M1.(a) $f_0 = 1 / (2\pi \times \sqrt{(L \times C)})$ $C = 1 / (f_0^2 \times 4\pi^2 \times L)$ ✓ [valid rearrangement]
$= 1 / (50^2 \times 4\pi^2 \times 0.1)$
$= 5.07\ (5.1)\ \mu F$ ✓ [μF]

2

(b) Q factor = $f_0 / f_B = 50 / 2.5 = 20$ ✓

1

(c) Resonant frequency becomes 25 Hz ✓

Peak higher than original at resonant frequency ✓✓

2

[5]

M2.(a) (i) (use of $X_C = \frac{1}{2\pi fC}$ gives)

$$f = \left(\frac{1}{2\pi X_C C}\right) = \frac{1}{2\pi 1000 \times (0.01 \times 10^{-6})}$$ = 16 × 10^4 Hz **(1)**

(ii) $\left(X_C = \frac{1}{2\pi fC}\right)$ low f gives high X_C **(1)**

X_C >> resistance 1.0 kΩ **(1)**

V_{out} (= IR) or $\frac{V_{out}}{V_{in}}$ is low **(1)**
(or correct usage of potentiometer equation)

4

(b) (shown in (i) that at low f, $\frac{V_{out}}{V_{in}}$ is low)

as f increases, X_C decreases and V_{out} (across R) increases **(1)**
until ≈ 0 V across X_C and $V_{out} = V_{in}$ **(1)**

2

[6]

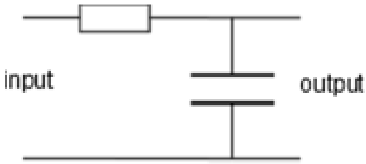
M3.(a) range of frequencies in signal ✓
reference to frequency at which signal drops by
e.g. power 3dB (50%) / voltage 6dB (71%) ✓

2

(b) low pass / treble cut ✓

1

(c) (i) RC filter circuit, with input & output labelled ✓
correct R & C positions ✓



2

(ii) substitute values into f = 1 / 2πRC ✓

rearrange for C ✓

40 (39.7) nF ✓

3

(d) (i) gain > 1 ✓

1

(ii) 100Hz ✓

1

(iii) gain = 0.2 ✓ output = 0.4V ✓

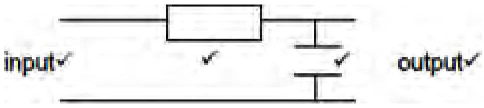
2

[12]

M4.(a) Low pass filter✓

1

(b)



4

(c) use of 1 / 2RC✓ = 1 / 6.28 × 10^{4} × 10^{-8} ✓= 1.6 kHz✓

3

(d) not suitable✓ cuts off frequencies from too low a frequency✓

2

[10]