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GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

**JUNE EXAMINATION
GRADE 12**

2026

**AMENDED MARKING GUIDELINES
2 JUNE 2026 19:48**

**ELECTRICAL TECHNOLOGY:
ELECTRONICS**

16 pages



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INSTRUCTIONS TO THE MARKER

1. All questions with multiple answers imply that any relevant, acceptable, and correct answer should be considered.
2. Calculations:
 - 2.1 All calculations must show the formulae.
 - 2.2 Substitution of values must be done correctly.
 - 2.3 All answers **MUST** contain the correct unit to be considered.
 - 2.4 Alternative methods must be considered, provided that the correct answer is obtained.
 - 2.5 Where an incorrect answer could be carried over to the next step, the first answer will be deemed incorrect. However, should the incorrect answer be carried over correctly, the marker has to recalculate the values, using the incorrect answer from the first calculation. If correctly used, the candidate should receive the full marks for subsequent calculations.
3. These marking guidelines are only a guide with model answers. Alternative interpretations must be considered and marked on merit. However, this principle should be applied consistently throughout the marking session.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

- 1.1 B ✓ (1)
- 1.2 C ✓ (1)
- 1.3 D ✓ (1)
- 1.4 B ✓ (1)
- 1.5 C ✓ (1)
- 1.6 D ✓ (1)
- 1.7 C ✓ (1)
- 1.8 C ✓ (1)
- 1.9 D ✓ (1)
- 1.10 D ✓ (1)
- 1.11 D ✓ (1)
- 1.12 B ✓ (1)
- 1.13 C ✓ (1)
- 1.14 D ✓ (1)
- 1.15 B ✓ (1)
- [15]**

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

- 2.1
- Meeting deadlines ✓
 - Taking ownership of mistakes ✓
 - Giving you best at work
 - Being on time for work (Punctuality)
 - Following company policies
 - Using resources wisely
- (Any TWO relevant answers) (2)
- 2.2
- Safety goggles ✓
 - Latex gloves ✓
 - Rubber boots
 - Apron (PVC, Rubber-coated)
 - Face shield
- (Any TWO relevant answers) (2)
- 2.3 Switch off the electricity ✓ at the main switch.
OR
Free the person from the electricity using a non-conductor, e.g. a broomstick. (1)
- 2.4 STEP 1: D ✓
STEP 2: B ✓
STEP 3: A ✓
STEP 4: E ✓
STEP 5: C ✓

Note: If an answer is out of sequence, mark it wrong, and then award marks for the rest of the answers that follow in the correct sequence.

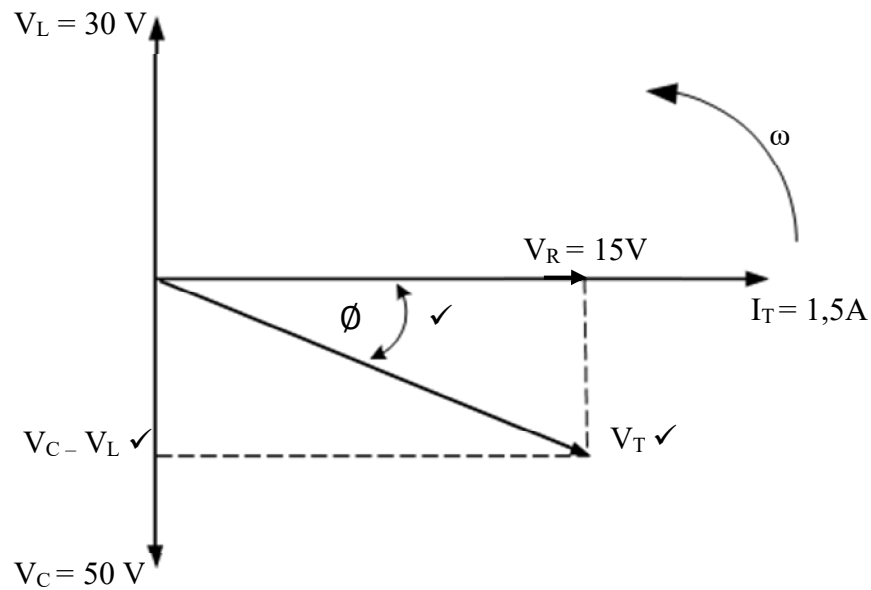
(5)
[10]

