Physics 20 - Lesson 1
Average Speed

1) /4

$\Delta t = 75\,\text{min} = 1.25h$
$V_{avg} = 75\,{}^{km}/_{h}$ ✓
$\Delta d = ?$

$\Delta d = V_{avg} \times \Delta t = 75\,{}^{km}/_{h} \times 1.25h$ ✓ ✓
$\boxed{\Delta d = 94km}$ ✓

2) /4

$\Delta t = 3days \times \frac{24h}{day} \times \frac{3600s}{h} = 2.592 \times 10^5 s$ ✓
$V_{avg} = 3.858 \times 10^{-5} cm/s$
$\Delta d = ?$

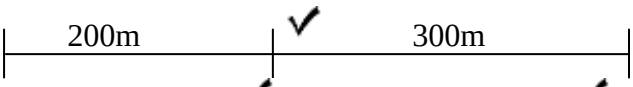
$\Delta d = V_{avg} \times \Delta t = 3.858 \times 10^{-5}\,{}^{cm}/_{s} \times 2.592 \times 10^5 s$ ✓ ✓
$\boxed{\Delta d = 10.00cm = 0.100m}$ ✓

3) /4

$\Delta t = ?$
$V_{avg} = 3.0 \times 10^8\,{}^{m}/_{s}$ ✓
$\Delta d = 1.5 \times 10^8 km (1.5 \times 10^{11} m)$

$\Delta t = \frac{\Delta d}{V} = \frac{1.5 \times 10^{11} m}{3.0 \times 10^8\,{}^{m}/_{s}}$ ✓ ✓
$\boxed{\Delta t = 500s}$ ✓

4) /9



✓

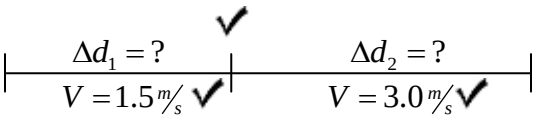
$\Delta t = \frac{\Delta d}{v_{ave}} = \frac{200m}{1.5m/s}$ ✓
$\Delta t = 133.3s$ ✓

$\Delta t = \frac{\Delta d}{\Delta v} = \frac{300m}{3.0m/s}$ ✓
$\Delta t = 100s$ ✓

$\Delta t_{total} = 100s + 133.3s = \boxed{233.3s}$ ✓

$V_{avg} = \frac{\Delta d}{\Delta t} = \frac{200m + 300m}{133.s + 100s}$ ✓ ✓
$\boxed{V_{avg} = 2.14m/s}$ ✓

5) /8



✓ ✓ ✓

$\Delta d_1 = V \times \Delta t$ ✓
$\Delta d_1 = 1.5m/s \times 25s$
$\Delta d_1 = 37.5m$

$\Delta d_2 = V \times \Delta t$ ✓
$\Delta d_2 = 3.0m/s \times 40s$
$\Delta d_2 = 120m$

$\Delta d = 37.5m + 120m$
$\boxed{\Delta d = 157.5m}$ ✓

$V_{avg} = \frac{\Delta d}{\Delta t} = \frac{157.5m}{65s}$ ✓
$\boxed{V_{avg} = 2.4m/s}$ ✓

6) /8


✓

2.5m/s ✓
500m
$\Delta t = \frac{\Delta d}{V} = \frac{500m}{2.5\,{}^{m}/_{s}}$
$\Delta t = 200s$ ✓
$\Delta t_{total} = 200s + 30.8s$

$\boxed{\Delta t_{total} = 230.8s}$ ✓

6.5m/s ✓
200m
$\Delta t = \frac{\Delta d}{V} = \frac{200m}{6.5\,{}^{m}/_{s}}$
$\Delta t = 30.8s$ ✓

$V_{avg} = \frac{\Delta d}{\Delta t} = \frac{700m}{230.8s}$ ✓
$\boxed{V_{avg} = 3.0\,{}^{m}/_{s}}$ ✓

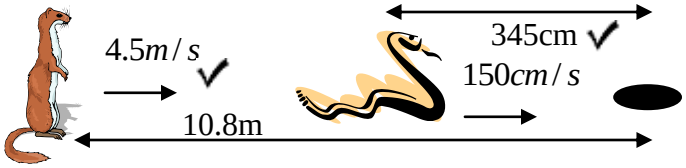
7) /8

Turtle	Hare	Distance apart
$\Delta t = 4.5\,\text{min}(270s)$	$\Delta t = 270s$ ✓	✓
$V_{avg} = 0.25m/s$ ✓	$V_{avg} = 5.0\,{}^{m}/_{s}$ ✓	$1350m - 67.5m = \boxed{1282.5m}$ ✓
$\Delta d_t = V_{avg} \times \Delta t$ ✓	$\Delta d_h = V_{avg} * \Delta t$ ✓	
$\Delta d_t = 0.25m/s \times 270s$	$= 5.0\,{}^{m}/_{s} * 270s$	
$\Delta d_t = 67.5m$ ✓	$= 1350m$ ✓	

8) /8

Jake	Mack	Distance apart
$\Delta t = 5.0s$ ✓	$\Delta t = 5.0s$ ✓	✓
$V_{avg} = 125cm/s$	$V_{avg} = 200cm/s$	$1000cm - 625cm = \boxed{375cm}$ ✓
$\Delta d_j = V_{avg} \times \Delta t$ ✓	$\Delta d_m = V_{avg} \times \Delta t$ ✓	
$\Delta d_j = 125cm/s \times 5.0s$	$\Delta d_m = 200cm/s \times 5.0s$	
$\Delta d_j = 625cm$ ✓	$\Delta d_m = 1000cm$ ✓	

