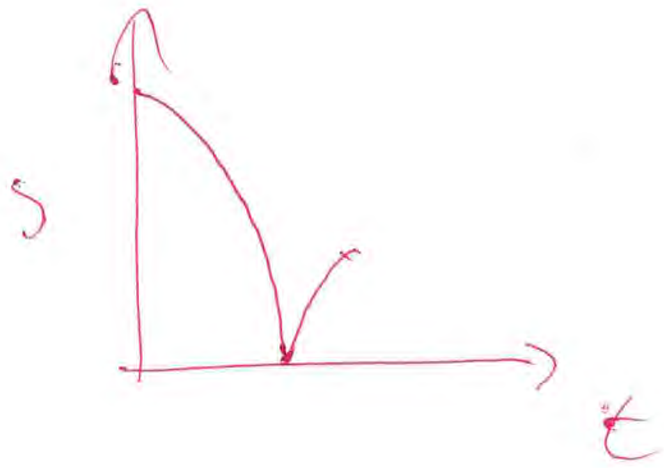
$$S_2 \times 1.9\,m$$

$$S_2 = \frac{12 \times 9.8 \times 0.95 + 84 \times 9.8 \times 1.5}{1.9}$$

$$=$$

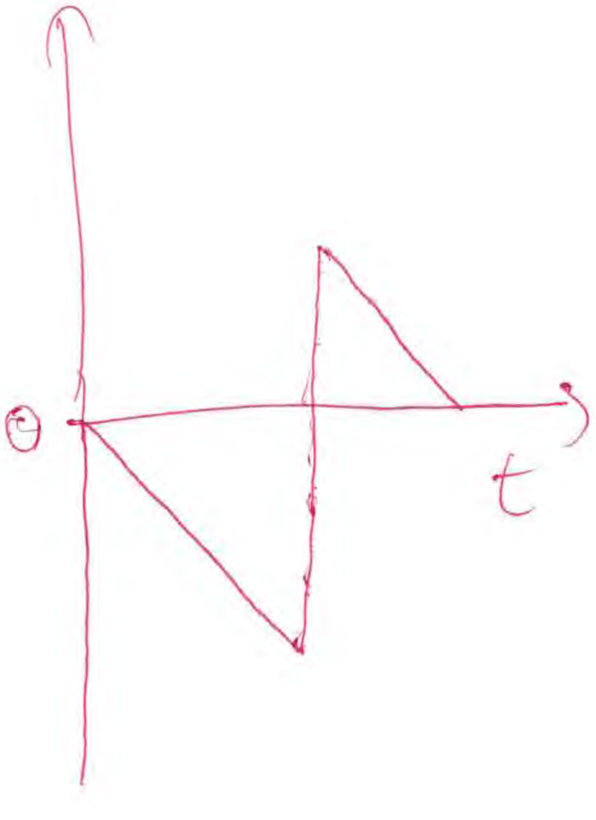
$$S_1 = 9.8 \times (12 + 84) - S_2 =$$

5. a)

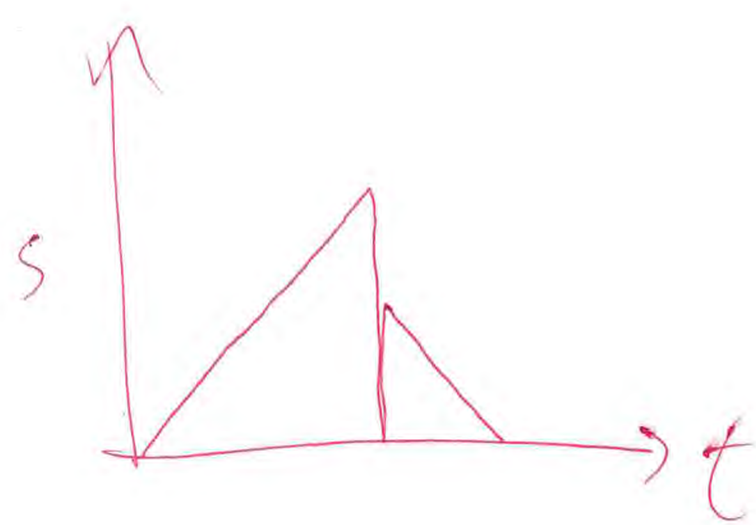


b)

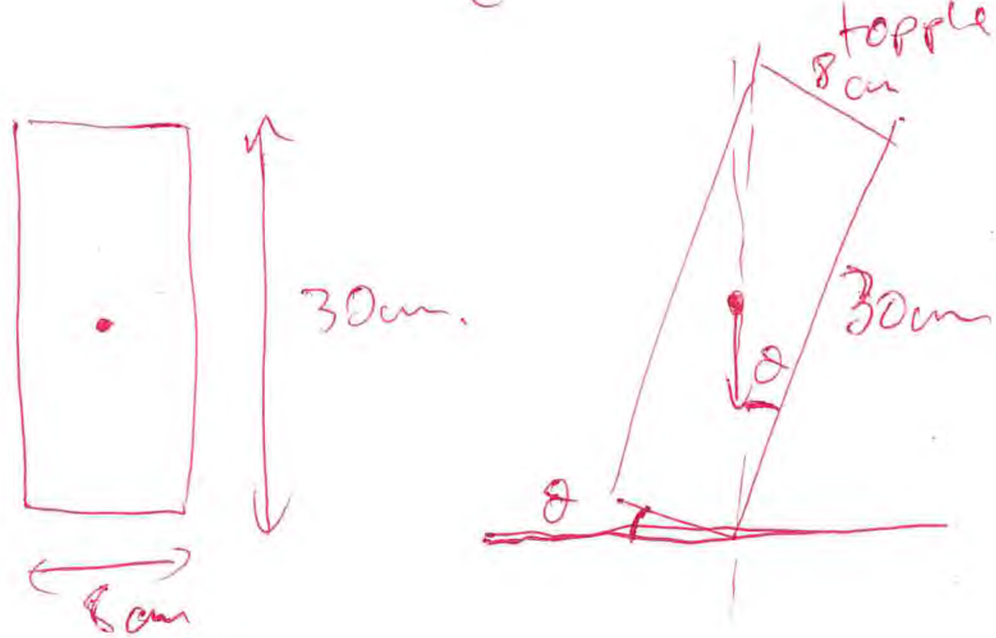
c)



