SPH 3UI Exam Review Solutions

1.

	1	2	3	Total
d	5 km	2 km	0.3 km	→ 7.3 km
t	0.625 h	0.333 h	600 s = 0.167 h	→ 1.125 h
v	8 $\frac{km}{h}$		0.5 $\frac{m}{s}$	6.5 $\frac{km}{h}$

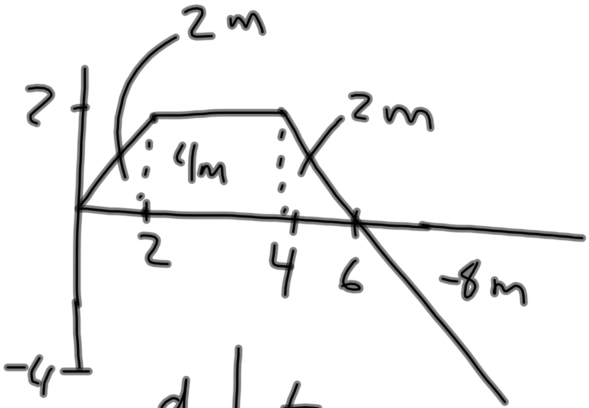
$t = \frac{d}{v} = 0.625\text{ h}$

$d = vt$
$= 300\text{ m}$
$= 0.3\text{ km}$

$v_{AV} = \frac{d_{TOT}}{t_{TOT}}$
$= 6.5\ \frac{km}{h}$
$= 1.8\ \frac{m}{s}$

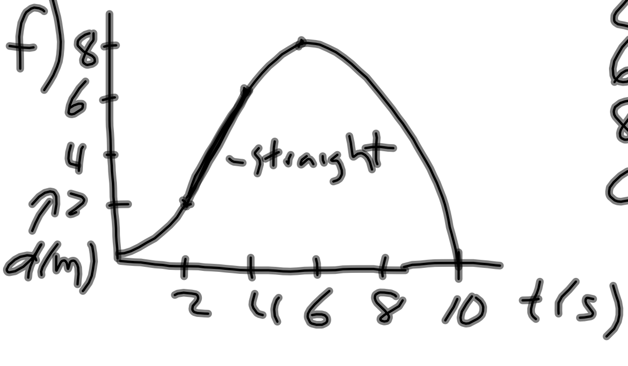
Practice Exam Answers

2. a) 0 s, 6 s
   b) 2 s - 4 s
   c) 0 s - 2 s
   d) 6 s
   e) 10 s



d	t
0	0
2	2
6	4
8	6
0	10

f)



3\.

speeder: $d = D$, $t = T$

$v = 135\ \frac{km}{h}$
$= 37.5\ \frac{m}{s}$

Police: accel | unifor

accel		unifor
$d = 0$, $t = 3.5\,s$	$t = t_a$	$d = D - d_a$
	$d = d_a$	$t = T - t_a - 3.5\,s$
	$v_i = 0$	$v = 41.7\ \frac{m}{s}$
	$v_f = 150\ \frac{km}{h} = 41.7\ \frac{m}{s}$	
	$a = 4\ \frac{m}{s^2}$	

$a = \frac{v_f - v_i}{t}$

a) $t_a = \frac{v_f - v_i}{a}$
$= \frac{41.7 - 0}{4}$
$= 10.4\,s$

b) $d = \frac{v_f^2 - v_i^2}{2a}$
$= \frac{41.7^2 - 0}{2(4)}$
$d_a = 217\,m$

$d = D - 217$
$t = T - 13.9$

$\therefore 41.7 = \frac{D - 217}{T - 13.9}$

$D - 217 = 41.7(T - 13.9)$
$D - 217 = 41.7T - 580$
$\boxed{D = 41.7T - 363}$ (1)

For speeder
$d = vt$
$\boxed{D = 37.5T}$ (2)

$37.5T = 41.7T - 363$
$363 = 4.2T$
$\boxed{T = 86.3\,s}$
$\therefore D = 37.5(86.3)$
$\boxed{D \approx 3240\ m}$

