Question 1

In a test of learning potential, a scientist wishes to see how quickly a rat can learn to obtain food from a dispenser when certain combinations of coloured lights are shown. The scientist devises the following experiment.

A rat is placed in a cage in which are three coloured lights, one red, one green and one blue. Every few minutes a buzzer sounds and a combination of lights come on. When certain combinations of these lights are on, a food dispenser becomes active and the rat can obtain food by pushing the door of the dispenser. When the right combinations of lights are not showing, then no amount of pushing by the rat will release food. It is expected that the rat will learn to push at the dispenser only when the correct lights are on.

The food dispenser will become active when the blue and green lights are on (irrespective of whether the red light is on or off); when the blue light is off and the green light is on (irrespective of whether the red light is on or off); and when only the blue light is on. All other combinations will not provide food.

1. Draw a truth table representing each light as a Boolean variable, showing all combinations of the variables and the output A which indicates whether the dispenser is active or not. (15 marks)

2. Using the truth table, write down a Boolean expression that will activate the dispenser when appropriate. (10 marks)

3. Use a Karnaugh Map to find the simplest representation of the expression. (15 marks)

4. Using the simplest expression, draw a circuit involving AND, OR and NOT gates which could be used to operate the dispenser. (10 marks)