Section 2: Applying Newton's second law

Solutions to Exercise level 1

1. (i) $F = ma = 1300 \times 3 = 3900$ N
   (ii) $F = ma = 45 \times 10 = 450$ N
   (iii) $F = ma = 3600000 \times 0.01 = 36000$ N
   (iv) $F = ma = 380000 \times 6 = 2280000$ N
   (v) $F = ma = 10^{-12} \times 0.002 = 2 \times 10^{-15}$ N

2. (i) $a = \frac{F}{m} = \frac{200}{5} = 40$ m s^{-2}
   (ii) $a = \frac{F}{m} = \frac{1200}{23} = 52.2$ m s^{-2} (3 s.f.)
   (iii) $a = \frac{F}{m} = \frac{1400}{2000} = 0.7$ m s^{-2}
   (iv) $a = \frac{F}{m} = \frac{6}{0.003} = 2000$ m s^{-2}
   (v) $a = \frac{F}{m} = \frac{75000}{160000} = 0.469$ m s^{-2} (3 s.f.)

3. (i) Vertically downwards: $10g - X = 10a$
   $X = 10 \times 9.8 - 10 \times 4 = 58$ N

   (ii) Vertically upwards: $X - 10g = 10a$
   $X = 10 \times 9.8 + 10 \times 4 = 138$ N

   (iii) Vertically upwards: $X - 10g = 0$
   $X = 10 \times 9.8 = 98$ N
   Horizontally: $Y = 10a = 10 \times 4 = 40$ N

   (iv) Vertically downwards: $mg - 20 = ma$
   $9.8m - 20 = 4m$
   $5.8m = 20$
   $m = 3.45$ kg (3 s.f.)

   (v) Vertically upwards: $196 - mg = ma$
   $196 - 9.8m = 4m$
   $13.8m = 196$
   $m = 14.2$ kg (3 s.f.)

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4. (i) Vertically downwards: $10g - 4.9 = 10a$

$10 \times 9.8 - 4.9 = 10a$

$93.1 = 10a$

$a = 9.31 \text{ ms}^2$

(ii) Vertically upwards: $90 - 8g = 8a$

$90 - 8 \times 9.8 = 8a$

$11.6 = 8a$

$a = 1.45 \text{ ms}^{-2}$

5. $F = ma = 5 \times 3 = 15$

The resultant force is 15 N.

6. $F = ma$

$9 = 45a$

$a = 0.2$

The acceleration of the particle is 0.2 ms^{-2}.

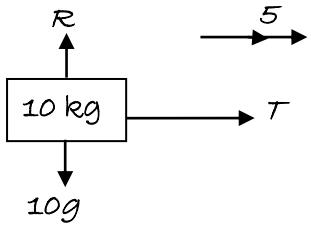
7. $F = ma$

$40 = 2m$

$m = 20$

The value of m is 20.

8.

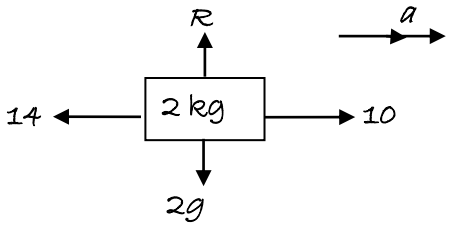


$F = ma$

$T = 10 \times 5 = 50$

The tension in the string is 50 N.

9.



$F = ma$

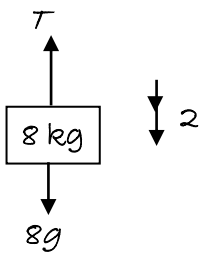
$10 - 14 = 2a$

$-4 = 2a$

$a = -2$

The acceleration is 2 ms^{-2} West.

10.



$F = ma$

$8g - T = 8 \times 2$

$T = 8 \times 9.8 - 16 = 62.4$

The tension is 62.4 N.