4. $V_{AV} = \frac{d}{t}$

& $V_{AV} = \frac{V_i + V_f}{2}$

$\therefore \frac{d}{t} = \frac{V_i + V_f}{2}$

so $d = \left(\frac{V_i + V_f}{2}\right)t \Rightarrow d = \frac{(V_f - at) + V_f}{2}\, t$

$= \frac{(2V_f - at)t}{2}$

$= \frac{2V_f t}{2} - \frac{1}{2}at^2$

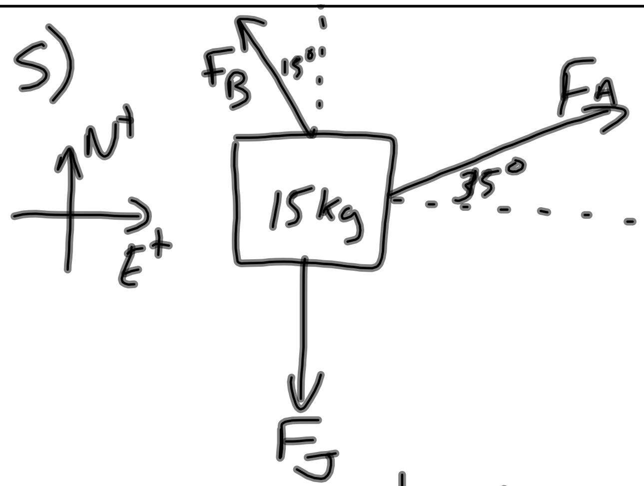
$\boxed{d = V_f t - \frac{1}{2}at^2}$

Also $a = \frac{V_f - V_i}{t}$

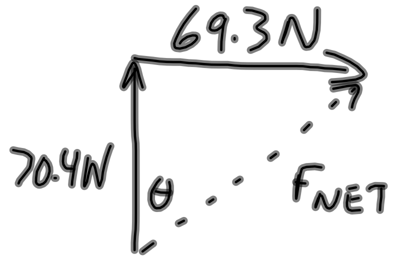
$\therefore at = V_f - V_i$

so $V_i = V_f - at$

5)



	B	A	J	Total
N-S	80 cos 15 = 77.3 N	110 sin 35 = 63.1 N	−70 N	70.4 N
E-W	−80 sin 15 = −20.7 N	110 cos 35 = 90 N	0	69.3 N



$$|\vec{F}_{NET}|^2 = 70.4^2 + 69.3^2$$

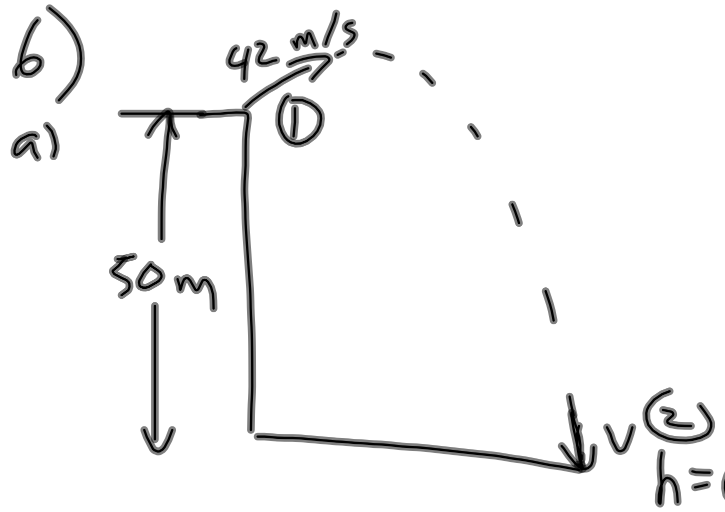
$$|\vec{F}_{NET}| = 98.8\ N$$

$\tan\theta = \frac{69.3}{70.4} \doteq 45°$ $\therefore \vec{F}_{NET} = 98.8\ N$ [N 45° E]

