Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Electricity

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Exam Preparation and Free Resources

Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) correct general shape ✔

accurate plotting to within $\frac{1}{2}$ square ✔

2

(b) 12 (V) ✔, 30 (W) ✔

2

(c) R = $\left(\frac{6}{1.9}\right)$ = 3.2 (Ω) ✔

1

(d) Resistance increases ✔

Temperature increases ✔

More collisions / interaction of electrons with lattice ions ✔

Condone 'atoms', 'molecule'.
*Do **not** allow electron−electron collisions.*

3

(e) Can attain neither maximum nor minimum voltage ✔

Explanation of either maximum OR minimum ✔

2

[10]

Q2.

(a) peak (to peak) voltage = 6.3(0) (V) ✔

accept any answer that rounds to 6.3 V
do not allow power of ten errors, eg 0.0063 V

1

(b) period = 8 divisions

(= 8 × 0.5 × 10^{-3} (s))

= 4 ms $_1$ ✔

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$\left(f = \frac{1}{T} = \frac{1}{0.004}\right)$

= 250 (Hz) $_2$ ✔

award both marks if 250 Hz seen

accept 4.0(0) ms for $_1$ ✔ but reject 4.05, 3.95 etc

ecf$_2$ ✔ for wrong period

2

(c) any valid approach leading to *RC* in range

2.1×10^{-4} to 3.4×10^{-4} or 3×10^{-4} (s)

OR

their *T* in 02.2 × 0.069 ± 10 % $_{12}$ ✔ ✔

1 mark can be awarded for use of any valid approach in which *RC* is seen with substitutions or with rearranged equations, eg

$0.5 = 6.3e^{\frac{-6\times10^{-5}}{RC}}$ or $RC = \frac{-t}{\ln\left(\frac{V}{V_0}\right)}$ or

$RC = \frac{t}{\ln\left(\frac{V_0}{V}\right)}$

OR

$1.75 \times 10^{-4} = RC \times \ln 2$

OR

$RC = \frac{t_{0.5}}{\ln(2)}$

valid approaches;

reads off t when C starts to discharge and t at a lower value of V:

$V = V_0 e^{\frac{-\Delta t}{RC}}$

rearranges to calculate RC

for ecf $_2$ ✔ Δt used must correspond to interpretation of time base used in determining the frequency in (b); there is no ecf for misinterpretation of the voltage scale

OR

reads off t when C starts to charge and t at a higher value of V:

$V = V_0\left(1 - e^{\frac{-\Delta t}{RC}}\right)$

rearranges to calculate RC etc

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OR

determines half-life $t_{0.5}$ and finds RC from $\frac{t_{0.5}}{\ln(2)}$

for ecf $_2$ ✔ *$t_{0.5}$ used must correspond to etc*

OR

uses idea that during discharge V falls to $0.37V_0$ in one time constant: determines suitable V and reads off RC directly

for ecf $_2$ ✔ *time interval used must correspond to etc*

OR

uses idea that during charging V rises to $0.63V_0$ in one time constant: determines suitable V and reads off RC directly

reject idea that V falls to zero in 5RC

2

(d) qualitative comment

idea that the waveform will stretch horizontally $_1$ ✔

quantitative comment

by a factor of $\left(\frac{0.5}{0.2} = \right) 2.5_2$ ✔

OR

half a cycle now covers 10 (horizontal) divisions on the screen $_2$ ✔
(and also earns $_1$ ✔)

(so the) <u>resolution</u> of the time axis has <u>increased</u> $_3$ ✔ (and also earns $_1$ ✔)

measuring <u>larger distance</u> / across <u>more divisions</u> from the screen <u>reduces</u> (percentage) <u>uncertainty</u> in reading the <u>time</u> (constant / interval / half life) $_4$ ✔

for $_1$ ✔ *look for reference to time axis or direction waveform is re-scaled*

accept 'graph is longer/stretched' or '<u>will</u> not see whole cycle' or 'fewer cycles shown' or 'period takes <u>more space</u>' or 'distance being measured is larger' or 'time per division is less' or 'larger in x direction' or 'time is stretched'

reject 'waveform becomes <u>larger</u>' or '<u>may</u> not see whole cycle' or 'measuring larger <u>time</u>'

for $_2$ ✔ *there needs to be valid quantitative detail*

award $_{12}$ ✔ ✔ *for '<u>half</u> a cycle now <u>fills the screen</u>' or '<u>half</u> a cycle is displayed' as these clearly recognise the stretching is along the time axis and 'half' is quantitative*

accept 'new distance (on screen corresponding to half life or time constant) is <u>2.5</u> × answer shown in working for (c)'

the candidate who realises that half a wave now covers the complete width of the screen cannot claim this is a disadvantage; they would still be able to bring either half cycle into view by using the X-shift and find RC for $_3$ ✔ *uses technical language correctly*

ignore (but do not penalise) 'times are more precise' or 'more accurate'

reject 'smaller resolution' or 'lower resolution'

