**1 a** $u = 10, v = 15, s = 15$

$$s = \frac{(u+v)t}{2}$$
$$= \frac{10+15}{2} \times t$$
$$\therefore t = \frac{30}{25}$$
$$= \frac{6}{5}$$

The time taken to go from $B$ to $C$ is $\frac{6}{5}$ seconds

**b**

$$v = u + at$$
$$15 = 10 + a \times \frac{6}{5}$$
$$\therefore a = \frac{5 \times 5}{6}$$
$$= \frac{25}{6}$$

The acceleration of the particle is $\frac{25}{6}$ $\mathrm{m/s^2}$

**c** In this situation take $v = 10, u = 0, a = \frac{25}{6}$

$$10 = \frac{25t}{6}$$
$$t = \frac{12}{5}$$

It takes $\frac{12}{5}$ seconds to go from $A$ to $B$.

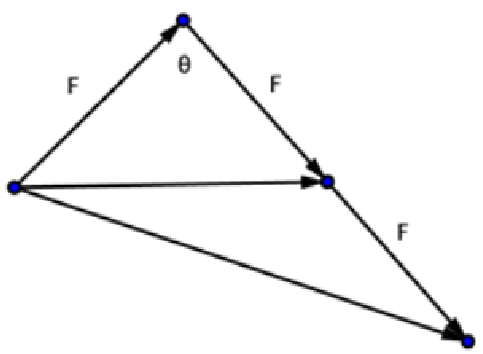
**d** Use $v^2 = u^2 + 2as$

$v = 10, u = 0, a = \frac{25}{6}$

$$100 = 2 \times \frac{25}{6} \times s$$
$$s = 12$$

The distance $AB$ is $12$ m.

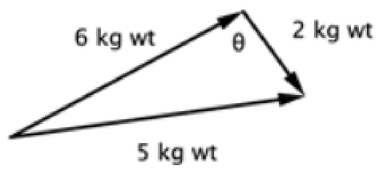
**2**




In the 'top triangle'
$36 = 2F^2 - 2F^2 \cos\theta \ldots (1)$
In the 'large triangle'
$121 = 5F^2 - 4F^2 \cos\theta \ldots (2)$
Multiply (1) by 2 and subtract from (2)
$49 = F^2$

$F = 7$
Substitute in (1)
$36 = 98 - 98\cos\theta$
$\cos\theta = -\frac{31}{49}$

**3**




Using the cosine rule:
$5^2 = 6^2 + 2^2 - 2\times 6\times 2\cos\theta$
$25 = 40 - 24\cos\theta$
$\frac{5}{8} = \cos\theta$
The cosine of the required angle is $\cos(180-\theta)^\circ = -\frac{5}{8}$

**4** For the object being dropped
$s = 50, a = 10$
$s = \frac{1}{2}at^2$
$50 = 5t^2$
$t = \sqrt{10}$
It takes $\sqrt{10}$ seconds to get to $50$ metres where it meets the other object.
For the object being projected up
$s = 50, t = \sqrt{10}, a = -10, u = ?$
$50 = \sqrt{10}u - \frac{1}{2}\times 10\times 10$
$100 = \sqrt{10}u$
$u = 10\sqrt{10}$
The particle is projected upwards at $10\sqrt{10}\,\mathrm{m/s}$

**5** Using the cosine rule the square of the magnitude of the resultant force of the $8$ $\mathbf{kg\ wt}$ and $6$ $\mathbf{kg\ wt}$ is given by
$6^2 + 8^2 - 2\times 6\times 8 - 2\times 6\times 8\cos 45^\circ$
$= 100 - 48\sqrt{2}$
That is $Q^2 = 100 - 48\sqrt{2}$

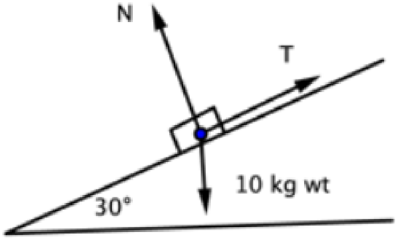
**6** Let $S_9$ be the distance covered in $9$ seconds.
Let $S_8$ be the distance covered in $8$ seconds.
$S_9 - S_8 = 51$
$\frac{1}{2}a\times 81 - \frac{1}{2}a\times 64 = 51$
$\frac{1}{2}a\times 17 = 51$
$\frac{1}{2}a = 3$
$a = 6$
The acceleration is $6\ \mathrm{m/s^2}$

