TSFX TRIAL EXAMINATION 2018

VCE PHYSICS UNIT 3 & 4

SOLUTIONS

SECTION A – MULTIPLE CHOICE QUESTIONS

Question 1	A	**B**	C	D
Question 2	A	B	**C**	D
Question 3	A	**B**	C	D
Question 4	A	B	C	**D**
Question 5	**A**	B	C	D
Question 6	A	B	**C**	D
Question 7	A	**B**	C	D
Question 8	A	B	C	**D**
Question 9	**A**	B	C	D
Question 10	A	B	C	**D**
Question 11	A	**B**	C	D
Question 12	A	**B**	C	D
Question 13	A	B	**C**	D
Question 14	**A**	B	C	D
Question 15	A	**B**	C	D
Question 16	A	B	C	**D**
Question 17	A	B	C	**D**
Question 18	**A**	B	C	D
Question 19	A	B	C	**D**
Question 20	**A**	B	C	D

SECTION B – SHORT ANSWER QUESTIONS

QUESTION 1

F = nILB
F = 1 X 5 X .2 X .25
F = 0.25 N

QUESTION 2

a. $E = \frac{V}{d} = \frac{800}{.05} = 16000\ Vm^{-1}$

b. F=Eq

$F = 16000 \text{ X } 2 \text{ X } 1.6 \text{ X } 10^{-19}$

$F = 5.12 \text{ X } 10^{-15}$ N   This is the weight

$\text{Mass} = \frac{5.12 \text{ X } 10^{-15}}{9.8} = 5.2 \text{ X } 10^{-16}$ Kg

c. The top plate is positive. The Electric Field is downwards and the force on the electron is upwards.

QUESTION 3

a. $g = \frac{GM}{R^2}$

$g = \frac{6.67 \text{ X } 10^{-11} \text{ X } 5.8 \text{ X } 10^{21}}{(3.1 \text{ X } 10^5)^2} = 4.03\ NKg^{-1} \text{ or } ms^{-2}$

b. $R = \sqrt[3]{\frac{GMT^2}{4\pi^2}}$

$R = \sqrt[3]{\frac{6.67 \text{ X } 10^{-11} \text{ X } 5.8 \text{ X } 10^{21}\ (8 \text{ x } 24 \text{ X } 60 \text{ x } 60)^2}{4\pi^2}}$

$R = 1.67 \text{ X } 10^7$ m

QUESTION 4

a. (i) P=IV
400 = I X 250
I = 16A

(ii) V_{loss} = IR
V_{loss} = 16 X 8 = 128V
V_{house} = 250 – 128 = 122V

b. Gamma is correct.

A step-up transformer at the start reduces current and increases voltage at the same power. This reduces line losses which are calculated from: $P_{loss} = I^2R$
The step-down transformer at the end reduces the voltage to the correct level for the house.

c. (i) 4000W Power in = Power out

(ii) $\frac{V_1}{V_2} = \frac{N_1}{N_2}$

$\frac{250}{V_2} = \frac{100}{800}$

$V_2 = 250 \text{ X } 8 = 2000V$

(iii) $I = 16 \div 8 = 2A$

$P_{loss} = I^2R$

$P_{loss} = 2^2 \text{ X } 8 = 32$ W

(iv) V_{out} of T1 = 2000V

$V_{loss} = IR = 2 \text{ X } 8 = 16V$

V_{into} T2 = 2000-16 = 1984V

V_{out} of T2 = $\frac{1984}{8}$ = 248V

d. Transformers do not work with DC currents. Transformers use the change of flux from the AC current to induce the current in the secondary turns.

QUESTION 5

a. The commutator changes contact to the other side of the coil every ½ turn at the zero current (maximum flux) point. This allows the current to flow out of the generator in the same direction. This creates the DC output.

b. C DC generator so current flows in one direction only

c. $\xi = \frac{n\Delta\emptyset}{\Delta t}$

$T = \frac{1}{100} = 0.01s$ $\frac{T}{4} = \frac{0.01}{4} = 0.0025s$

$\xi = \frac{8 \text{ X } 0.6 \text{ X } 20 \text{ X } 10^{-4}}{0.0025} = 3.84$ V

