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

Merit Minds
www.merit-minds.com
Exam Preparation and Free Resources

**Name of the Student**:_____
**Max. Marks : 21 Marks** **Time : 21 Minutes**

## Q1.

A die, where dots on the faces of a cube indicate the numbers 1 to 6, is shown in **Figure 1** and is used in many games.

**Figure 1**

A student makes an electronic version of this by feeding pulses from a pulse generator into a 4-bit binary counter.

The circuit uses the first three outputs of the counter A (least significant bit), B and C.

By feeding the outputs from the counter through logic gates, the seven LEDs shown in **Figure 2** can be made to display the numbers 1 to 6 in sequence.

**Figure 2**

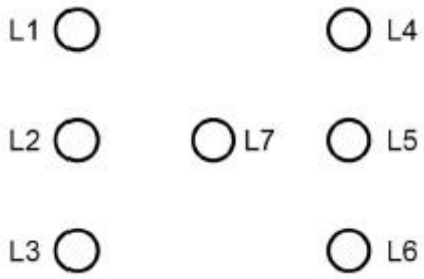
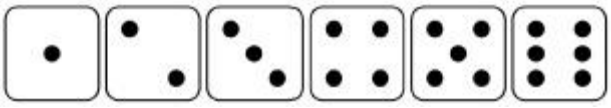



**Figure 3** shows the sequence of numbers.

**Figure 3**



The black dots show which LEDs are lit for each of the numbers 1 to 6.

The partially completed truth table below shows which of the LEDs (L1 to L6) are ON (logic 1) and which are OFF (logic 0) during the counting sequence.

| Number | Logic inputs | Logic outputs |
|---|---|---|

| shown on die | C | B | A | L1 | L2 | L3 | L4 | L5 | L6 | L7 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | | 1 |
| 2 | 0 | 0 | 1 | | 0 | 0 | 0 | 0 | | 0 |
| 3 | 0 | 1 | 0 | | 0 | 0 | 0 | 0 | | 1 |
| 4 | 0 | 1 | 1 | | 0 | 1 | 1 | 0 | | 0 |
| 5 | 1 | 0 | 0 | | 0 | 1 | 1 | 0 | | 1 |
| 6 | 1 | 0 | 1 | | 1 | 1 | 1 | 1 | | 0 |
| Reset 6 → 1 | | | | | | | | | | |

(a) Complete the table to show the logic outputs for the lamps L1 and L6.

**(2)**

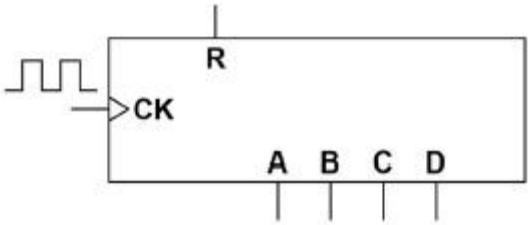
(b) Deduce the **simplest** Boolean expression that can be used to show how output L7 can be controlled by the logic inputs.

_____

**(1)**

(c) **Figure 4** shows some of the input and output pins of the 4-bit binary counter.

**Figure 4**




The data sheet for the counter indicates that the counter resets when the reset pin **R** is taken from logic 0 to logic 1.

Draw on **Figure 4** the logic gate needed and the connections required from the outputs to the reset pin **R** on the counter so that the counter cycles as required.

