TSFX TRIAL EXAMINATION 2020

VCE PHYSICS UNIT 3 & 4

SOLUTIONS

Errors and updates relating to this examination paper will be posted at www.tsfx.edu.au/examupdates

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 (3 marks)

The electron bends out of the page. Use the right hand force rule. Magnetic field down, current left, so force is out

QUESTION 2 (6 marks)

a. E = $\frac{kq}{r^2}$

E = $\frac{8.99 \times 10^9 \times 5.3 \times 10^{-5}}{0.2^2}$

E = $1.19 \times 10^7 = 1.2 \times 10^7$ Right (to 2 sig figs)

b. Double the distance, so one-quarter the effect in the opposite direction.

Result = ¾ x $1.19 \times 10^7 = 8.9 \times 10^6$ Right

The effects can also be calculated and subtracted.

QUESTION 3 (4 marks)

a. Read from the graph = 4.0 N kg^{-1}

b. Energy gained = Area under graph X mass

Each square = 1×10^6 Joules. There are 16.5 squares.

Energy = $16.5 \times 1 \times 10^6 \times 240 = 4.0 \times 10^9$ Joules

QUESTION 4 (7 marks)

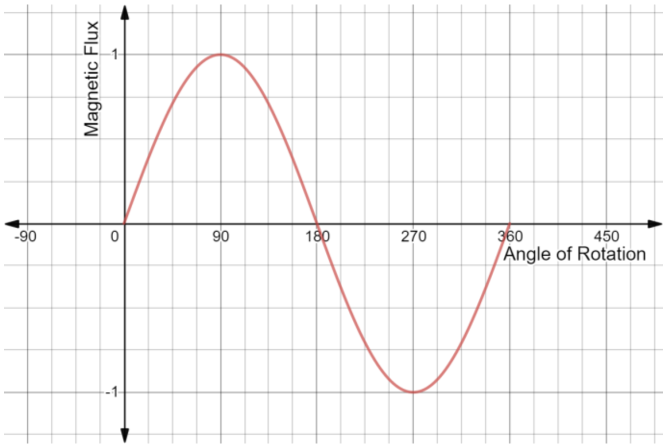
a. The split-ring commutator reverses the connection to the coil every ½ turn at the position where the force has the minimum turning effect. This keeps the force in the same direction and allows the motor to keep turning.

b. Zero force and no direction. The current is parallel to the magnetic field.

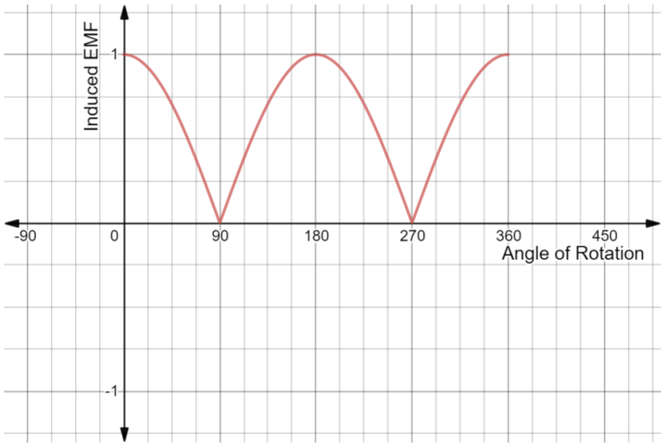
c. F = nILB = 8 x 2.4 x .06 x .7 = 0.81 N Down

QUESTION 5 (9 marks)

a. Value on the Flux axis does not matter. Maximum values must be equal.



b. Maximum values must be equal. The inverse graph is also acceptable.



c. The split-ring commutator swaps the connection between the coil and the output every ½ turn. It swaps at the maximum flux position. This allows the current to keep flowing out of the generator in the same direction – DC.

d. $T = \frac{1}{f} = \frac{1}{8} = 0.125$ s

$\frac{1}{4}T = \frac{0.125}{4} = .03125$ s

$EMF = \frac{n\Delta\Phi}{\Delta t} = \frac{6 \times .6 \times .06 \times .06}{.03125} = 0.41$ V

QUESTION 6 (3 marks)

Increasing primary flux down. To oppose the change (Lenz's Law) there is an induced secondary flux upwards. Apply the Right Hand Screw Rule to the secondary flux and find that an anticlockwise current (viewed from above) is created in the coil.

QUESTION 7 (9 marks)

a. $P = IV$

$1500 = I \times 250$

$I = 6.0$ A

b. $P_{generator} = P_{loss} + 1500$

$Pg = I^2R + 1500 = 6^2 \times 8 + 1500 = 288 + 1500 = 1788$ W

c. No, this increases the power losses.

With a 2:1 step down transformer the voltage is halved and the current is doubled. (12 A)

$P_{loss} = I^2R = 12^2 \times 8 = 1152$ W

Accept a complete argument without calculations.

d. Current at the light = 6A. With a 4:1 step-down transformer at the light the current in the lines is now 1.5 A.

