

Mechanics Homework 1 Speed-Time Graphs

Solutions

Section 1

1.) a) $36000 \text{ cm} = \frac{36000}{100,000} = \underline{\underline{0.36 \text{ km}}}$

b) $24000 \div 3600 = 6\frac{2}{3} \text{ hours} = \underline{\underline{6 \text{ h } 40 \text{ min}}}$

c) $72 \text{ km/h} = \frac{72 \times 1000}{3600} = \underline{\underline{20 \text{ ms}^{-1}}}$

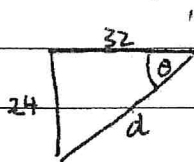
d) $35 \text{ ms}^{-1} = \frac{35 \times 3600}{1000} = \underline{\underline{126 \text{ km/h}}}$

2) a) $(40 - 15) + 40 = 65 \text{ m}$

b) $25 \text{ m downwards} \Rightarrow -15 \text{ m}$

3) a) $32 + 24 = 56 \text{ m}$

b)



$$d = \sqrt{24^2 + 32^2} = 40 \text{ m}$$

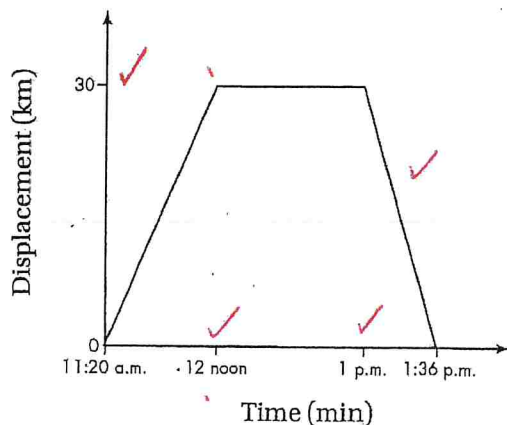
$$\theta = \tan^{-1}(24/32) = 36.9^\circ \quad \text{Bearing} = 270 - \theta = 233.1^\circ$$

Displacement = 40m on a bearing of 233.1°

c) $56/28 = \underline{\underline{2 \text{ ms}^{-1}}}$

Section 2

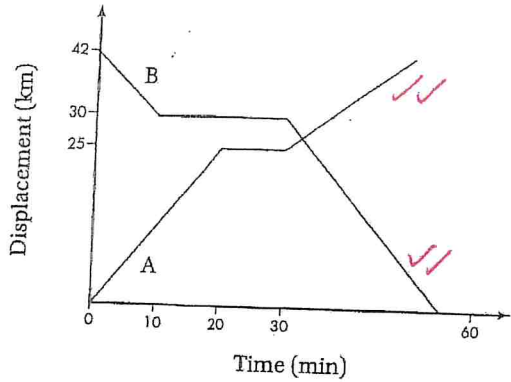
1.) a)



b) 1.36 pm ✓

5

2) a

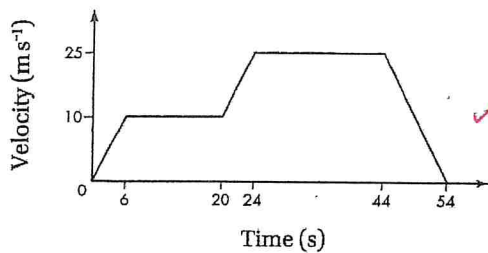


b) At 5.15, A and B are 5 km apart.
 Relative speed = $51 + 72 = 123 \text{ kmh}^{-1}$
 Time taken to meet = $\frac{5}{123}$ hours
 $= \frac{5}{123} \times 60 = 2.4 \text{ minutes} \Rightarrow \underline{\underline{5.17 \text{ pm}}}$

6

3.) a) Time to reach 10 ms^{-1} is 6 sec, constant speed for 14 sec, time to accelerate to 25 ms^{-1} is $\frac{25-10}{3.75} = \underline{4 \text{ sec}}$, steady speed for $\frac{500}{25} = \underline{20 \text{ sec}}$, time to decelerate to rest is $\frac{25}{2.5} = \underline{10 \text{ sec}}$.
 Total = $6 + 14 + 4 + 20 + 10 = \underline{\underline{54 \text{ sec}}}$

b.)

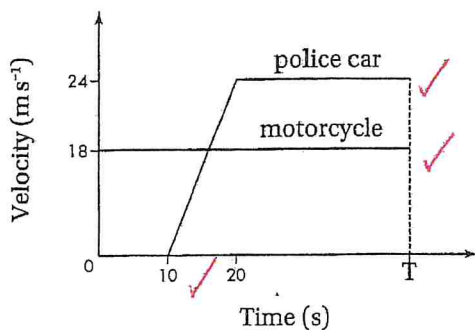


c.) Area = $(\frac{1}{2} \times 6 \times 10) + (14 \times 10) + (4 \times 10) + (\frac{1}{2} \times 4 \times 15) + (20 \times 25) + (\frac{1}{2} \times 10 \times 25)$
 $= 30 + 140 + 40 + 30 + 500 + 125 = \underline{\underline{865 \text{ m}}}$

d) $\frac{10}{6} = \underline{\underline{1.67 \text{ ms}^{-2}}}$

8

4.) a)



b) When police car catches up, distances are equal

$$\Rightarrow 18T = (\frac{1}{2} \times 10 \times 24) + (T-20) \times 24$$

$$18T = 120 + 24T - 480$$

$$360 = 6T \Rightarrow T = \underline{\underline{60 \text{ sec}}}$$

c.) $18 \times 60 = \underline{\underline{1080 \text{ m}}}$

7

Extension Question

(a) ratio is $\frac{\frac{3}{4}d}{3} : \frac{\frac{1}{4}d}{2}$
 $= \frac{1}{4} : \frac{1}{8} = 2 : 1$

(b) 80 km h^{-1} for 5 hrs = 400 km

$\frac{3}{4}$ of 400 = 300 km

av. speed on first part of journey = $\frac{300}{3} = 100 \text{ km h}^{-1}$