



2020 Sec 3 Physics
Answers to AS 5.1 - 5.3

AS 5.1

Reminders on presentation:

- State the formula/equation first!
- Insert units in the first step of substitution
- Final answer:
 - In decimal, not fraction
 - In 2 or 3 s.f. in general
- Vectors (displacement, velocity & acceleration) have both magnitude & direction

1 (a) Frequency, $f = 60 \text{ Hz}$

$$\text{Initial average speed, } u = \text{distance} / \text{time} = \frac{5.0}{\left(\frac{2}{60}\right)} = 150 \text{ cm s}^{-1} \quad [1]$$

$$\text{Final average speed, } v = \text{distance} / \text{time} = \frac{2.0}{\left(\frac{4}{60}\right)} = 30 \text{ cm s}^{-1} \quad [1]$$

$$\text{Average acceleration, } a = \frac{v - u}{t} = \frac{30 - 150}{\left(\frac{5}{60}\right)} = -1440 \text{ cm s}^{-2}$$
$$= -14 \text{ m s}^{-2} \text{ or } -14.4 \text{ m s}^{-2} \quad [1]$$

(b) The negative sign indicates that the velocity of the trolley is decreasing in magnitude or the trolley moves with a decreasing speed or the trolley moves with a deceleration.

2 (a) The velocity increases by a constant value of 0.80 m s^{-1} every second.

(b) $a = (v - u) / t = (3.2 - 0.0) / 4.0 = 0.8 \text{ m s}^{-2}$

(c) Distance = speed * time = $\frac{1}{2} (3.20)(4.0) = 6.4 \text{ m}$

(d) 1.60 m s^{-1}

Note: At the end of this chapter, revisit this question using graphical method and equations of motion.

3 (a) $120 + 400 = 520 \text{ m}$

(b) $120 - 400 = 280 \text{ m West}$

(c) $520 \div (80 + 30 + 25) = 520 \div 135 = 3.85 \text{ m s}^{-1}$

(d) $280 \div 135 = 2.07 \text{ m s}^{-1} \text{ West}$

4 If downstream is given a positive sign convention,

(a) resultant velocity = $5.0 - 20.0 = -15.0 \text{ km h}^{-1}$

(b) resultant velocity = $5 + 20.0 = 25.0 \text{ km h}^{-1}$

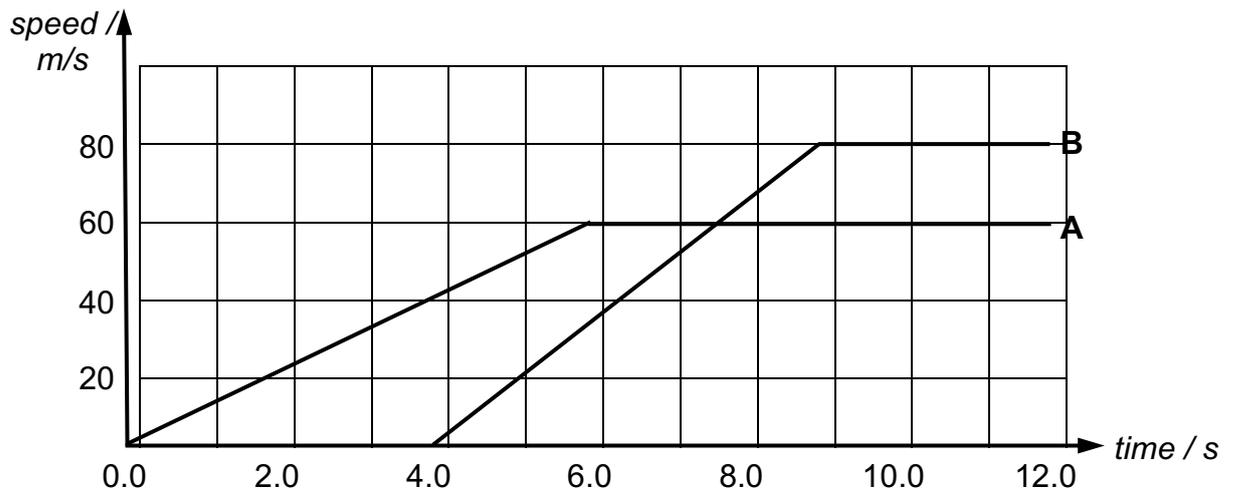
AS 5.2

1. A : constant deceleration or velocity decreasing at a constant rate
 B : constant velocity or zero acceleration
 C : constant acceleration or velocity increasing at a constant rate
 D : decreasing acceleration or velocity increasing at an decreasing rate
 E : increasing deceleration or velocity decreasing at an increasing rate

Note:

- Describe motion in terms of “v” or “a” (preferably not both)
- Describe “v” with “rate of change”, but “a” without.