QUESTION 3: RLC CIRCUITS

- 3.1 3.1.1 The quality factor (Q) of an inductor refers to the ratio of the inductor's reactance (X_L) ✓ to the inductor's internal resistance (R_{int}). ✓ (2)
- 3.1.2 Selectivity of a resonant circuit indicates how well a resonant circuit responds to a range of frequencies ✓ while ignoring others. ✓ (2)
- 3.1.3 The total opposition to current flow ✓ in an alternating current ✓ RLC circuit, that is, the reactance plus the physical resistance, ✓ is called the impedance, and it is measured in ohms. (3)
- 3.2 The brightness of the light bulb will decrease/diminish. ✓ The reason is that, with an increase in frequency, the inductive reactance will increase ✓ ($X_L = 2\pi fL$), which will reduce the current. ✓ (3)

- 3.3 3.3.1 The waveforms are from a capacitive circuit ✓ because the current leads ✓ the voltage by 90°. ✓
OR
 The waveforms are from a capacitive circuit because the voltage lags the current by 90°. (3)
- 3.3.2 The resistor will reduce the phase angle ✓, causing the voltage and current to be more in phase. ✓ (2)
- 3.4 3.4.1 $f_r = \frac{1}{2\pi\sqrt{LC}}$ ✓
 $92,7 \times 10^6 = \frac{1}{2\pi\sqrt{27,32 \times 10^{-6} \times C}}$ ✓
 $C = 1 \times 10^{-5} \text{F}$
 $= 10 \mu\text{F}$ ✓
OR
 $C = \frac{1}{4\pi^2 f_r^2 L}$
 $= \frac{1}{4\pi^2 \times 92,7 \times 10^6 \times 27,32 \times 10^{-6}}$
 $= 1 \times 10^{-5} \text{F}$
 $= 10 \mu\text{F}$ (3)
- 3.4.2 Tank ✓ circuit (1)
- 3.5 3.5.1 The phasor diagram is that of a series ✓ circuit because it is a voltage divider, and the phasor diagram shows the voltage ✓ drops across the components of the RLC circuit.
OR
 The phasor diagram is that of a series circuit because current is used as a reference. (2)

3.5.2



(3)

3.5.3

$$Z = \frac{V_T}{I_T} \checkmark$$

$$Z = \frac{25}{1,5} \checkmark$$

$$Z = 16,67 \Omega \checkmark$$

(3)

$$3.5.4 \quad \cos \phi = \frac{V_R}{V_T} \checkmark$$

$$= \frac{15}{25} \checkmark$$

$$\phi = \cos^{-1}(0,6)$$

$$= 53,13^\circ \checkmark \text{ lagging} \checkmark$$

(4)

$$3.5.5 \quad V_L = I_T \times X_L \checkmark$$

$$X_L = \frac{V_L}{I_T}$$

$$= \frac{30}{1,5} \checkmark$$

$$= 20 \Omega \checkmark$$

(3)



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6

3.5.6 $X_L = 2\pi fL$ ✓

$$L = \frac{X_L}{2\pi f}$$

$$= \frac{20}{2\pi \times 30}$$
 ✓

$$= 0,1061 \text{ H}$$

$$= 106,1 \text{ mH}$$
 ✓

(3)

- 3.6
- $X_L = X_C$ ✓
 - $I_L = I_C$ ✓
 - Maximum impedance (Z) ✓
 - Minimum current flow (I_T)
 - Phase angle (ϕ) is zero
 - Power factor ($\cos \phi$) is 1
- (Any THREE relevant answers)

(3)

3.7 3.7.1 $X_C = \frac{1}{2\pi fC}$ ✓

$$= \frac{1}{2\pi \times 1\,000 \times 795 \times 10^{-9}}$$
 ✓

$$= 200,2 \Omega$$
 ✓

(3)

3.7.2 $I_C = \frac{V_T}{X_C}$ ✓

$$= \frac{50}{200,2}$$
 ✓

$$= 0,25 \text{ A}$$
 ✓

(3)

3.7.3 $I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$ ✓

$$= \sqrt{0,1^2 + (0,25 - 0,125)^2}$$
 ✓

$$= 0,16 \text{ A}$$
 ✓

(3)