$P_{loss} = I^2R = 1.5^2 \times 8 = 18$ W

QUESTION 8 (4 marks)

a. $u = 0$, $v = 8$, $t = 4$, $a = ?$

$v = u + at$

$8 = 0 + 4 \times a$

$a = 2\ m\ s^{-2}$

$\sum F = ma = 0.8 \times 2 = 1.6$ N

b. $\sum F = ma$

$-1.2 = .8 \times a$

$a = -1.5\ ms^{-2}$

$u = 8$, $v = 0$, $s = ?$, $a = -1.5$

$v^2 = u^2 + 2as$

$0 = 8^2 - 2 \times -1.5 \times s$

$s = 21$ m

Could also use Kinetic energy = work done to stop the car.

QUESTION 9 (2 marks)

Reaction = mg – $\frac{mv^2}{r}$

100 = 70 x 9.8 – $\frac{70v^2}{90}$

v = 27.4 ms^{-1}

QUESTION 10 (8 marks)

a. $m_1v_1 + m_2v_2 + m_1v_3 + m_2v_4$

$4.5 \times 10^3 \times 6 + 0 = 4.5 \times 10^3 \times -2 + 20 \times 10^3 \times v_4$

v_4 = 1.8 ms^{-1} east

b. Impulse = mΔv = $4.5 \times 10^3 \times -8 = 3.6 \times 10^4$ $kgms^{-1}$ (or NS) West

c. Initial kinetic energy = ½ mv^2 = $.5 \times 4.5 \times 10^3 \times 6^2$ = 81000 Joules

Final kinetic energy = $.5 \times 4.5 \times 10^3 \times 2^2 + .5 \times 20 \times 10^3 \times 1.82$ = 41400 Joules

Because kinetic energy is lost the collision is inelastic.

QUESTION 11 (5 marks)

a. Uv = $42\sin27^0$ = 19.1
v = 0
a = –9.8
s = ?
$v^2 = u^2 + 2as$
$0 = 19.1^2 - 2 \times 9.8 \times s$
s = 18.5 m

b. Time to hit:

Uh = 42cos27
s = 100

t = $\frac{d}{v} = \frac{100}{42\cos27}$ = 2.67 s

Height:

u = 19.1
t = 2.67
a = –9.8
s = ?

s = ut + 1/2 at^2 = $19.1 \times 2.67 - .5 \times 9.8 \times 2.67^2$ = 16.1 m above the ground

QUESTION 12 (4 marks)

a. This is the proper length. It is at rest in the frame of reference in which the measurement was made.

b. L $= \frac{L_0}{\gamma}$

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1}{\sqrt{1-\frac{.97^2c^2}{c^2}}} = 4.1$$

L $= \frac{L_0}{\gamma}$ $= \frac{1.5}{4.1} = 0.37$ m

QUESTION 13 (7 marks)

a. Us = ½ kx^2 = .5 X 500 X .04^2 = 0.4 Joules

b. Ek = Us

½ mv^2 = 0.4
.5 x .08 x v^2 = 0.4
v = 3.2 ms^{-1}

c. Ek top = Ek bottom – Ug top

Ek top = ½ mv^2 – mgh
Ek top = .5 x 0.08 x 3^2 – 0.08 x 9.8 x 0.42
Ek top = .36 – .33 = 0.03 Joules left at the top. It makes it over the hill

QUESTION 14 (4 marks)

a. There are 2 forces. Weight straight down from the ball and tension up along the string from the ball.