2. a)



b) average speed = total distance / total time = $[(\frac{1}{2} \times 60 \times 6.0) + (60 \times 6.0)] / 12.0$
 $= 45 \text{ m s}^{-1}$

c) Let t be the time taken for the cars to reach the finishing line.

distance travelled by car A = distance travelled by car B

$$(\frac{1}{2} \times 60 \times 6.0) + (t - 6.0)(60) = (\frac{1}{2} \times 80 \times 5.0) + (t - 9.0)(80)$$

$$t = 340 / 20$$

$$t = 17 \text{ s}$$

3 a) downwards positive

b) distance traveled = $\frac{1}{2} \times 1.2 \times 12.0 = 7.2 \text{ m}$

bii) acceleration = $0 - (-12.0) / 1.2$ or $16.0 - (-12.0) / 2.8 = 10 \text{ m s}^{-2}$

ci) Ball will end up **lower** [1]. The distance moved downwards is greater than the distance moved upwards as shown by the areas under the graph.

(up: -7.2 m, down: 12.8 m)

cii) displacement = $\frac{1}{2} (12.0 + 16.0) (2.8 - 2.4) = 5.6 \text{ m}$

or $s = \text{average } v \times \text{time}$

AS 5.3

1 a) Sign convention: A towards B is positive
 $v = u + at$
 $25.0 = u + (0.670)(12.0)$
 $u = 16.96 \text{ m s}^{-1} = \mathbf{17.0 \text{ m s}^{-1} \text{ (to 3 s.f.)}}$

b) $s = ut + \frac{1}{2} at^2$
 $s = (16.96)(12.0) + \frac{1}{2} (0.670)(12.0)^2$
 $s = 251.76 = \mathbf{252 \text{ m (to 3 s.f.)}}$

2 a) Sign convention: downhill is positive
 $s = ut + \frac{1}{2} at^2$
 $s = (3.0)(8.0) + \frac{1}{2} (1.5)(8.0)^2 = \mathbf{72 \text{ m (to 2 s.f.)}}$

b) $v^2 = u^2 + 2as$
 $7.0^2 = 3.0^2 + 2(1.5)(s)$
 $s = 13.33 = \mathbf{13 \text{ m (to 2 s.f.)}}$

3

Note: Good to sketch a diagram to illustrate the known and unknown quantities.

a) Sign convention: A towards B is positive
 $s = ut + \frac{1}{2} at^2$
 $30 = (14)(2.5) + \frac{1}{2} (a)(2.5)^2$
 $a = -1.6 \text{ m s}^{-2}$

Retardation is $\mathbf{1.6 \text{ m s}^{-2}}$

b) $v = u + at$
 $v = 14 + (-1.6)(2.5) = \mathbf{10 \text{ m s}^{-1} \text{ (to 2 s.f.)}}$

c) $v = u + at$
 $0 = 14 + (-1.6)(t)$
 $t = 8.75 = \mathbf{8.8 \text{ s (to 2 s.f.)}}$

4 a) Sign convention: upwards is positive
 $v^2 = u^2 + 2as$
 $0 = 40^2 + 2(-10)(s)$
 $s = \mathbf{80 \text{ m (to 2 s.f.)}}$

b) $s = ut + \frac{1}{2} at^2$
 $0 = (40)(t) + \frac{1}{2}(-10)t^2$
 $t = \mathbf{8 \text{ s}}$

5 Sign convention: downwards is positive

(a) $t = 4.0 \text{ s}$

(b) $v = 40 \text{ m s}^{-1}$

(c) $t = 1.0 \text{ s}$

(d) $v = 20 \text{ m s}^{-1}$