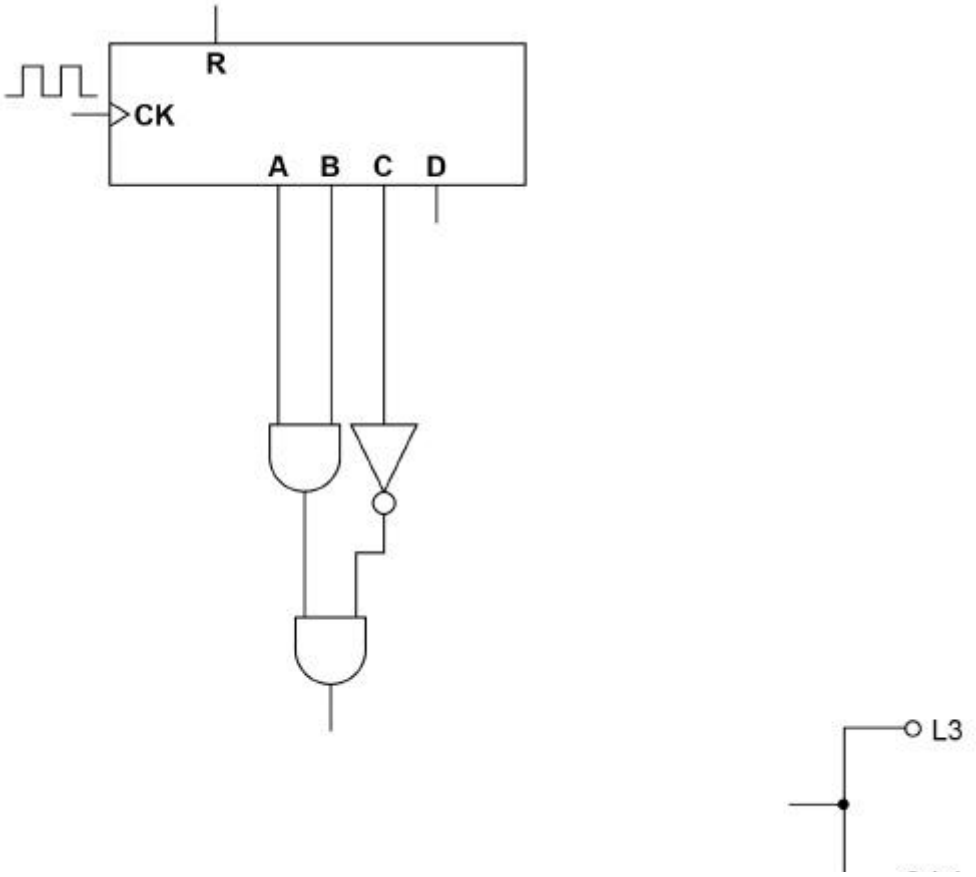
**(2)**

(d) The output of both L3 and L4 can be written as $\mathbf{(A.B.\overline{C}) + (\overline{B}.C)}$

**Figure 5** shows part of a logic circuit needed to represent this Boolean expression.

Complete the logic circuit in **Figure 5** by adding AND, OR and NOT gates.

**Figure 5**



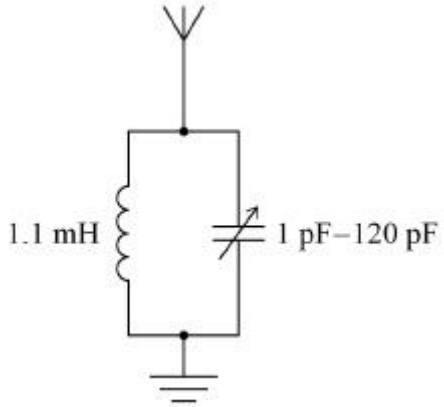

**(3)**

**(Total 8 marks)**

## Q2.

**Figure 1** shows the first-stage filter circuit for a simple AM receiver. The circuit can be adjusted to resonate at 910 kHz so that it can receive a particular radio station.

