

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Mark Schemes

Q1.

- (a) Label the virtual earth point eg X, **on** the junction between the two resistors ✓

*Allow the centre of the 'X' to be placed **on** any of the three lines leading to the op amp inverting input junction.*

Do not allow an 'X' in space unless accompanied by unambiguous arrow.

1

- (b) Set up equation for $I = V_{in} / R_{in} = -V_{out} / R_f$ then rearrange ✓

Reason to support setting up of equation ✓

Second mark given only if reason provided for one of:

I through $R_{in} = I$ through R_f (Infinite input impedance)

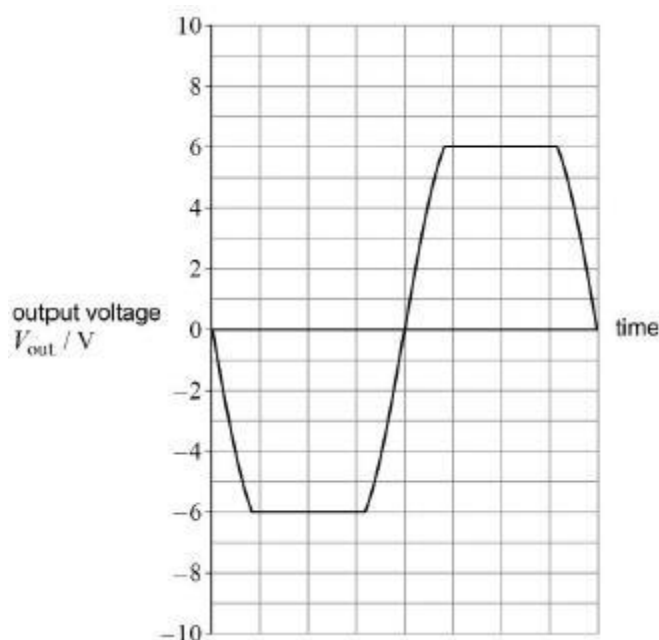
–ve sign (Virtual earth point used)

2

- (c) Inverted sine wave of same period as signal shown in Fig 2A ✓

Attempt to use a gain of 20

and show a Cut-off/plateau at ± 6 V ✓

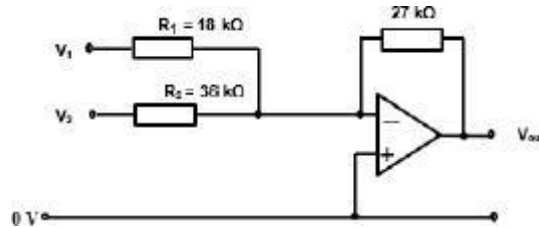


2

(d) 1 mark for correct connection of resistor R_1 and R_2 ✓

1 mark for correct values of R_1 and R_2 ✓

1 mark for values correct way round – referenced to V_1 and V_2 ✓



3

[8]

Q2.

- (a)
- When V_c reaches a value of V_U , the output voltage V_{out} drops LOW. ✓
 - The capacitor now discharges through the resistor causing the value of V_c to fall. ✓
 - When V_c reaches a value of V_L , the output voltage V_{out} jumps HIGH. ✓

3

(b) **Mark-to-space ratio**

R_B gets smaller and hence (t_H) is reduced

OR

R_A gets bigger and hence (t_L) is increased ✓

First mark: Either statement or equivalent labelled diagram(s).

Hence mark:space ratio is reduced / smaller ✓

Second mark: Conclusion

$$\text{PRF} = \frac{1}{T} = \frac{1}{(t_H + t_L)} = \frac{1}{0.7C(2R + R_A + R_B)}$$

The total resistance $(2R + R_A + R_B)$ is constant ✓

As a result of a constant resistance in the circuit, PRF does not change ✓

First mark: explanation of how total resistance in the circuit affects the periodic time

Second mark: Conclusion.

4

[7]

Q3.

(a) $(f = 1 / T ; f = 1 / 5 \mu s)$

200 ✓ (kHz)

1

(b) Measurement from the graph of the half wavelength of signal

$$T = 2 \times 42 \mu\text{s} \quad \checkmark$$

First mark for factor 2 in calculation

Allow range $2 \times (40 - 44) \mu\text{s}$

Calculation of frequency ($f = 1 / T$) using their T
 11.9 kHz (± 0.6 kHz) $\checkmark$

Second mark – allow ecf only if their T is clearly derived from analysis of the graph

2

(c) Any one from: $\checkmark$

- Immune to any noise in amplitude. (since information stored in the frequency variation)
- Quality of an FM signal remains high even when the transmitter power is low.
- (since most of power is in sidebands / information).
- Carries more information
- (since the FM bandwidth is much wider than that of AM)

Max 1 mark

1

(d)

= 100 stations $\checkmark$

$$\frac{(108 \text{ MHz} - 88 \text{ MHz})}{200 \text{ kHz}}$$

1

(e) Bandwidth = $2(\Delta f + f_m) = 2 \times (75 \text{ kHz} + 15 \text{ kHz}) = 180 \text{ kHz}$ $\checkmark$

This fits in allocated 200 kHz band $\checkmark$

Second mark – allow ecf if conclusion is consistent with their calc.

2

[7]