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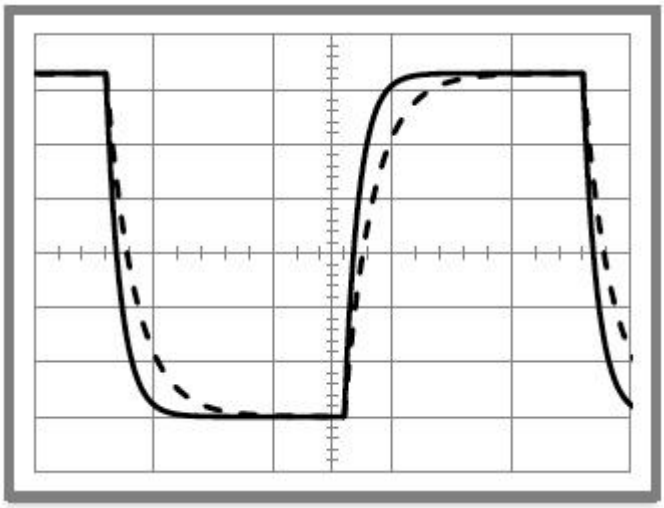
for 4 ✔ there needs to be a qualifying explanation for the comment about uncertainty

reject 'advantage because the (time) scale is easier to read'

3 MAX

(e) valid sketch on **Figure 7** showing discharge time <u>to 0 V reduced</u> and charging time <u>to peak voltage reduced</u> (see below) $_1$ ✔

connecting resistor in parallel with R <u>halves</u> [reduces by <u>50%</u>] circuit [total] resistance [time constant] $_2$ ✔



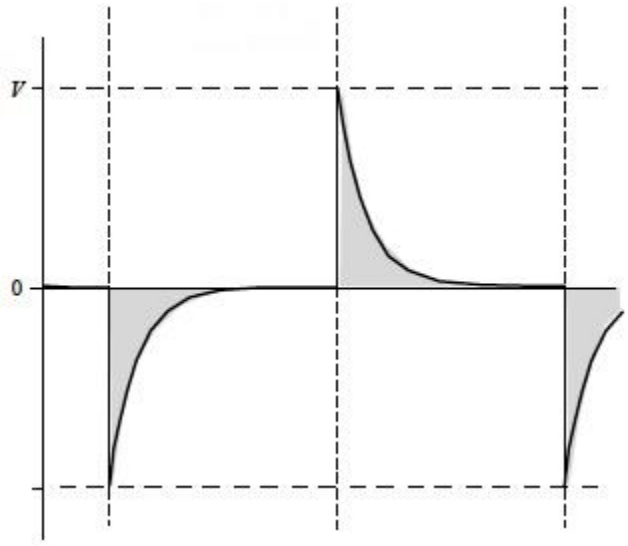
do not insist on seeing second discharge although if shown this must look correct

2

(f) amendment to **Figure 8** showing waveform across R with approximately the correct shape, amplitude ± *V* and the correct phase

correct waveform shown while signal generator output is low (0 V): only the complete negative half cycle needs to be shown but if second negative half cycle is included it must be correct $_1$ ✔

correct waveform shown while voltage across signal generator output is high; condone no signal or signal = 0 V before going to –V for the first time $_2$ ✔



don't insist on seeing vertical lines

2

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(g) reduce the (sensitivity of) (Y-voltage)) gain $_1$ ✔

(change) to 2 V division^{-1} $_2$ ✔ (and earns $_1$ ✔)

adjust the Y (vertical) shift $_3$ ✔

'make (Y-) gain smaller' or 'increase the volts per division' or 'reduce the Y-resolution' are acceptable substitutes for 'reduce the (Y-)gain'

increase the (Y-) gain to 2 V division^{-1} $_2$ ✔ not $_1$ ✔

reduce the (Y-) gain to 0.5 V division^{-1} $_1$ ✔ not $_2$ ✔

ignore any comment about time base or 'X-gain'

if all positive waveform is given for (f) allow sensible comment about triggering/stability control, eg

waveform may not be stable $_1$ ✔ ; adjust triggering $_2$ ✔

2 MAX

[14]

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