**Figure 1**



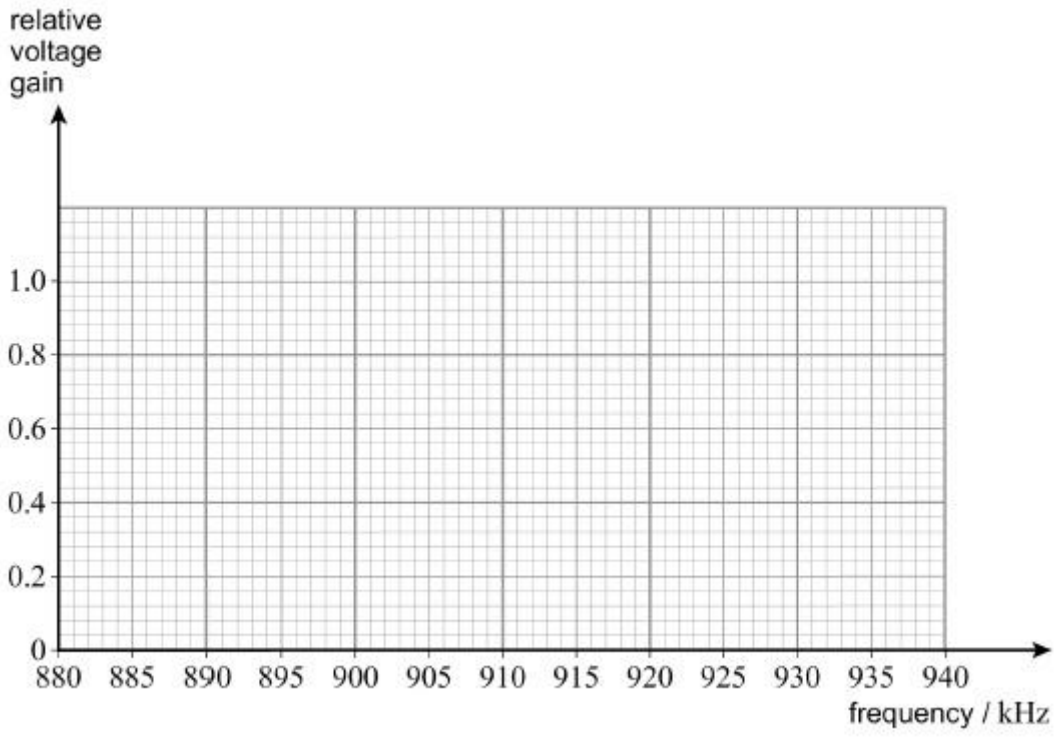

(a) Calculate the value of the capacitance when the circuit resonates at a frequency of 910 kHz.

capacitance = _____ pF

**(2)**

(b) Draw on **Figure 2** an ideal response curve for the resonant circuit, labelling all relevant frequency values based upon a 10 kHz bandwidth.

**Figure 2**




**(3)**

(c) The *Q*-factor for the practical tuning circuit has a smaller value than the ideal one assumed in question (b).

Discuss the changes the listener might notice when tuning to this station due to the practical *Q*-factor being smaller.