$\vec{a} = \frac{\vec{F}}{m} = 6.59\ \frac{m}{s^2}$ [ ]

6)

a)



$E_1 = E_2$

$\frac{1}{2}\cancel{m}v_1^2 + \cancel{m}gh_1 = \frac{1}{2}\cancel{m}v_2^2$

$\frac{1}{2}(42)^2 + (9.8)(50) = \frac{1}{2}v_2^2$

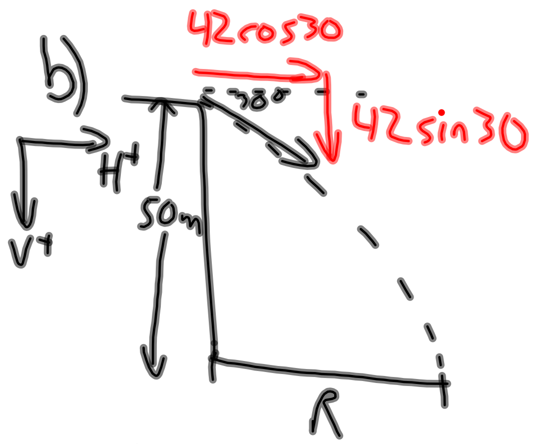
$882 + 490 = \frac{1}{2}v_2^2$

⋮

$v_2 = 52.4\ \frac{m}{s^2}$

(regardless of angle)

b)



vert. (down +)

$v_1 = 21\ \frac{m}{s}$

$a = 9.8\ \frac{m}{s}$

$d = 50m$

$t = T$

$d = v_1 t + \frac{1}{2}at^2$

$50 = 21T + 4.9T^2$

$4.9T^2 + 21T - 50 = 0$

$T = \frac{-21 \pm \sqrt{21^2 - 4(4.9)(-50)}}{9.8}$

⋮

$\cancel{T < 0}$ or $T = 1.70\,s$

Hor.

$v = 42\cos 30$

$= 36.4\ \frac{m}{s}$

$t = 1.70\ s$

$d = vt$

$= 61.8\ m$

(slightly off from 1st posted answer)

7) $F_g = 900\ N$

$m = 70\ kg$

and $F_g = mg$

$\therefore g = \frac{900}{70}$

$= 12.9\ \frac{m}{s^2}$

$F_g = F_g$

$\cancel{m}g = \frac{G\cancel{m}m_p}{r^2}$

$12.9 = \frac{(6.67\times10^{-11})m_p}{(4.8\times10^6)^2}$

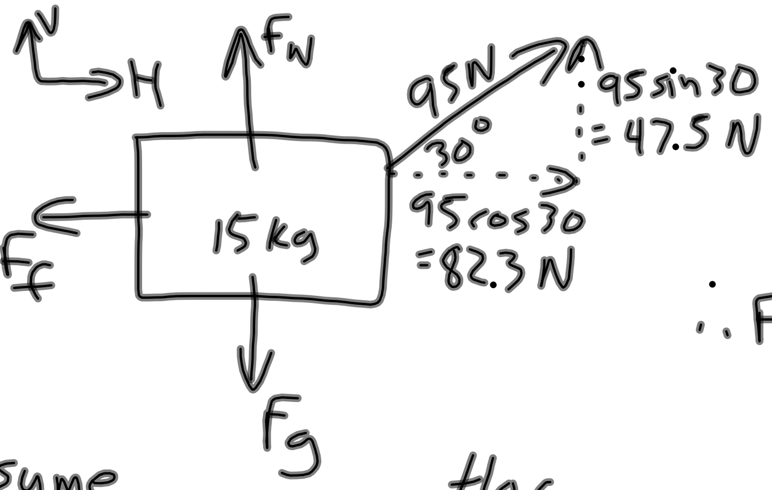
$m_p = 4.44\times10^{24}\ kg$

or $F_g = \frac{Gmm_p}{r^2}$

$900 = \frac{(6.67\times10^{-11})(70)m_p}{(4.8\times10^6)^2}$

$m_p = 4.44\times10^{24}\ kg$

8



Vert.

