Higher HW4 – Forces, Energy & Power.

1. D. (decelerating downwards gives same effect as accelerating upwards).

2. total moving mass $= 4 + 6 = 10\,kg$.

$F_{un} = ma$

$18 = 10 \times a$

$a = 1.8\,ms^{-2}$

Balance shows the force pulling the 4kg mass

$F = ma$

$F = 4 \times 1.8$

$F = 7.2\,N$ answer A.

3. $F_x = F\cos\theta$ $F_y = F\sin\theta$

$= 75\cos 28°$ $= 75\sin 28°$

$E_w = Fd$ but F & d must lie in same direction → use F_x

$E_w = F_x d$

$= (75 \times \cos 28°) \times 8$

$E_w = 530\,J$ answer B.

4. at $v = 40\,ms^{-1}$

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

$= \frac{1}{2} \times 1000 \times 40^2$

$= 800\,000\,J$ $\left(\begin{matrix} 8\times10^5\,J \\ \text{or} \\ 800\,kJ \end{matrix}\right)$

at $v = 10\,ms^{-1}$

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

$= \frac{1}{2} \times 1000 \times 10^2$

$= 50\,000\,J$ $\left(\begin{matrix} 5\times10^4\,J \\ \text{or} \\ 50\,kJ \end{matrix}\right)$

change in kinetic energy

$= 800\,000 - 50\,000$

$= \underline{\underline{750\,000\,J}}$ $\left(\begin{matrix} 7.5\times10^5\,J \\ \text{or} \\ 750\,kJ \end{matrix}\right)$

5. (a) (i) the net effect of all forces acting

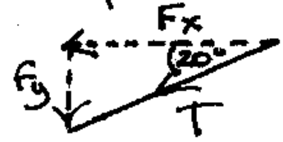
or the single force that produces the same effect as all of the forces.

(ii) resultant force is 0N → balanced forces.

→ horizontal force components are balanced

→ vertical force components are balanced.

components of rope tension



$F_x = T\cos 20°$ $\qquad$ $F_y = T\sin 20°$

$F_x = 1200 \times \cos 20°$ $\qquad$ $F_y = 1200 \times \sin 20°$

$F_x = 1128\,N$ $\qquad$ $F_y = 410\,N$

Other vertical component is weight = 900N

→ total $F_y = 410 + 900 = 1310\,N$

total $F_x = 1128\,N$

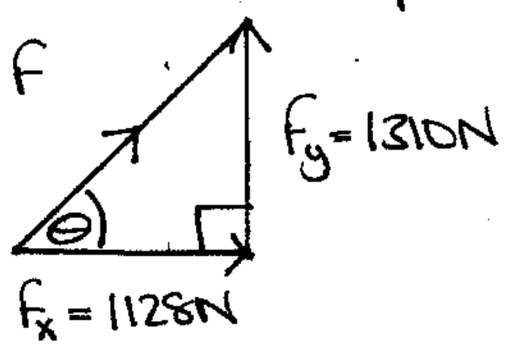
5 (a) (ii) For balanced forces

$F_{x\,parasail} = 1128N$

and

$F_{y\,parasail} = 1310N$

add these components to get parasail force.



$F^2 = F_x^2 + F_y^2$

$F^2 = 1128^2 + 1310^2$

$F = \sqrt{1128^2 + 1310^2}$

$F = 1722N.$

for direction of force F, use trig.

$\tan\theta = \frac{1310}{1128}$

$\theta = \tan^{-1}\left(\frac{1310}{1128}\right)$

$\theta = 49.3°$ above the horizontal.

Force exerted by the parasail is 1722N at 49.3° above horizontal.

5. (b) When the rope is released, the forces are no longer balanced. Force of parasail is now unbalanced force and the parasender accelerates upwards.

6. Using symmetry, sideways forces cancel. Each boy provided a forward component F_x, given by $F_x = F\cos\Theta$

$$F_x = 400 \times \cos 20^\circ$$

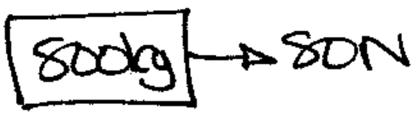
$$F_x = 376N$$

∴ total pulling force in forward direction is $2 \times 376 = 752N$.

unbalanced force $F_{un} = Ma$

$$F_{un} = 800 \times 0.1$$

$$F_{un} = 80N.$$



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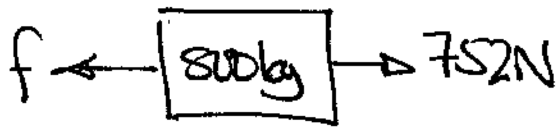

so $752 - f = 80$

$$f = 752 - 80$$

$$f = \underline{\underline{672N}} \text{ of friction.}$$

7. (a) $F_1 = Mg\sin\Theta$

$$= 2600 \times 9.8 \times \sin 12^\circ$$

$$= \underline{5298N}$$

7. (b) $F_{un} = 5298 - 1400 = 3898\,N$

$F_{un} = ma$

$3898 = 2600 \times a$

$\underline{a = 1.5\,ms^{-2}}$

(c) $v^2 = u^2 + 2as$

$v^2 = 5^2 + (2 \times 1.5 \times 75)$

$v^2 = 25 + 225$

$v^2 = 250$ (no need to find square root)

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

$E_K = \frac{1}{2} \times 2600 \times 250$

$\underline{E_K = 3.25 \times 10^5\,J}$