MARKING GUIDELINES	ELECTRICAL TECHNOLOGY: ELECTRONICS	GR12 0626
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- 3.8 3.8.1 A: Z_{\max} ✓
 B: 70,7% of 0,707 of -3 dB ✓
 C: f_r ✓ (3)
- 3.8.2
 - The resonance curve will become sharper and narrower. ✓
 - Higher quality factor (Q). ✓
 - Improved frequency selectivity.
 - Higher impedance.
 (Any TWO relevant answers) (2)
- 3.8.3 $BW = f_2 - f_1$ ✓
 $= 2\,550\text{ Hz} - 2\,450\text{ Hz}$ ✓
 $= 100\text{ Hz}$ ✓ (3)
- 3.8.4 $BW = \frac{f_r}{Q}$ ✓
 $Q = \frac{f_r}{BW}$
 $= \frac{2\,500}{100}$ ✓
 $= 25$ ✓ (3)
- [60]**

QUESTION 4: SEMICONDUCTOR DEVICES

- 4.1
 - High Input Impedance ✓
 - Lower Power Consumption ✓
 - More effective
 (Any TWO relevant answers) (2)
- 4.2 4.2.1 Depletion region ✓ (1)
- 4.2.2
 - As (V_{GS}) increases, the Gate-Source becomes more reverse biased. ✓
 - It causes the depletion region to widen. ✓
 - As the depletion region expands, it narrows the conductive channel between the source and drain, ✓ restricting/lowering the flow of current (I_D). ✓
 (4)
- 4.3 The MOSFET's Gate is isolated from the channel by a thin layer of insulating material (metal-oxide-silicon). ✓
 The advantage of this is that it prevents any leakage current from flowing. ✓ (2)

- 4.4 4.4.1 Depletion mode ✓ (1)
- 4.4.2 **A:** Drain ✓ or Source
- B:** Gate ✓
- C:** Source ✓ or Drain
- D:** Metal oxide silicon insulation ✓
- E:** N-type channel ✓
- Note: The answers for A and C must be opposite to one another, and cannot be repeated twice. (5)
- 4.5
- Sawtooth Waveform Generators ✓
 - Relaxation Oscillators ✓
 - Timing Circuits ✓
 - Triggering SCRs & Triacs
 - Pulse Generation
 - Voltage or Phase Control
 - Alarm and Sensing Circuits
- (Any THREE relevant answers) (3)
- 4.6 When the Unijunction Transistor (UJT) switches on due to sufficient emitter voltage (V_e), a phenomenon known as negative resistance ✓ occurs. This means that as the emitter current increases, ✓ the emitter voltage actually decreases ✓ which is the opposite of what Ohm's Law predicts. (3)
- 4.7 **A:** Cut-off region ✓
- B:** Negative resistance region ✓
- C:** Saturated region ✓
- D:** Valley point ✓ (4)
- 4.8 4.8.1 R_1 ✓ and C_1 ✓ (2)
- 4.8.2 Sawtooth waveform ✓ (1)
- 4.8.3 The motor used is a DC motor ✓ because the SCR that controls its speed can only conduct current in one direction. ✓ (2)



- 4.9 4.9.1 A Darlington transistor is suitable for activating a relay because it provides very high current gain, ✓ allowing it to switch large currents with only a small input current. This makes it ideal for controlling a relay coil, especially when the control signal is weak or comes from a low-power source such as a sensor or microcontroller. ✓ (2)
- 4.9.2
- Alarm system activated by light. ✓
 - Day-night switch.
- (Any relevant answer) (1)
- 4.9.3 A diode is connected in parallel with the relay to protect the darlington transistor ✓ from high voltage back emf spikes ✓ caused by the inductive coil when the relay is turned off. In practice, this diode is called a flyback diode or a freewheeling diode. ✓ (3)
- 4.10 4.10.1
- Stable gain ✓
 - Stable operation
 - Linear Amplification
- (Any relevant answer) (1)
- 4.10.2 $V_{OUT} = V_{IN} \left(1 + \frac{R_F}{R_{IN}}\right)$ ✓
- $$= 20 \times 10^{-3} \left(1 + \frac{150 \times 10^3}{2 \times 10^3}\right) \checkmark$$
- $$= 1,52 \text{ V } \checkmark \quad (3)$$
- 4.11
- Basic timing, such as switching a device on or off after a certain time delay. ✓
 - Warning lights that flash on and off. ✓
 - Generates pulses, oscillations, and waveforms.
 - Digital logic testers.
 - Produces musical notes of a certain frequency.
 - Industrial applications such as temperature measurement.
 - Positioning of servo devices.
- (Any TWO relevant answers) (2)
- 4.12 200 milliamps (mA) ✓ (1)
- 4.13 An active low trigger means that the 555 timer is activated or triggered when the voltage on the trigger pin (pin 2) drops below a certain threshold, ✓ typically 1/3 of the supply voltage (Vcc). ✓
- OR
- In simpler terms, the timer starts its timing cycle when it receives a LOW signal (close to 0V) on the trigger pin — hence the term “active low.” (2)