$F_{NET} = 0$

$F_{NET} = F_N + 47.5 - mg$

$\therefore F_N = (15)(9.8) - 47.5$

$= 99.5\ N$

Assume $v_i = 0$

Hor.

$F_{NET} = ma$

$F_{NET} = 82.3 - F_f$

$\therefore 15a = 82.3 - (0.15)(99.5)$

$a = \frac{67.4}{15} = 4.49\ \frac{m}{s^2}$

Now...

a) $d = v_i t + \frac{1}{2} a t^2$

$= 0 + \frac{1}{2}(4.49)(1.5)^2$

$= 5.1\ m$

b) $W_m = \vec{F_m} \cdot \vec{d}$

$= (95)(5.1)\cos 30$

$= 420\ J$

c) $W_f = \vec{F_f} \cdot \vec{d}$

$= (14.9)(5.1)\cos 180$

$= -76\ N$

d) $\Delta E = W_{TOT}$

$= 420 + (-76)$

$= 344\ J$

(There are longer ways to do this, too... get v_f then $E_{kf} = \frac{1}{2} m v_f^2$)

9)

$$Q_{gained} = -Q_{lost}$$

$$\underset{\text{(water)}}{mc\Delta T} + ml_v + \underset{\text{(vapour)}}{mc\Delta T} = -\underset{\text{(Al)}}{mc\Delta T}$$

$$(5)(4200)(100-85) + (5)(2\,300\,000) + 5(2000)(110-100)$$

$$= -m(910)(110-600)$$

varies depending on soure of data

$$315\,000 + 115000 + 100\,000 = -(910)(-490)m$$

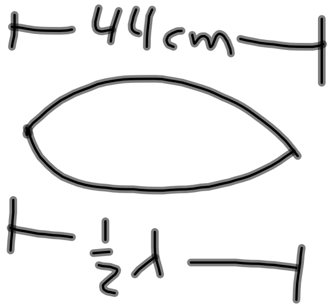
$$m = 26.7\text{ kg}$$

10) $^{237}_{92}U \rightarrow {}^{4}_{2}He + {}^{233}_{90}Th$

$^{3}_{2}He \rightarrow {}^{3}_{3}Li + {}^{0}_{-1}e + \bar{\nu}$ (β^-)

$^{3}_{2}He \rightarrow {}^{3}_{1}H + {}^{0}_{+1}e + \nu$ (β^+)

11)



$\lambda = 2(0.44)$
$= 0.88\text{ m}$
$v = 245\ \frac{m}{s}$

$f = \frac{v}{\lambda}$
$= 278\text{ Hz}$

In air....
$f = 278\text{ Hz}$
$v = 332 + 0.59T$
$= 343.8\ \frac{m}{s}$

$\lambda = \frac{v}{f}$
$= 1.24\text{ m}$

12) a) When a magnetic field changes near a conducting wire, an induced current will be created in the wire

b) KCL → the current entering a point must equal the current leaving it.

KVL → the voltage gained in any full path of a circuit must equal the voltage lost

c) The induced current (see a)) will flow in such a way that it will oppose the motion of the changing magnetic field

d) N1L: An object maintains its velocity unless acted upon by an external, unbalanced force

N2L: When a net force is applied, the object will accelerate in the direction of the net force. The acceleration is proportional to the force, and inversely proportional to the object's mass

N3L: If 'A' exerts a force on 'B', the 'B' exerts a force on 'A' that is equal in magnitude but opposite in direction

