

- 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 is projected vertically upwards from horizontal ground with a speed of $u \text{ m s}^{-1}$. The particle has height $s \text{ m}$ above the ground at times 3 seconds and 4 seconds after projection.

Find the value of u and the value of s .

[3]

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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 .

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

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- 2 A particle is projected vertically upwards from horizontal ground. The speed of the particle 2 seconds after it is projected is 5 m s^{-1} and it is travelling **downwards**.

(a) Find the speed of projection of the particle. [2]

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(b) Find the distance travelled by the particle between the two times at which its speed is 10 m s^{-1} . [2]

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

- (a) Find the speed of P when it is 10 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 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 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 $u \text{ m s}^{-1}$ 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 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 m s^{-1} . [3]

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

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

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- (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 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]

[illegible]