[45]

QUESTION 5: SWITCHING CIRCUITS

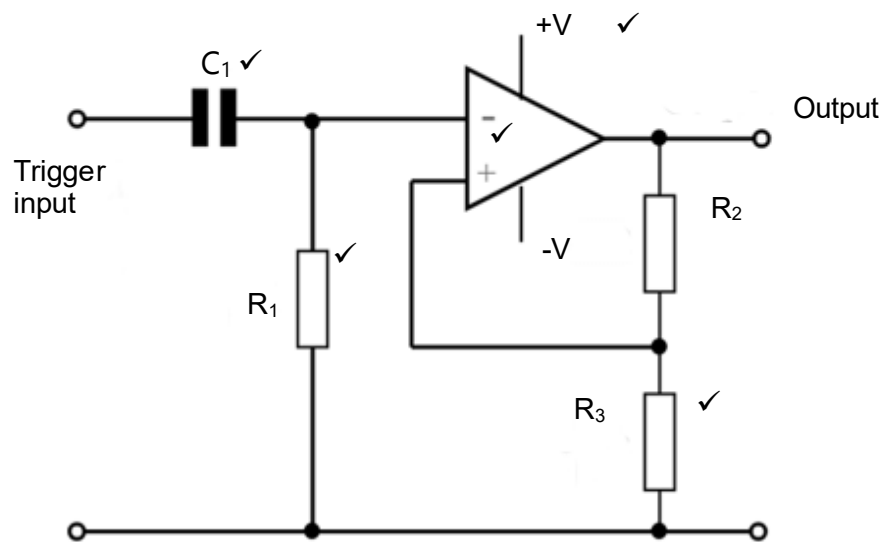
- 5.1 5.1.1. B ✓ and E ✓ (2)
 5.1.2. A ✓ and C ✓ (2)
 5.1.3. D ✓ and F ✓ (2)

- 5.2 The bistable multivibrator has two stable output states — HIGH and LOW ✓— and it switches between these states when the input is triggered. ✓ (2)

OR

In summary, the bistable multivibrator functions like a memory switch — it holds its output state until an external input changes it. (2)

