

- 1 (a) suitable scales (more than half each scale used, no products of 3s, 7s etc.) B1
 2 straight line sections, continuous 0 to 120s, 1st section positive gradient, B1
 2nd section negative gradient B1
 section 1 straight line, from(0, 0) to (30, 900) B1
 section 2 straight line from end of section 1 to (120, 0) B1 [4]
- (b) (use of $a = \Delta v / t$ or $\Delta v / t$ in any form words, symbols or numbers C1
 ($a = 900 / 30 =$) 30 m/s^2 A1 [2]
 e.c.f. from graph
- (ii) use of $s = \text{area under graph}$ (accept valid equation(s)) C1
 (distance = $0.5 \times 900 \times 120 =$) $54\,000 \text{ m}$ A [2]
 e.c.f. from continuous graph, if curves working must be cle
 no e.c.f. from graph if it's a single rectangle

[Total: 8]

- 2 (a) (i) constant/uniform gradient/slope OR straight line B1
- (ii) ($a = \frac{\Delta}{t}$), $v_2 \div t$ OR $36 \div 48$ C1
 0.75 m/s^2 (NOT 0.76) A1
- (b) b) horizontal line from (48, 36) to (120, 36) B1
- (ii) area under graph (mentioned **or** implied) B1
 864 OR 2592 C1
 3500/3460/3456 m A [7]

- 3 (a) (i) $v = u + at$ OR $(a =) (v - u)/t$ OR $24 = a \times 60$ OR $24/60$
 $0.4(0)\text{m/s}^2$ A1
- (ii) $(F =) ma$ OR $7.5 \times 10^5 \times 0.40$ C1
 $300\,000\text{N}$ OR 300kN
- (b) (i) in words or symbols $(P =) W/t$ OR $F \times d/t$ OR Fv
OR $7.2 \times 10^4 \times 24 / 1$ OR OR $7.2 \times 10^4 \times 24$ C1
 $1.7 \times 10^6\text{W}$ A1
- (ii) gravitational/potential energy of train has to be increased B1
OR force acts down the slope/backward force acts (on train)
- (for the same distance moved) more work done has to be done OR energy B1
has to be provided (by the engine) B1
in the same time (so needs more power)
- [Total: 9]**
- 4 (a) measure area (under curve) B1 [1]
- (b) draws tangent at steepest part by eye, within thickness of lines B1
accept triangle/lines to indicate values on straight steepest part of curve
- finds Δv and Δt from tangent or at straight steepest part of curve B1
- any v divided by any t or in equation B1
- $3.0 - 4.2\text{m/s}^2$ B1 [4]
- (c) uses 62 and 10 NOT 2×62 C1
 6.2m/s A1 [2]
- [Total: 7]**

- 5 (a) (i) Increasing speed / acceleration B1
- (ii) Constant / steady / uniform speed or motion B1
- (iii) Decreasing speed / deceleration / braking / slowing / stopping / negative acceleration B1
- (b) (i) (Total) distance / (total) time OR d / t OR 400 / 60 C1
6.67 m/s at least 2 s.f. A1
- (ii) Mention of maximum gradient OR clear that whole or part of B to C is used C1
Use of correct data from graph to $\pm \frac{1}{2}$ square C1
Answer rounds to 9.2 to 9.4 m/s, at least 2 s.f. A1

[Total: 8]

- 6 (a) (i) constant/steady/uniform speed/velocity OR speed/velocity = 2.5 (m/s)
speed/velocity = 2.5 m/s accept fraction, average speed/velocity = 2.5 m/s [2]
- (ii) shape curving upward but not to vertical, at least to 3.5s unless reaches 25 m B1 [1]
- (b) horizontal (straight) line OR careful sketch
accept parallel to time/x-axis [1]
- (c) tolerance on both axes $\pm \frac{1}{2}$ small square throughout both parts
- (i) horizontal straight line at 2.5 m/s from 0 to 2s, ecf from (a)(i) B1
- (ii) straight line rising to the right as far as the edge of the graph area M1
 $\Delta v = 4$ m/s or gradient clearly 2 m/s^2 A1 [3]
- (d) horizontal (straight) line M1
at 0 m/s A1 [2]
accept for both marks: line in/along time/x-axis OR line with $y/v = 0$ OR careful sketch

[Total: 9]