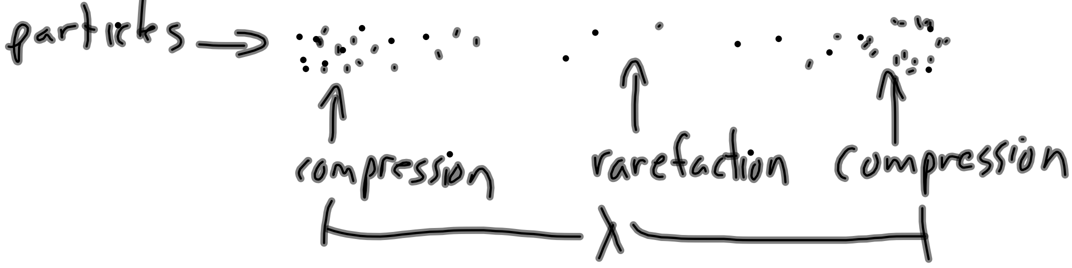
e) When a current is present in a conductor, a magnetic field will be produced around the conductor

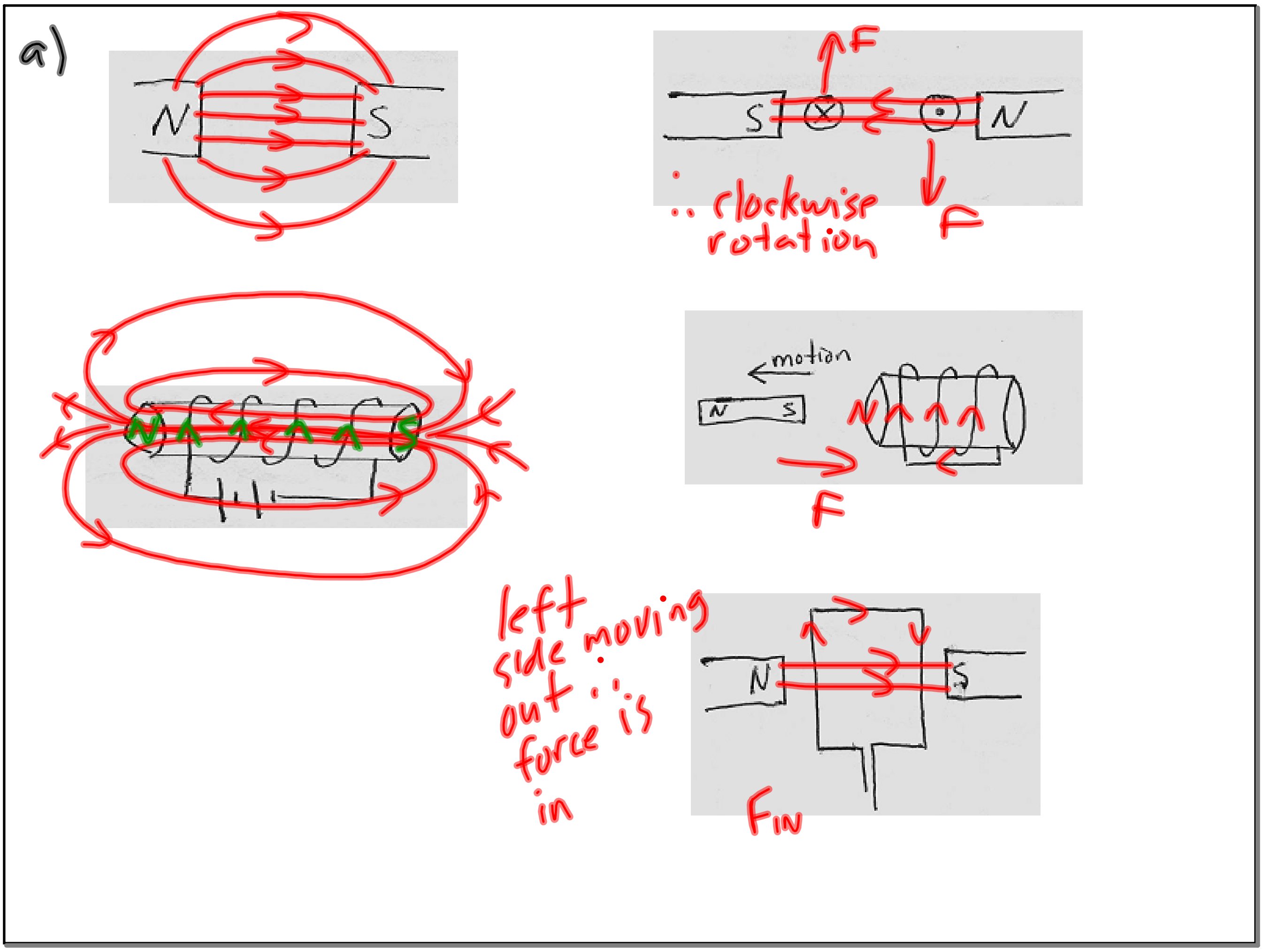
13) a) a fluid-filled, spiral-shaped sac in the inner ear filled with tens of 1000s of tiny hairs called cilia. Each cilia responds to a particular frequency, which allows us to distinguish frequencies

