Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section B (Section 13_ Electronics)

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Name of the Student:____
Max. Marks : 23 Marks **Time : 23 Minutes**

Mark Schemes

Q1.

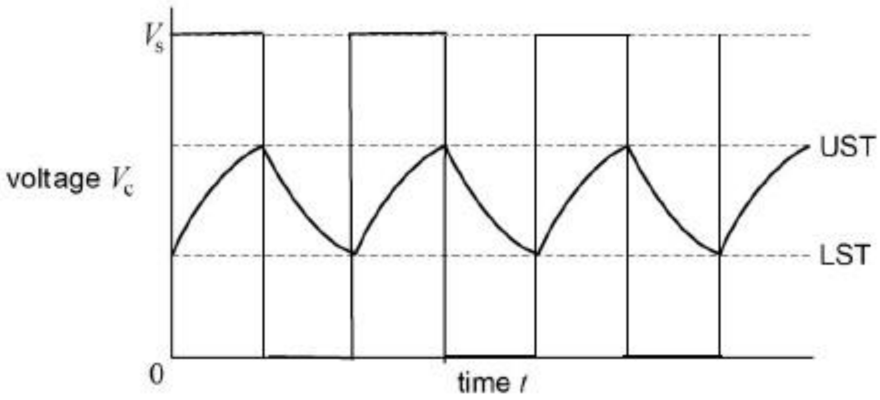
(a) PRF = 1 / (1.4 RC)

$= 1 / (1.4 \times 5.1 \times 10^3 \times 10 \times 10^{-9})$

14 kHz ✔

1

(b) Square wave with correct phase and amplitude ✔



1

(c) New resistor calculated and stated to be 1.7 kΩ ✔

New resistor placed in parallel with original resistor ✔

Ecf from part (a)

2

(d) $T = \frac{1}{f} = \frac{1}{5 \times 10^3}$ = 0.2 ms (200 μs)

$t_C = 0.2 \times 10^{-3} \times \frac{3}{4}$ = 150 μs

$t_D = 0.2 \times 10^{-3} \times \frac{1}{4}$ = 50 μs

$R_2 = \frac{t_D}{0.7 \times C} = \frac{50 \times 10^{-6}}{0.7 \times 10 \times 10^{-9}}$ = 7.1 kΩ (Accept 7kΩ)

$R_1 = \frac{t_C}{\quad} - R2 = 14.3\ k\Omega$ (Accept 14kΩ)

1 mark for significant calculation

Eg showing $R_1 = 2R_2$

OR

Calculation for t_C or t_D

1 mark for values of R_1 and R_2

2

(e) Two properties per mark – (max mark 2)✔✔

- A square wave
- Amplitude of 0 V to 5 V
- Periodic time of 0.2 ms
- High for 0.15 ms – Low for 0.05 ms

2

[8]

Q2.

(a) **D** ✔

1

(b) **A** ✔

1

(c) One of: ✔

Attenuation of e-m wave across transmission path

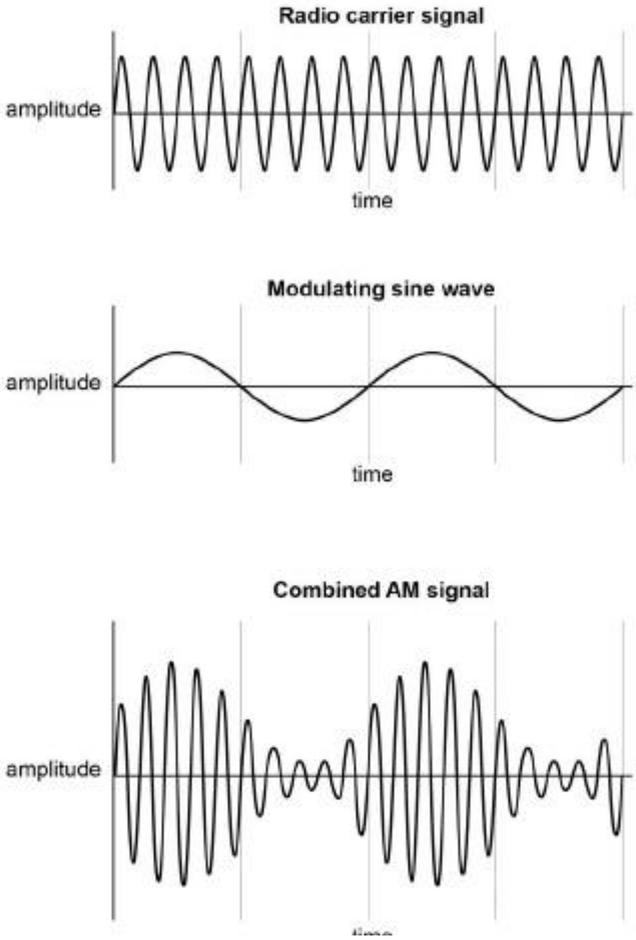
Small fraction of radiated energy in direction of receiver

Energy loss due to reflection from ground / natural topography / absorption in atmosphere

Accept any other reasonable response

1

(d)



Correct relative positions of envelope max – min on AM and an attempt made to keep carrier frequency constant ✔

Modulating signal forms envelope around carrier

1

(e) About 55 stations can be picked up in London

- A full audio frequency of 20 kHz would require a bandwidth of 40 kHz for each station ✔
- 55 × 40 kHz = 2200 kHz. This is twice as much as waveband available ✔ so stations would have to overlap leading to crosstalk / interference ✔

Accept equivalent arguments / calculations

3

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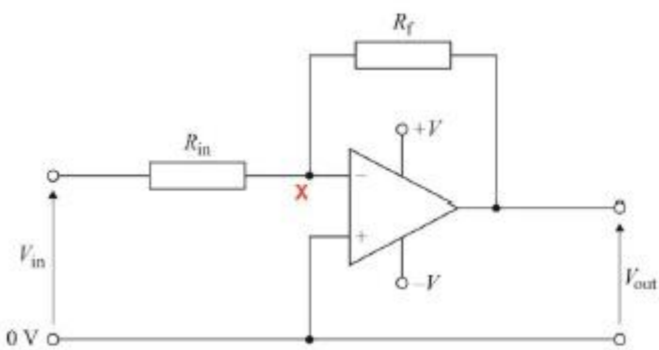
Q3.

(a)



Correct position of X:

1

(b) The non-inverting input

(non-inverting)

1

(c) $I = (V_{in} – V_x) / R_{in} = (V_x – V_{out}) / R_f$
But $V_x = 0$ V (a virtual earth)
$I = V_{in} / R_{in} = – V_{out} / R_f$

Making use of: $I_{in} = - I_F$

$$\frac{V_{out}}{Vin} = \frac{R_f}{R_{in}}$$

Making use of virtual earth concept

2

(d) Voltage gain (Channel 1) = $– R_f / R_{in}$ 1

–(150 kΩ / 7.5 kΩ)

–20

*Both number **and** sign must be correct*

1

(e) $V_{out} = – R_f (V_{in\ Ch1} / R_1 + V_{in\ Ch2} / R_2)$

= – 150 kΩ ((15mV / 7.5kΩ) + (–100 mV / 30 kΩ))

= – ((0.3) + (–0.5)) = 0.2 Volts

Evidence of correct method

*Answer **and** correct sign*

2

(f) By using variable resistors

The gain can easily be changed
or
the relative levels of the two channels can be set
or
the required balance between the two signals can be made

One relevant point made

1

[8]