9) /7



$\Delta t_j = \frac{\Delta d}{V} = \frac{245cm}{150cm/s}$ ✓

$\Delta t_j = 2.3s$ ✓

$\Delta t_m = \frac{\Delta d}{V} = \frac{10.8m}{4.50m/s}$ ✓

$\Delta t_m = 2.4s$ ✓

✓

∴ Jake escapes down the hole

10) /7

Zeke ✓

$\Delta t = 1.0\,\text{min}^*(not\ 5\,\text{min})$

$V_z = 7.25m/s$

$\Delta d_t = V_{avg} \times \Delta t$ ✓

$= 7.25m/s \times 1.0\,\text{min}$

$= 435m$ ✓

✓

Total distance for Zeke $= 435m + 350m = \boxed{785m}$

Jack

$\Delta t = 60s$

$V_z = 13.0\,{}^{m}/_{s}$ ✓

$\Delta d_t = V_{avg} * \Delta t$

$= 13.0\,{}^{m}/_{s} * 60s$

$= 780m$ ✓

Total distance for Jack $= \boxed{780m}$

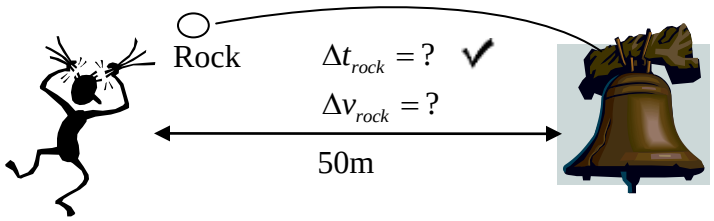
785 > 780 ✓

∴ Zeke escapes

In the real world, zebras are in Africa, jaguars are in South America

11)

/8



sound $V_{sound} = 330\,{}^{m}/_{s}$ ✓
$\Delta t_{sound} = ?$

$\Delta t_{sound} = \dfrac{\Delta d}{V} = \dfrac{50m}{330m/s}$ ✓

$\Delta t_{sound} = 0.152s$ ✓

$\Delta t_{total} = \Delta t_{rock} + \Delta t_{sound}$ ✓

$4.5s = \Delta t_{rock} + 0.152s$

$\Delta t_{rock} = 4.35s$ ✓

$V_{rock} = \dfrac{\Delta d}{V} = \dfrac{50m}{4.35s}$ ✓

$\boxed{V_{rock} = 11.5m/s}$ ✓

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12)

Bonus /10

BC

$\Delta t_1 = ?$
$V_1 = 2500\,{}^{km}/_{h}$
$\Delta d_1 = 20000km$

$\Delta t_2 = ?$
$V_2 = 1000\,{}^{km}/_{h}$
$\Delta d_2 = 20000km$

$\Delta t_1 = \dfrac{\Delta d_2}{V_2} = \dfrac{20000km}{2500\,{}^{km}/_{h}}$ ✓

$\Delta t_1 = 8.0h$ ✓

$\Delta t_2 = \dfrac{\Delta d_1}{V_1} = \dfrac{20000km}{1000\,{}^{km}/_{h}}$ ✓

$\Delta t_2 = 20h$ ✓

$\Delta t_{BC} = 8.0h + 20h = \boxed{28h}$ ✓

FC

$t = total\ time$
$\Delta t_1 = {}^{1}/_{2}t$
$V_1 = 2500km/h$
$\Delta d_1 = d$

$\Delta t_2 = {}^{1}/_{2}t$
$V_2 = 1000km/s$
$\Delta d_2 = 40000km - d$

$\Delta d_1 = V_1 \times \Delta t_1$
$\Delta d_1 = 2500({}^{1}/_{2}\Delta t)$ ✓
$\Delta d_1 = 1250\Delta t$

Substitute

$\Delta d_2 = V_2 \times \Delta t_2$ ✓
$40000 - d = 1000({}^{1}/_{2}\Delta t)$
$40000 - d = 500\Delta t$

$40000 - 1250t = 500\Delta t$ ✓
$40000 = 1750\Delta t$
$\boxed{\Delta t_{FC} = 22.86h}$ ✓

$\Delta t = 28 - 22.86 = \boxed{5.14h}$ ✓

The French Concorde will arrive 5.14h ahead of the British Concorde

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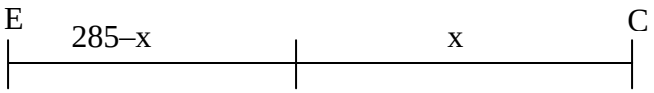
13)



Bonus /10

$v_E = 120$ km/h $\qquad$ $v_C = 140$ km/h

$$v_E = \frac{\Delta d}{\Delta t} \qquad v_C = \frac{\Delta d}{\Delta t}$$

$$v_E = \frac{285 - x}{\Delta t} \qquad v_C = \frac{x}{\Delta t}$$

$$\Delta t = \frac{285 - x}{v_E} \qquad \Delta t = \frac{x}{v_C}$$

$$\Delta t = \frac{285 - x}{120} \qquad \Delta t = \frac{x}{140}$$

$$\frac{285 - x}{120} = \frac{x}{140}$$

$$140(285 - x) = 120x$$

$$285(140) - 140x = 120x$$

$$285(140) = 120x + 140x$$

$$285(140) = 260x$$

$$\frac{285(140)}{260} = x$$

$$x = 153\,km$$