d)



6.



$$\tan\theta = \frac{8\,cm}{30\,cm}$$

$$\theta = \tan^{-1}\left(\frac{8}{30}\right) =$$

b)

c.o.m raised ∴ topples at smaller angle

4. $s = 100m$
$u = 10m/s$
$v =$
$a = 5m/s^2$
$t = ?$

$s = ut + \frac{1}{2}at^2$

$100 = 10t + 2{\cdot}5t^2$

$40 = 4t + t^2$

can use quadratic formula

$t^2 + 4t - 40 = 0$

or complete the square.

$(t+2)^2 = 44$

$t + 2 = \pm\sqrt{44}$

$t = -2 \pm \sqrt{44}$.

t must be positive here, so

$t = -2 + \sqrt{44}$.

8. vertically:

$s = -30m$

$u = 0$

$v = ?$

$a = -9.8ms^{-1}$

t

$v^2 = u^2 + 2as$

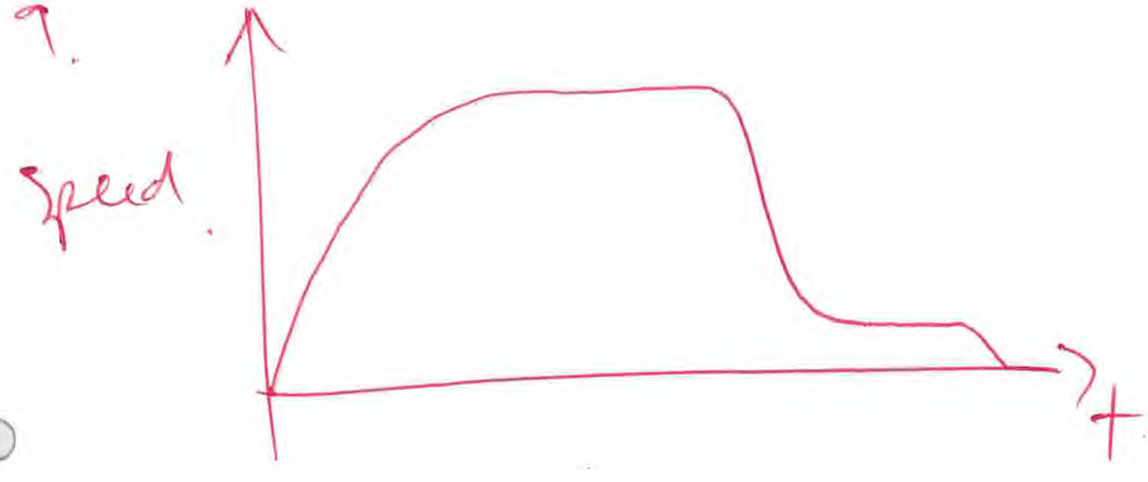
$v = \sqrt{2as}$

$= \sqrt{2 \times -9.8 \times -30} = \ldots$

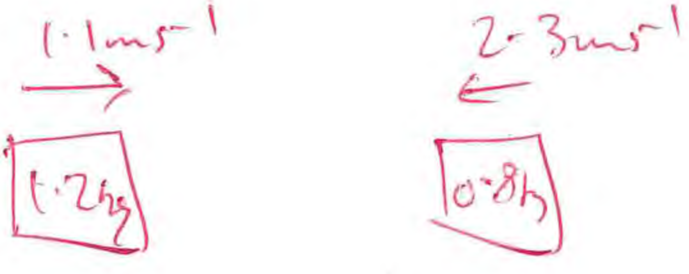
horizontally:

v is constant - ∴ horizontal component is still 10m/s

9.



10.



before: $p = 1.2 \times 1.1 - 0.8 \times 2.3$

$= \ldots$

after: $p = (1.2 + 0.8)v$

$\therefore v = \frac{\ldots}{2} = \ldots$

11. a) $F = m\frac{\Delta v}{\Delta t}$ or $F = v\frac{\Delta m}{\Delta t}$

$F = v\frac{\Delta m}{\Delta t} = 5m/s \times \frac{2kg}{1.2s} = \_\_\_\_ N$

b)
- Rocket accelerates
- As more water is ejected, the mass of the rocket decreases, so the acceleration increases ($a = \frac{F}{m}$).
- (however the air pressure inside is also decreasing, making it complicated...)
- When the water stops, it experiences deacceleration downwards (due to g) and also probably slows down horizontally (due to drag).