_____

_____

_____

_____

_____

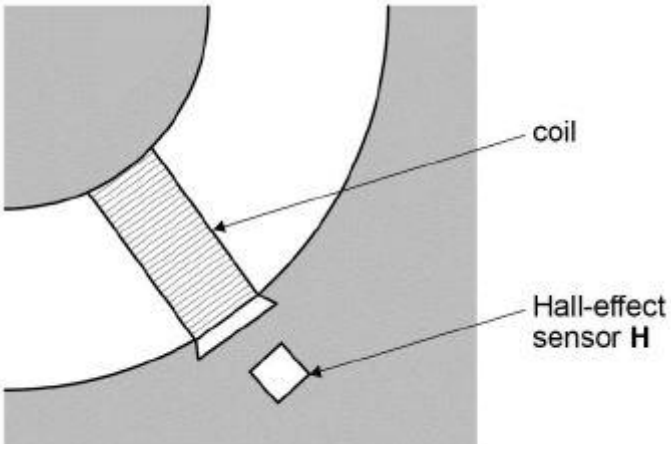
_____

**(2)**

**(Total 7 marks)**

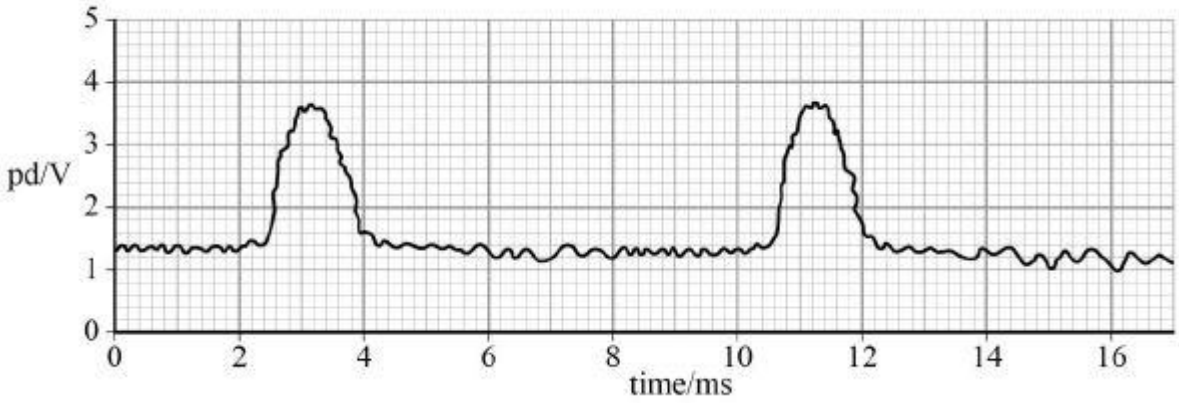
## Q3.

The diagram shows part of the motor from a computer disk drive.




On each rotation a small magnet passes a Hall-effect sensor **H** which detects the change in magnetic field and produces an output potential difference (pd) that varies with time as shown in **Figure 1**.

**Figure 1**




(a) Determine the speed of the motor in revolutions per second.

speed of motor = _____ rev $s^{-1}$

**(2)**

(b) Explain why the output from the magnetic field sensor is unsuitable to be applied directly to the logic circuit of the motor controller.

_____

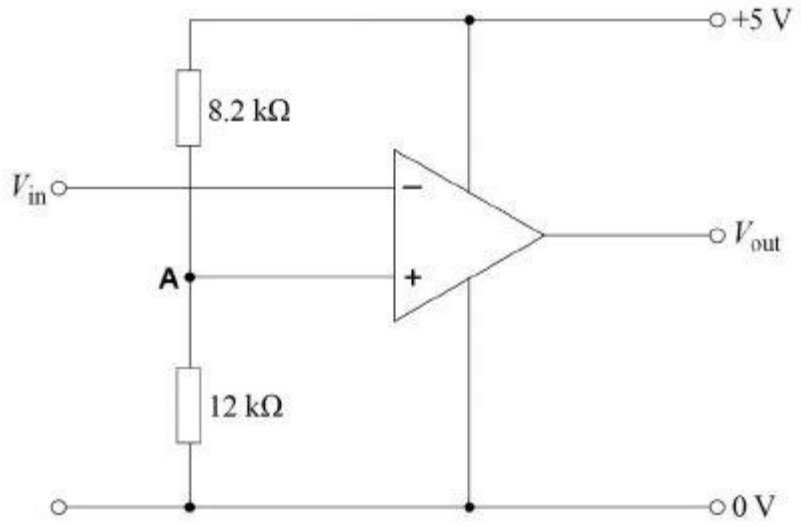
_____

_____

**(1)**

(c) The signal from the magnetic field sensor is applied to the circuit shown in **Figure 2**.

**Figure 2**




Show that the potential of point **A** is about +3 V.

**(1)**

(d) Draw on **Figure 1** the waveform showing the variation with time of the output voltage $V_{out}$ of the circuit shown in **Figure 2**.

**(2)**

**(Total 6 marks)**