2025 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) 120 + 400 = 520 m
  (b) 120 – 400 = 280 m West
  (c) 520 ÷ (80+30+25) = 520 ÷ 135 = 3.85 m s^{-1}
  (d) 280 ÷ 135 = 2.07 m s^{-1} West
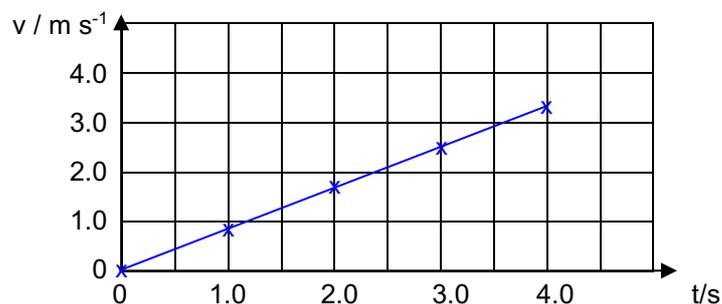
2   If downstream is given a positive sign convention,

  (a) resultant velocity = 5.0 – 20.0 = -15.0 km h^{-1}
      15.0 km h^{-1} upstream
  (b) resultant velocity = 5 + 20.0 = 25.0 km h^{-1}
      25.0 km h^{-1} downstream

3   (a) Frequency, f = 60 Hz

  average speed = distance / time = $\dfrac{10.0}{\left(\dfrac{8}{60}\right)}$ = 75 cm s^{-1} [1]

  (b) The speed of the trolley is decreasing.

4   (a)

  (b) The gradient of the v-t graph is constant.
 (c) a = (v-u) / t = (3.2 – 0.0) / 4.0 = 0.80 m s^{-2}

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)
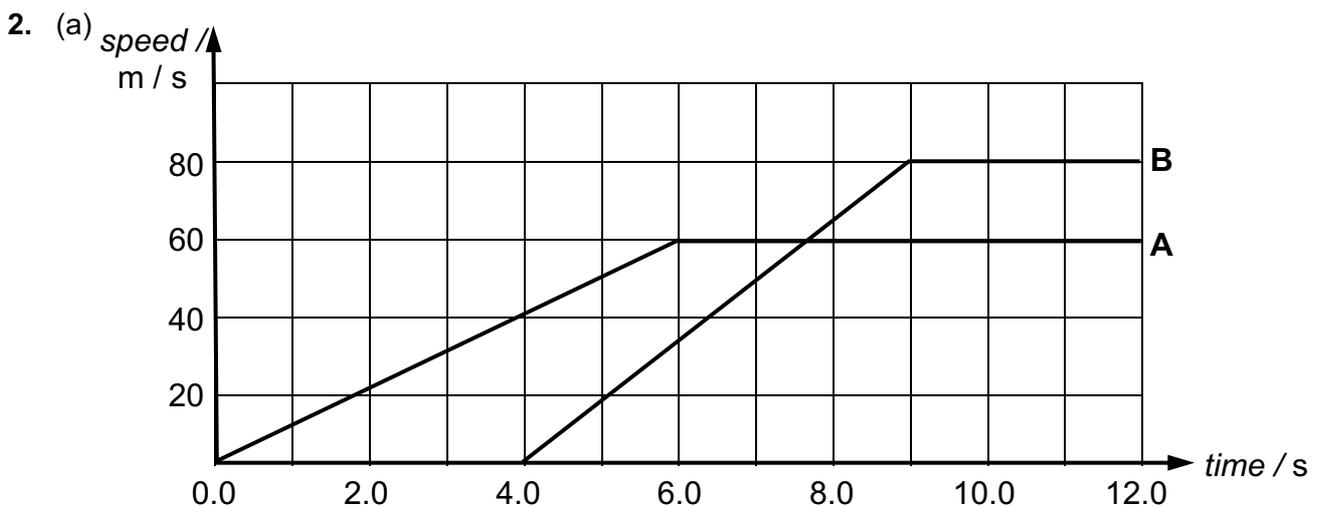
(b) average speed = total distance / total time = [(½ x 60 x 6.0)+(60 x 6.0)] / 12.0
   = **45 m s^{-1}**

(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
   (½ x 60 x 6.0) + (**t** – 6.0)(60) = (½ x 80 x 5.0) + (**t** – 9.0)(80)
   t = 340 / 20
   t = **17 s**

3 (a) downwards positive

   (b)(i)   distance traveled = ½ x 1.2 x 12.0 = **7.2 m**

   (b)(ii)   acceleration = 0 – (-12.0) / 1.2 or   16.0 – (-12.0) / 2.8 = **10 m s^{-2}**

   (c)(i)   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)

   (c)(ii)   displacement = ½ (12.0 + 16.0) (2.8 – 2.4) = **5.6 m**

      or   s = average v × time

AS 5.3

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

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

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

   (b) $v^2 = u^2 + 2as$
     $7.0^2 = 3.0^2 + 2(1.5)(s)$
        $s = 13.33 =$ **13 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 m s^{-2}

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

   (c) $v = u + at$
     $0 = 14 + (-1.6)(t)$
     $t = 8.75 =$ **8.8 s (to 2 s.f.)**

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

     height = 80 m

   (b) $s = ut + \frac{1}{2} at^2$
      $0 = (40)t + \frac{1}{2}(-10)t^2$
       $t =$ **8.0 s**

5   Sign convention: downwards is positive
    (a) $s = ut + \frac{1}{2} at^2$
      $80 = (0) t + \frac{1}{2} (10)t^2$
      t = 4.0 s

   (b) $v = u + at$
     $v = 0 + 10 (4.0)$
     v = 40 m s^{-1}

   (c) $v^2 = u^2 + 2as$
     $v^2 = 40^2 + 2(-20)(30)$
     v = 20 m s^{-1}
     (reject negative answer since motion is downwards, and downwards is taken as positive)

(d) $v = u + at$
     $20 = 40 + (-20)t$
     t = 1.0 s

     alternatively,
     $s = ut + \frac{1}{2}at^2$
     $30 = (40)t + \frac{1}{2}(-20)t^2$
     t = 1.0 s (reject t = 3.0 s as acceleration is -20 m s^{-2} only before hitting the seabed)

(e) $v = u + at$
     $v = 40 + (-20)(1.0)$
     v = 20 m s^{-1}