d. One of the children in Question 2 steps of the shelf. When their centre of mass is 0.700 m above the ground estimate their velocity and kinetic energy.
3 marks

$E_P = mgh = 20 \times 9.8 \times 0.7 = 1.4 \times 10^2$ J 1 mk
$E_K = (3 - 1.4) \times 10^2$ J = 2 (1.8) x 10^2 J 1 mk

$$v = \sqrt{\frac{2E_K}{m}}$$

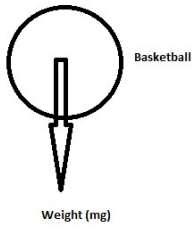
$$v = \sqrt{\frac{2 \times 1.8 \times 10^2}{20}}$$

v = 4 m s^{-1} 1 mk

Question 12 **15 marks**

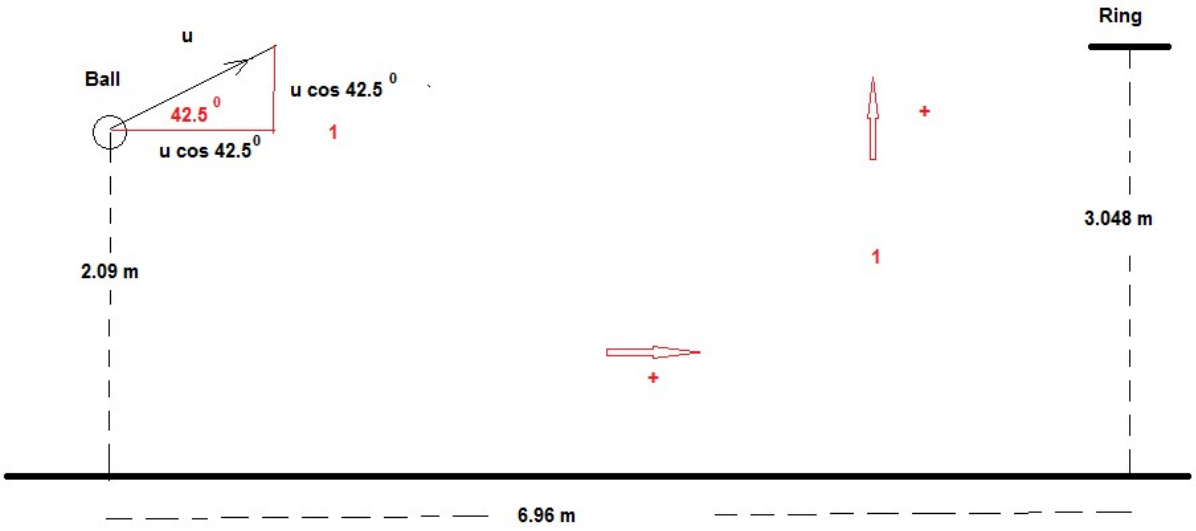
The Perth Wildcats basketball team is two points down and Nat Jawai has the ball in centre court. He puts up the shot and scores.

a. In the space below draw a diagram of the ball showing the force/s acting on it whilst in flight. Assume no air resistance. (2 marks)



2 mks for just 1 force, 1 off for each additional arrow added

b. He propels the ball at an angle to the horizontal of 42.5^0. What is the initial speed of the ball? 6 marks



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Horizontal
s_h = 6.96 m
u_h = u cos 42.5^0 m s^{-1}
a_h = 0
t_h = T s

Vertical
s_v = (3.048 – 2.09) m = 0.958 m
u_v = u sin 42.5^0 m s^{-1}
a_v = -9.80 m s^{-2}
t_v = T s

3 mks for all info, diagram plus defining directions

$t_h = \frac{s_h}{\text{u cos A}} = \frac{6.96}{\text{u cos } 42.5}$ (1 mk)

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

$0.958 = \text{u sin A x } \frac{6.96}{\text{u cos A}} + \frac{1}{2}(-9.80)\, x\, (\frac{6.96}{\text{u cos A}})^2$ (1 mk)

$0.958 = \tan 42.5 \text{ x } 6.96 + \frac{1}{2}(-9.80)\, x\, (\frac{6.96}{\text{u cos } 42.5})^2$

$0.958 = 6.38 - \frac{437}{u^2}$

$u^2 = 437/(6.38\text{-}0.958) = 80.6$

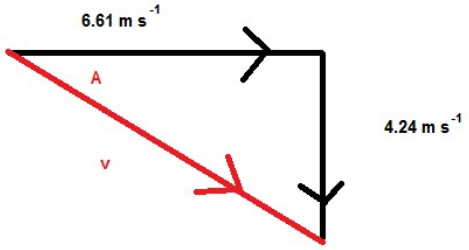
u = 8.98 m s^{-1} (1 mk)

c. Calculate the velocity as it passes through the ring in order to score the three points to win the game? . (7 marks)

$u_h = u \cos 42.5 = 6.61$ m $s^{-1} = v_h$ (1 mk)

$u_v = u \sin 42.5 = 6.06$ m s^{-1} (1 mk)
$v^2 = u^2 + 2as$
$v^2 = 6.06^2 + 2\ (-9.8)\ 0.958$
$v^2 = 18.0$ $v = \pm 4.24$ m s^{-1} (1 mk)

Use -4.24 m s^{-1} as is going down (1 mk)

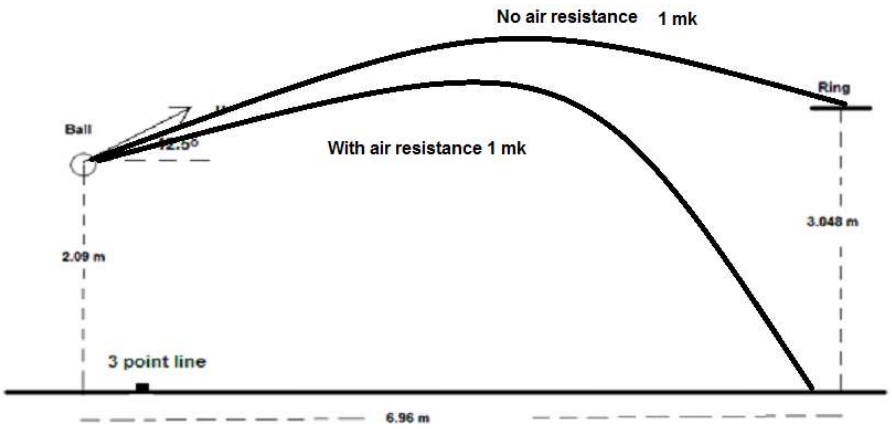


1 mk

$v^2 = 6.61^2 + 4.24^2$
v = 7.86 m s^{-1} (1 mk)

$\tan A = \frac{4.24}{6.61}$
$A = 32.7^0$ (1 mk)

d. On the diagram below draw the path of the ball with and without air resistance. Assume that the basketball is launched with the same initial velocity. (2 marks)



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