b) a region in which a force may be exerted

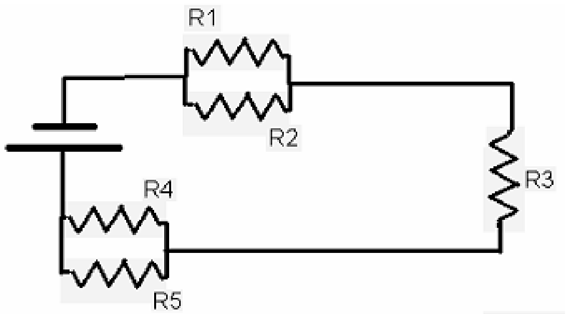
c) frequencies below the threshold of human hearing

d) area of low pressure/particle density in a longitudinal wave




a)
N
S
F
S
N
F
∴ clockwise rotation
motion
N
S
N
F
N
S
left side moving out ∴ force is in
N
S
F IN

VT = 60 V	V1 = 25 V	V2 = 25 V	V3 = 20.64	V4 = 14.36	V5 = 14.36
IT = 1.2 A	I1 = 0.7 A	I2 = 0.5 A	I3 = 1.2	I4 = 0.718 A	I5 = 0.479 A
RT = 50 Ω	R1 = 35.7 Ω	R2 = 50 Ω	R3 = 17.2 Ω	R4 = 20 Ω	R5 = 30 Ω



① $V_1 = V_2$

$\therefore V_2 = 25\,V$

② $I_2 = \frac{V_2}{R_2}$

$= 0.5\,A$

③ $I_T = I_1 + I_2$

$\therefore I_1 = 1.2 - 0.5$

$= 0.7\,A$

④ $R_1 = \frac{V_1}{I_1} = \frac{25}{0.7} = 35.7\,\Omega$

⑤ $\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{1}{35.7} + \frac{1}{50}$

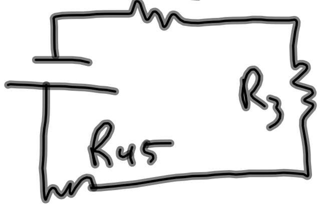
$R_{12} = 20.8\,\Omega$

$\frac{1}{R_{45}} = \frac{1}{R_4} + \frac{1}{R_5}$

$= \frac{1}{20} + \frac{1}{30}$

$= \frac{3}{60} + \frac{2}{60}$

$R_{45} = 12\,\Omega$



$R_T = R_{12} + R_3 + R_{45}$

$= 50\,\Omega$

⑥ $V_T = I_T R_T$

$= (1.2)(50)$

$= 60\,V$

⑦ $I_3 = I_T$

$= 1.2\,A$

⑧ $V_3 = I_3 R_3$

$= (1.2)(17.2)$

$= 20.64$

⑨ $V_T = V_1 + V_3 + V_4$ or V_5

$\therefore V_4 = 60 - 20.64 - 25$

$= 14.36$

⑩ $I_4 = \frac{V_4}{R_4}$

$= \frac{14.36}{20}$

$= 0.718$

& $I_5 = \frac{V_5}{R_5}$

$= \frac{14.36}{30}$

$= 0.479$

Check

$I_4 + I_5 = 1.197\,A$

$\sim 1.2\,A$

$\sim I_T$ ✓