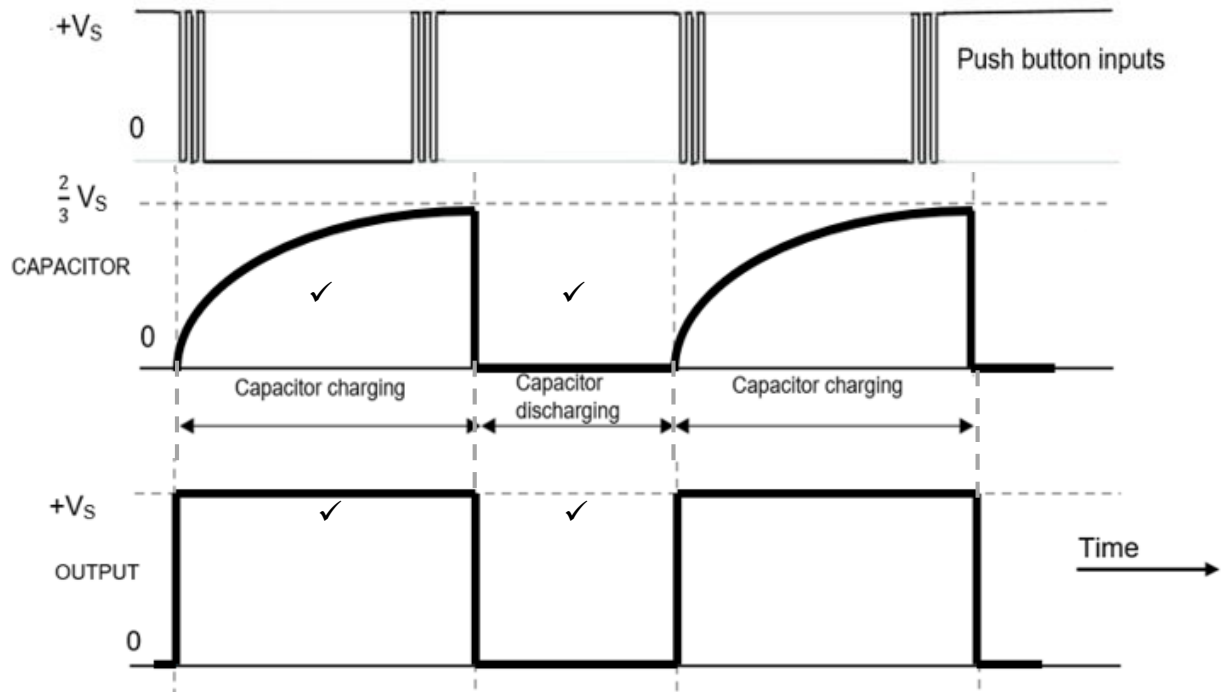
5.3



(5)

- 5.4 5.4.1 When a mechanical electrical switch closes, the contact points do not connect immediately. ✓ They make microscopic bounces/sparks ✓ up and down before finally settling. This is known as switch bounce. ✓ (3)
 5.4.2 Monostable multivibrator ✓ (1)

5.4.3



(1 mark for the correct polarity ✓)

(5)

- 5.5 5.5.1 Free-running oscillator ✓ (1)
- 5.5.2 Pin 2 - Trigger, ✓, and Pin 6 – Threshold ✓ (2)
- 5.5.3 C_1 ✓ (1)
- 5.5.4
- No external trigger input. ✓
 - Pin 2 (Trigger) and Pin 6 (Threshold) are connected together. ✓
 - A capacitor (C_1) is connected from Pin 6/2 to ground.
 - Two resistors (R_1 and R_2):
 - R_1 is connected between V_{cc} (Pin 8) and Discharge (Pin 7).
 - R_2 is connected between Pin 7 and Pin 6/2
- (Any TWO relevant answers) (2)
- 5.6 5.6.1 Hysteresis ✓ (1)
- 5.6.2 Regenerative feedback ✓ (1)



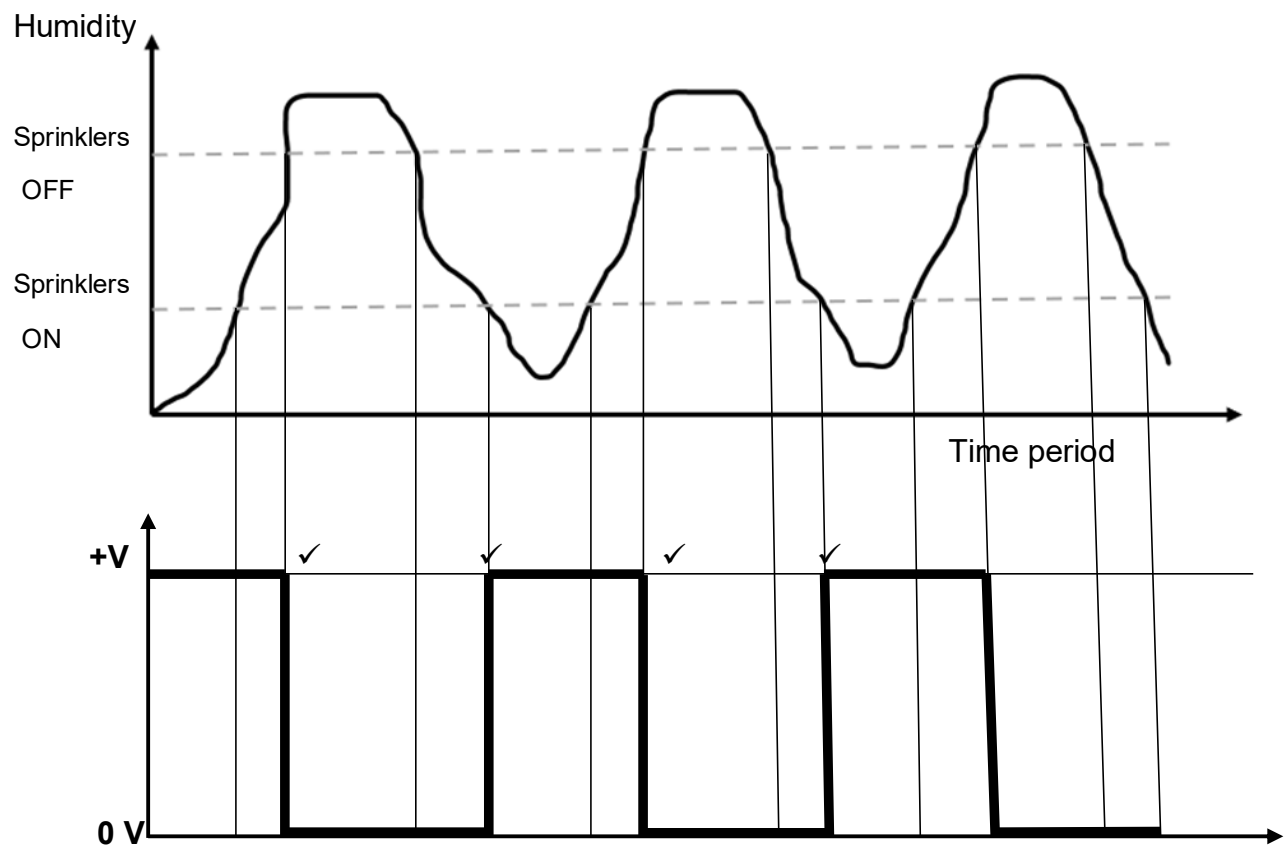
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12

