1 A particle P is projected vertically upwards with speed $v\,\text{m s}^{-1}$ from a point on the ground. P reaches its greatest height after 3 s.

(a) Find v. [1]

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(b) Find the greatest height of P above the ground. [2]

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1 A particle P is projected vertically upwards with speed $u\,\mathrm{m\,s^{-1}}$ from a point on the ground. P reaches its greatest height after 3 s.

(a) Find u. [1]

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(b) Find the greatest height of P above the ground. [2]

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2   A particle P is projected vertically upwards from horizontal ground with speed $u\,\text{m s}^{-1}$. P reaches a maximum height of 20 m above the ground.

   (a) Find the value of u.   [2]

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   (b) Find the total time for which P is at least 15 m above the ground.   [3]

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2   A particle P is projected vertically upwards from horizontal ground with speed $15\,\text{m s}^{-1}$.

(a)   Find the speed of P when it is $10\,\text{m}$ above the ground.   [2]

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At the same instant that P is projected, a second particle Q is dropped from a height of $18\,\text{m}$ above the ground in the same vertical line as P.

(b)   Find the height above the ground at which the two particles collide.   [3]

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3 A particle P is projected vertically upwards with speed $5\,\text{m s}^{-1}$ from a point A which is 2.8 m above horizontal ground.

(a) Find the greatest height above the ground reached by P. [3]

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(b) Find the length of time for which P is at a height of more than 3.6 m above the ground. [4]

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4 A particle is projected vertically upwards with speed u m s^{-1} from a point on horizontal ground. After 2 seconds, the height of the particle above the ground is 24 m.

(a) Show that $u = 22$. [2]

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(b) The height of the particle above the ground is more than h m for a period of 3.6 s.

Find h. [4]

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2 A particle P is projected vertically upwards from horizontal ground. P reaches a maximum height of $45\,\text{m}$. After reaching the ground, P comes to rest without rebounding.

(a) Find the speed at which P was projected. [2]

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(b) Find the total time for which the speed of P is at least $10\,\text{m\,s}^{-1}$. [3]

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5 A particle is projected vertically upwards with speed $40\,\text{m s}^{-1}$ alongside a building of height h m.

(a) Given that the particle is above the level of the top of the building for 4 s, find h. [4]

(b) One second after the first particle is projected, a second particle is projected vertically upwards from the top of the building with speed $20\,\text{m s}^{-1}$.

Denoting the time after projection of the first particle by t s, find the value of t for which the two particles are at the same height above the ground. [4]

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