b. T cos 30^0 = mg

T cos 30^0 = 2.2 x 9.8

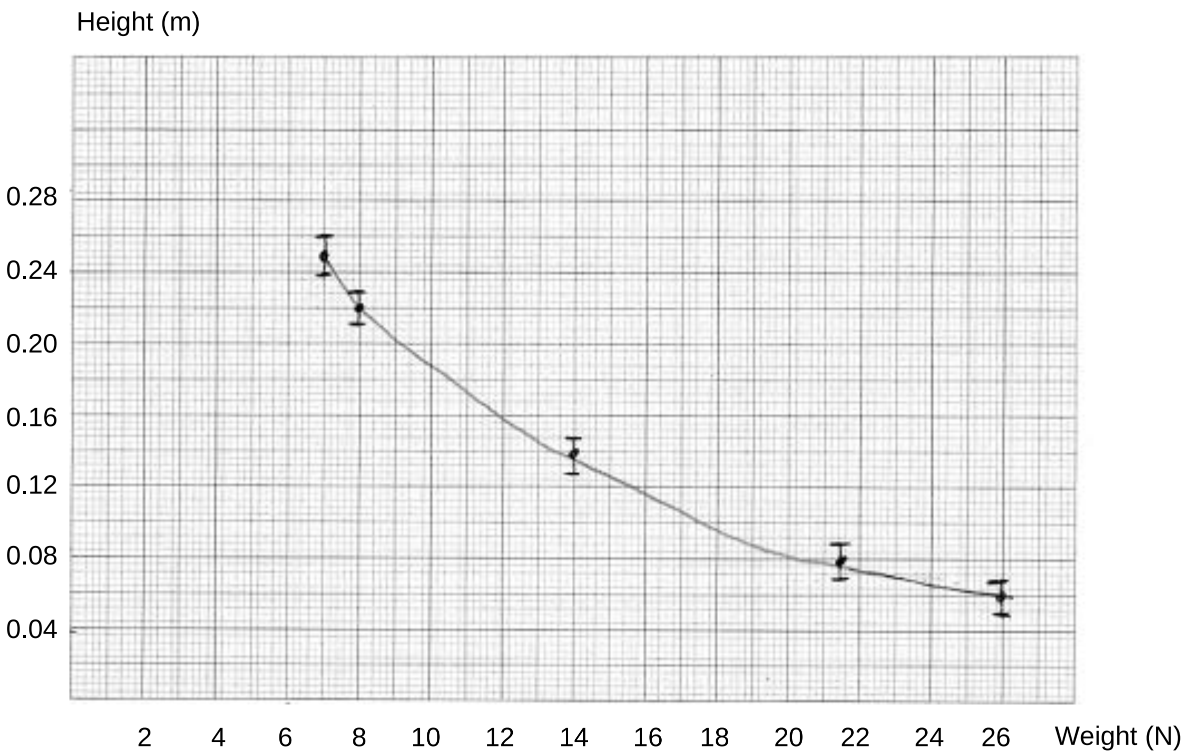
T = 25 N

QUESTION 15 (9 marks)

a.

Controlled Variable	Balloon type, or starting diameter, or starting inflation
Independent Variable	Weight
Dependent Variable	Height

b. Plot points = 2 marks
Axes labelled = 1 mark
Appropriate scale = 1 mark
Uncertainty bars = 1 mark
Curve of best fit through uncertainty bars = 1 mark



QUESTION 16 (6 marks)

a. v = fλ

340 = 680 x λ

$\lambda = 0.5\ m$

b. X will have a higher intensity than the nearby points (i.e. a local maximum). It occurs because there is zero path difference. So constructive interference occurs.

c. $\Delta x = \frac{\lambda L}{d} = \frac{.5 \times 12}{2}$ = 3.0 m

3.0 m between maxima. The second minimum is 1.5 fringe spacing's from the centre = 4.5 m.

QUESTION 17 (4 marks)

a. Young's experiment created an interference pattern with light. Only waves can create an interference pattern, so light must be demonstrating wave properties.

b. The photoelectric effect can only be explained by the impact of particles. Light must be acting as particles. Thus light can be both a wave and a particle

QUESTION 18 (7 marks)

a. P = mv

= $9.1 \times 10^{-31} \times 5.7 \times 10^{6}$

= 5.2×10^{-24} $kgms^{-1}$

b. Photons and electrons have the same momentum for the same pattern.

p = $\frac{hf}{c}$

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

$= \frac{5.187 \times 10^{-24} \times 3 \times 10^{8}}{6.63 \times 10^{-34}}$

= 2.3×10^{18} Hz

c. Spread $\propto \frac{\lambda}{d}$

Increase d, decrease the spread.

QUESTION 19 (5 marks)

a. 2.9 eV, 1.6 eV, 1.3 eV

b. $\lambda = \frac{hc}{E}$

$= \frac{4.14 \times 10^{-15} \times 3 \times 10^{8}}{1.3}$

= 9.6×10^{-7} m

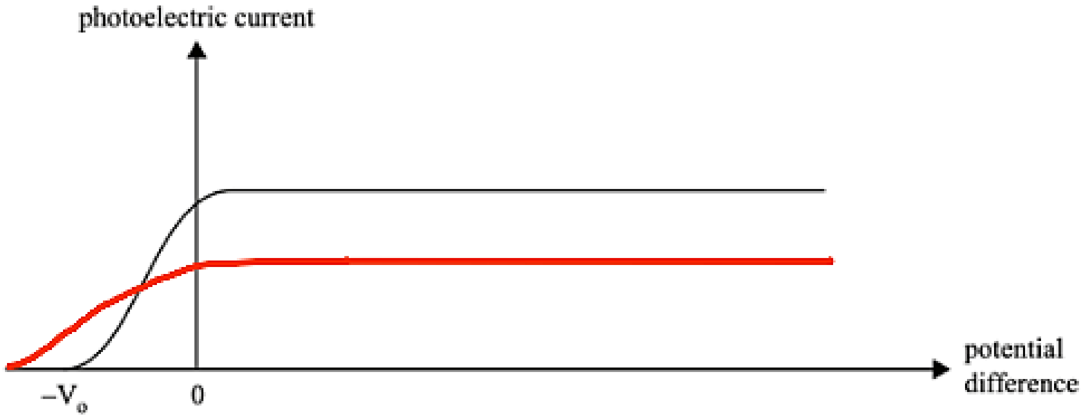
QUESTION 20 (4 marks)

a. $V = h \times \Delta f$

$V = 4.14 \times 10^{-15} \times (5.5–4.2) \times 10^{14}$

$V = 0.54$ V

b.



Horizontal intercept must be to the left of the original graph (due to higher cut-off potential caused by shorter wavelength/higher frequency light). Saturation current must be less than the original graph (due to reduced intensity).