- 5.6.3
- The restoration of a signal that has been severely distorted by external interference. ✓
 - Signal Conditioning – It is used to remove noise from a signal by converting a noisy input into a clean digital output. ✓
 - Debouncing Mechanical Switches – It helps eliminate false triggering due to contact bounce in pushbuttons or mechanical switches.
 - Waveform Shaping – Converts a sine wave or other analog waveform into a square wave.
 - Oscillators – Used in relaxation oscillator circuits to generate clock pulses or waveforms.
- (Any TWO relevant answers) (2)

5.6.4



(1 mark for the correct polarity ✓)

(5)



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13

- 5.7 5.7.1 This is an inverting comparator. ✓ (1)
- 5.7.2 The input is connected to the inverting input, ✓ and the polarity of the output waveform is inverted / out of phase ✓ to that of the input waveform. (2)
- 5.7.3 This circuit operates in open-loop mode. ✓
An open-loop mode means that there is no feedback path from the output back to the input ✓ of the operational amplifier. In comparator circuits like this one (whether inverting or non-inverting), the op-amp is used without any feedback to simply compare voltages and switch the output accordingly. Because it does not use negative feedback to stabilise or control the gain, it operates in open-loop mode. (2)
- 5.7.4
- Analogue-to-digital conversion (ADC) ✓
 - Signal conditioning – cleaning up noisy or distorted signals. ✓
 - Dark sensor (Day-Night sensor, temperature sensor, alarm. (Any TWO relevant answers) (2)
- 5.7.5
- The input sine wave is applied to the inverting input of the comparator. ✓
 - The non-inverting input is set to a reference voltage, ✓ usually zero volts (ground).
 - When the sine wave voltage is above the reference, the comparator output switches to a low voltage (negative saturation). ✓
 - When the sine wave voltage is below the reference, the output switches to a high voltage (positive saturation). ✓
 - This switching produces a square wave output corresponding to the zero crossings of the sine wave. ✓ (5)
- 5.8 5.8.1 Each input to the summing amplifier is connected through its own resistor. By adjusting the value of these input resistors (or using variable resistors like potentiometers), ✓ the gain for each input can be individually controlled. ✓ This allows each signal to be amplified or attenuated separately before being summed at the output. In audio mixers, this lets you control the volume level of each audio source independently. (2)