**7** Use $s = ut + \frac{1}{2}at^2$
$u = 8, a = 2, s = 65, t = ?$

$$65 = 8t + t^2$$
$$t^2 + 8t - 65 = 0$$
$$(t + 13)(t - 5) = 0$$
$$t = -13 \text{ or } t = 5$$

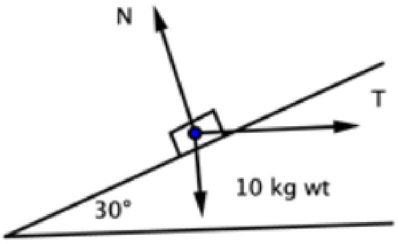
Therefore it takes $5$ seconds to travel this distance.

**8 a**



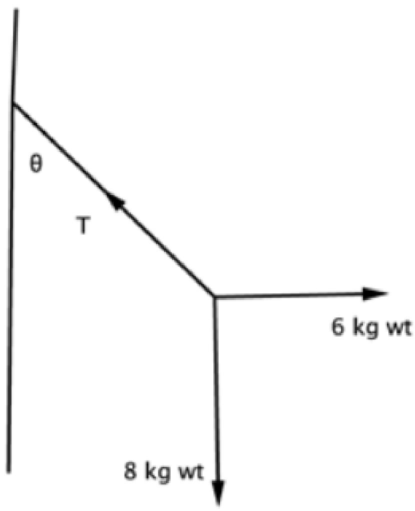

Resolve parallel to the plane.
$T = 10\cos 60^\circ = 5$
The tension in the string is $5 \text{ kg wt}$ $N = 10\sin 60^\circ = 5\sqrt{3} \text{ kg wt}$

**b**




Resolve parallel to the plane.
$T\cos 30^\circ = 10\cos 60^\circ$
$T = \frac{10}{\sqrt{3}} = \frac{10\sqrt{3}}{3}$ $N = \frac{20\sqrt{3}}{3}$

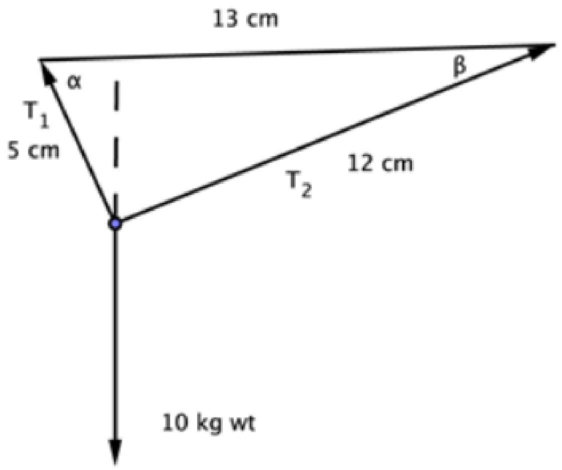
**9**



Resolve vertically
$T\cos\theta = 8 \ldots (1)$
Resolve horizontally
$T\sin\theta = 6 \ldots (2)$
Divide (2) by (1)
$\therefore \tan\theta = \frac{3}{4}$
$\therefore \sin\theta = \frac{3}{5}$ and $\cos\theta = \frac{4}{5}$

$\therefore T = \frac{6\times 5}{3} = 10 \text{ kg wt}$

**10**




The triangle has sides $5$ cm, $12$ cm and $13$ cm and is therefore a right-angled triangle.
$\cos\alpha = \frac{5}{13}$ and $\cos\beta = \frac{12}{13}$
Resolving vertically
$T_2\cos\alpha + T_1\cos\beta = 10 \ldots (1)$
Resolving horizontally
$T_2\cos\beta = T_1\cos\alpha \ldots (2)$
$\therefore 12T_1 + 5T_2 = 130$ and $5T_1 - 12T_2 = 0$
$\therefore T_1 = \frac{120}{13} \text{ kg wt}$ and $T_2 = \frac{50}{13} \text{ kg wt}$

**11a** Total distance $= \frac{15}{2}(20+55) = \frac{1125}{2}$ metres

**b** $\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$
$= \frac{225}{22}\text{m/s}$

**c** Acceleration in the first 20 seconds $= \frac{3}{4}$ m/s $^2$

**d** First: $10 = \frac{3}{4}t$,
$\therefore t = \frac{40}{3}$
Secondly: $10 = 55 - t$
$\therefore t = 45$
The speed is $10$ m/s when $t = \frac{40}{3}$ and $t = 45$