QUESTION 6

a. $u = 6ms^{-1}$
$v = 64ms^{-1}$
$s = 120m$
$a = ?$

$v^2 = u^2 + 2as$
$64^2 = 6^2 + 2 X a X 120$
$a = 16.9ms^{-2}$

b. $u = 6ms^{-1}$
$v = 64ms^{-1}$
$s = 120m$
$t = ?$

$s = ½(u + v)t$
$120 = .5(6 + 64) X t$
$t = 3.43 s$

QUESTION 7

a. $\Sigma F = \text{Applied force} - \text{friction}$
ma = Applied force – (120 + 90)
Applied force = 2000 X 1.2 + 210
Applied force = 2610N

b. Applied force = tension in tow bar = $\Sigma F + \text{friction}$ $\Sigma F = 800 X 1.2 = 960N$
Applied force = 960 + 90 = 1050N

QUESTION 8

a. Vertical calculation $U_v = 113.16 X \sin 60^0 = 98.0ms^{-1}$
$u = 98.0ms^{-1}$
$v = 0$
$a = -9.8ms^{-2}$
$s = ?$

$v^2 = u^2 + 2as$
$0 = 98^2 + 2 X -9.8 X s$
$s = 490m$

b. Find the time:

$U_v = 98ms^{-1}$
$V = -98ms^{-1}$
$a = -9.8ms^{-2}$
$t = ?$

v = u + at
-98 = 98 – 9.8t
t = 20s

Range = Uh X time
Range = 113.16 X Cos 60 X 20
Range = 1131.6m

c. Find the time to impact:

$$t = \frac{800}{113.16\cos 60} = 14.1s$$

Find the height:

$U = 98ms^{-1}$
$a = -9.8ms^{-2}$
t = 14.1s
s = ?

$s = ut + 1/2at^2$

$s = 98 X 14.1 – ½ X 9.8 X 14.1^2$

s = 407.63m

QUESTION 9

a. $m_1v_1 + m_2v_2 = (m_1 + m_2)v_3$

$0.13 X 40 + 0.4 X 0 = (0.13 + 0.4)v_3$

$$v3 = \frac{0.13 X 40}{0.53} = 9.8ms^{-1}$$

b.

Eki	Ekf
$= 1/2mv^2$	$=1/2mv^2$
$= 0.5 X 0.13 X 40^2$	$= 0.5 X 0.53 X 9.8^2$
= 104J	= 25.5J

Kinetic energy is lost so the collision is inelastic.

QUESTION 10

a. Ekx = Ekw + Gravitational potential change (w-x)

$1/2mv^2 = 1/2mv^2 + mgh$

Cross out m as common:

$0.5 X v^2 = 0.5 X 12^2 + 9.8 X 30$
$v = 27.1ms^{-1}$

b. The total energy is constant.
Kinetic energy at x is the kinetic energy at w plus the converting of gravitational potential energy added to the height change from w to x.

c. $F_{circular}$ (resultant) = Weight – Reaction

Reaction = Weight – Fc

Reaction = 320 X 9.8 – $\frac{320 X 10^2}{15}$

Reaction = 3126 – 2133.3

Reaction = 992.7N

QUESTION 11

$L = \frac{L_0}{\Upsilon}$

$L = L_0 \sqrt[2]{1 - \frac{v^2}{c^2}}$

$L = 64 X \sqrt[2]{1 - 0.92^2}$

L = 25.1m

QUESTION 12

The electrons and the X-rays must have the same wavelength/momentum.

QUESTION 13

a. The lowest frequency corresponds to the lowest energy gap – level 3 to level 2.

Energy gap = 6.2 – 4.5 = 1.7eV

E = hf

$f = \frac{E}{h}$

$f = \frac{1.7}{4.14 X 10^{-14}} = 4.1 X 10^{14}$ Hz

b. The only energy levels available are those that correspond to standing wave patterns of the electron around the nucleus. The orbit must have a whole number of the electron's DeBroglie wavelengths matching the circumference of the orbit.

QUESTION 14

a. f_0 = the intersection on the frequency axis = 3 X 10^{14} Hz

b. Ek_{max} = hf – w

When Ekmax = 0W=hf_0 = 4.14 X 10^{-15} X 3 X 10^{14} = 1.24 eV or 2.0 X 10^{-19}J