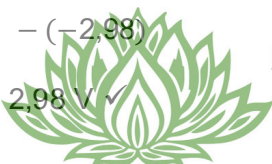
5.8.2

$$\begin{aligned}
 V_{\text{OUT}} &= -\left(V_1 \frac{R_F}{R_1} + V_2 \frac{R_F}{R_2}\right) \checkmark \\
 &= -\left(3 \text{ V} \frac{470 \times 10^3}{220 \times 10^3} + (-0,2 \text{ V} \frac{470 \times 10^3}{10 \times 10^3})\right) \checkmark \\
 &= -((6,42) + (-9,4)) \\
 &= -(-2,98) \\
 &= 2,98 \text{ V} \checkmark
 \end{aligned}$$

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14



5.8.3 If the feedback resistor (R_F) value is halved in a summing amplifier, the gain of the amplifier will decrease, ✓ which means the output voltage will also decrease. The output voltage will be halved. ✓ (2)

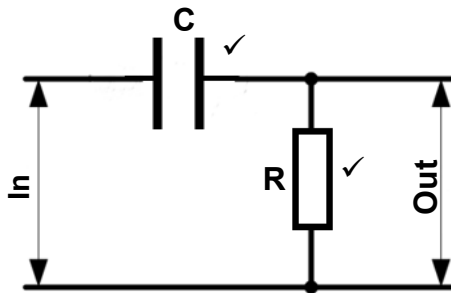
5.8.4 The gain for each input is the ratio of the **feedback resistor (R_f)** to the **input resistor** in each of the input branches.

a. Feedback resistor (R_f) ✓

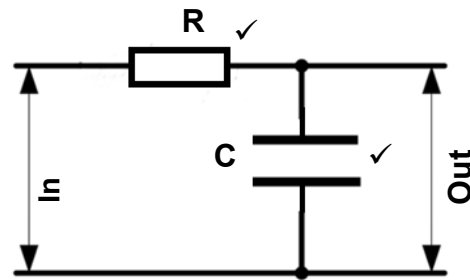
b. Input resistor ✓

(2)

5.9 5.9.1



**PASSIVE RC
DIFFERENTIATOR**



PASSIVE RC INTEGRATOR

(4)

5.9.2

- Improve the input and output impedances. ✓
- Improved accuracy and stability ✓
- Increased gain and better signal processing
- Better frequency response
- Noise reduction and filtering capabilities

(Any TWO relevant answers)

(2)

5.9.3

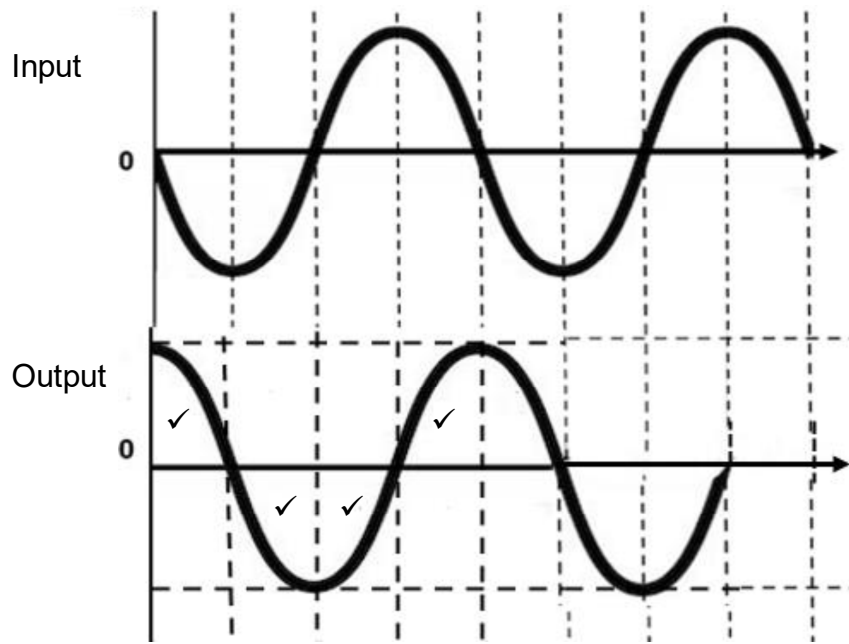
- Converts square waves into triangular waves. ✓
- Used in low-pass filters to smooth signals.
- Analogue to Digital converters.

(Any ONE relevant answer)

(1)



5.9.4



(1 Mark for the correct polarity ✓)

(5)
[70]

TOTAL: 200