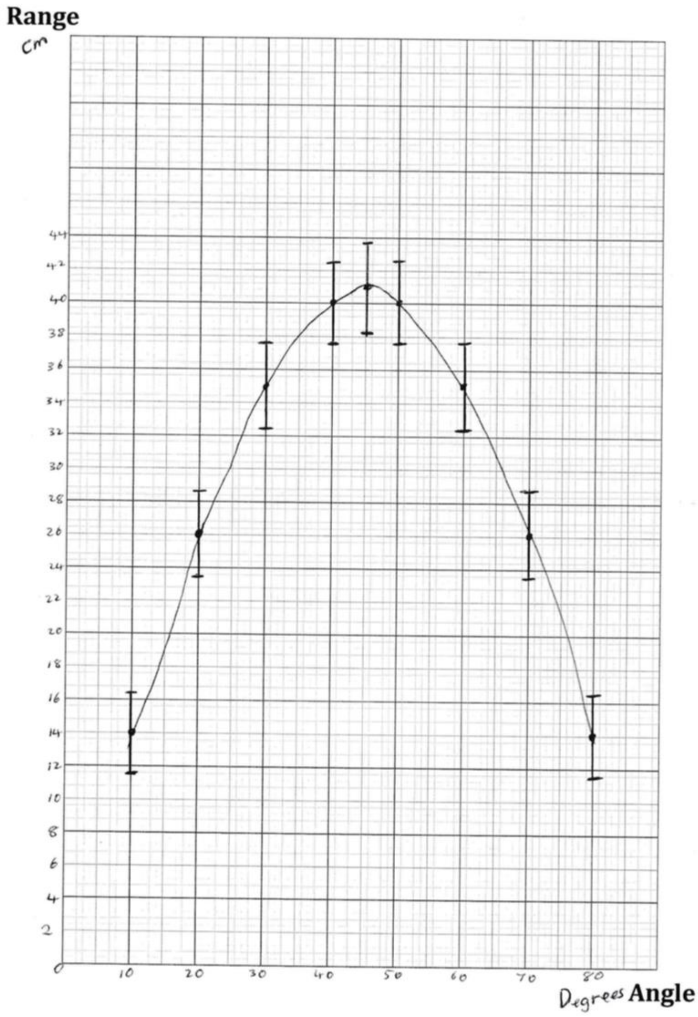
c. Any line that is parallel to the first line and cuts the frequency axis between 0 and 3. It is parallel because all line must have the same gradient of h.

QUESTION 15

a.

Controlled variable	Launch speed or mass
Independent variable	Angle of projection
Dependent variable	Range

b.



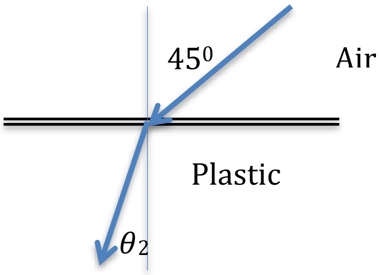
c. There is an ideal angle of 45^0 for maximum range.

QUESTION 16

It is the second harmonic. You know it because it has half the wavelength and double the frequency of the first harmonic. The second harmonic is always one whole wavelength.

QUESTION 17

a.



b. $n_1\sin\theta_1 = n_2\sin\theta_2$

$1 \text{ X } \sin45^0 = 1.6\sin\theta_2$

$\theta_2 = 26.2^0$

QUESTION 18

$n_1 = 1.4 \quad n_2 = 1.0 \quad \theta_2 = 90^0 \qquad \theta_c = ?$

$n_1\sin\theta_c = n_2\sin\theta_2$

$1.4 \text{ X } \sin\theta_{1c} = 1 \text{ X } 1$

$\sin\theta_c = \frac{1}{1.4}$

$\theta_c = 45.6^0$

QUESTION 19

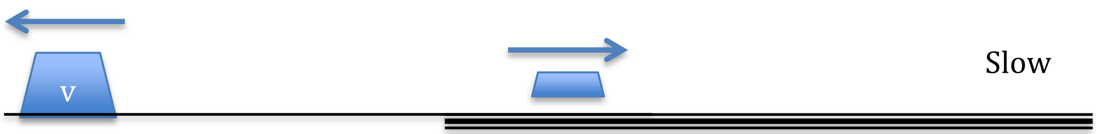
Nodal points are the results of destructive interference. This is when a crest from one source meets a trough from the other source. At a nodal point the path difference from the sources is a multiple of $\frac{n\lambda}{2}$.

QUESTION 20

a. Less spread
b. More spread

QUESTION 21

Fast



Slow

QUESTION 22

a. $v = f\lambda$

$3 \times 10^8 = 2.5 \times 10^9 \times \lambda$

$\lambda = 0.12m$

b. Yes, significant diffraction will occur.

c. The wavelength and the gap are similar size so significant diffraction will occur.

$\frac{\lambda}{w} \geq 1.$

QUESTION 23

$$\Delta x \Delta p \geq \frac{h}{2\pi}$$

As Δx (width) is reduced the uncertainty in Δp is increased. This means that the path of the electrons after the gap is more spread (unpredictable).