

# 2023 HSC Automotive Marking Guidelines

## Section I

### Multiple-choice Answer Key

Question	Answer
1	A
2	B
3	D
4	A
5	B
6	B
7	C
8	B
9	A
10	B
11	C
12	A
13	D
14	A
15	C

## Section II

### Question 16 (a)

Criteria	Marks
<ul style="list-style-type: none"> <li>Identifies who is responsible for work health and safety in the workplace</li> </ul>	1

**Sample answer:**

Employer

**Answers could include:**

- Employees
- All staff members.

### Question 16 (b)

Criteria	Marks
<ul style="list-style-type: none"> <li>Outlines clearly TWO methods for improving work health and safety practices</li> </ul>	3
<ul style="list-style-type: none"> <li>Outlines ONE method for improving work health and safety practices</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

**Sample answer:**

The workshop could review work health and safety practices in the workshop to identify safety hazards and poor work practices.

To manage safety hazards the workshop can carry out a risk assessment and implement changes based on the hierarchy of controls.

**Answers could include:**

A work health and safety committee could be formed to monitor WHS in the workplace and recommend changes as needed during regular meetings.

### Question 17 (a)

Criteria	Marks
• Demonstrates a sound understanding of how the capacity of a four-stroke engine is calculated.	2
• Provides some relevant information	1

**Sample answer:**

The engine capacity is calculated as the (diameter of the bore) × (stroke) × (no. of cylinders).

$$\pi r^2 \times H \times \text{number of cylinders}$$

### Question 17 (b)

Criteria	Marks
• Provides a sound description of ONE engine design feature that affects the compression ratio in a four-stroke engine	3
• Provides some description of an engine design feature that affects the compression ratio in a four-stroke engine	2
• Provides some relevant information	1

**Sample answer:**

Piston design                      Dome top pistons increase compression ratio and dished pistons reduce the compression ratio. This is because dome top pistons will decrease combustion chamber volume and therefore increase compression ratio. Dished pistons increase combustion chamber volume and therefore lower compression ratio.

**Answers could include:**

Engine stroke                      The longer the engine stroke, the higher the compression ratio.

Combustion chamber design      The volume of the combustion chamber will affect the compression ratio.

Head gasket thickness              The head gasket thickness will affect the cylinder volume and engine stroke which will affect the compression ratio.

Forced induction                      Turbo/Super charging – forced induction will increase the compression ratio by forcing more air into the cylinder.

Variable valve timing              This will affect the amount of air in the cylinder.

### Question 18 (a)

Criteria	Marks
• Provides how diesel air pollutants harm the environment	2
• Provides some relevant information	1

**Sample answer:**

Diesel engines produce carbon dioxide which contributes to climate change.

Diesel engines also produce oxides of nitrogen (NO<sub>x</sub>) which can cause acid rain.

Diesel engines produce particulate matter which are damaging to the environment.

### Question 18 (b)

Criteria	Marks
• Describes clearly how diesel emission control systems reduce diesel emissions	3
• Provides some description of how diesel emission control systems reduce diesel emissions	2
• Provides some relevant information	1

**Sample answer:**

Diesel engines use diesel particulate filters (DPF) to filter out particulate matter then burn it off at a higher temperature into less harmful emissions. They also use selective catalytic reduction to reduce oxides of nitrogen (NO<sub>x</sub>).

**Answers could include:**

Diesel engines also use exhaust gas recirculation (EGR) systems to reduce the combustion temperature. This reduces the oxides of nitrogen (NO<sub>x</sub>) in the exhaust.

## Question 19

Criteria	Marks
• Provides a sound description of methods to manage the situation	3
• Provides some description of methods to manage the situation	2
• Provides some general information	1

**Sample answer:**

The workshop will address the customer's complaint by thoroughly inspecting the suspension system to find the vibration source. They will communicate with the customer, acknowledging their frustration and explaining the resolution steps. Prompt correction will be done, followed by proper testing and verification of the suspension repair to ensure customer satisfaction. Also, the previous repair will be examined to determine the previous work done.

## Question 20 (a)

Criteria	Marks
• Provides TWO sources of information	2
• Provides ONE source of information	1

**Sample answer:**

The technical information required when diagnosing a fault with a vehicle can be found in workshop manuals and the technical bulletins.

**Answers could include:**

- Manufacturer repair manuals in either digital, paper or CD Rom based formats
- Manufacturer wiring diagrams and system descriptions
- Scan tool live data
- Scan tool guided fault finding
- Work colleagues
- Technical bulletins
- Internet search.

## Question 20 (b)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides a comprehensive description of the possible faults that could cause the vehicle to steer sharply to the left when the brakes are applied</li> </ul>	6
<ul style="list-style-type: none"> <li>Provides a sound description of the possible faults that could cause the vehicle to steer sharply to the left when the brakes are applied</li> </ul>	5
<ul style="list-style-type: none"> <li>Provides some description of the possible faults that could cause the vehicle to steer sharply to the left when the brakes are applied</li> </ul>	4
<ul style="list-style-type: none"> <li>Provides an outline of the possible faults that could cause the vehicle to steer sharply to the left when the brakes are applied</li> </ul>	2–3
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

### **Sample answer:**

When diagnosing a vehicle that is deviating from a straight line when applying the brakes, there are several areas of the braking, steering and suspension systems that must be evaluated to determine the cause of the fault.

When inspecting the braking system, a fault which causes uneven braking distribution between the left and right sides of the vehicle will cause the vehicle to deviate from a straight line. These faults can include a seized brake caliper piston, a restricted or twisted brake line, disc pad contamination or a hydraulic circuit that is inoperative.

Other factors to consider include uneven tyre pressures, excessive wear in steering and suspension components and faults with the electronic brake distribution system.

### **Answers could include:**

- Seized caliper piston
- Restricted or twisted brake hose
- Hydraulic circuit inoperative
- Disc pad contamination
- Hydraulic fluid leak
- Seized caliper slide
- Incorrectly adjusted tyre pressures
- Worn tyres
- Brake master cylinder fault
- Excessive free play in steering or suspension components.

### Question 21 (a)

Criteria	Marks
• Provides the purpose of a relay in the petrol fuel system	2
• Provides some relevant information	1

**Sample answer:**

The purpose of a relay in a petrol fuel system is to switch the power supply to the fuel pump, allowing it to operate and supply fuel to the engine.

### Question 21 (b)

Criteria	Marks
• Describes the process to test the relay for correct operation	3
• Demonstrates some understanding of the process to test the relay for correct operation	2
• Provides some relevant information	1

**Sample answer:**

The relay should be removed from the vehicle and test for signals at the plug where the relay has been removed. Refer to the circuit diagram, or printed diagram on the relay, to test the pins for the following.

- Pin 30 – Battery voltage
- Pin 87 – Output voltage
- Pin 86 – Ignition voltage
- Pin 85 – Ground

**Answers could include:**

A correctly labelled diagram of a relay.

### Question 21 (c)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides a thorough explanation of how the voltage drop at the relay will affect the horn operation</li> <li>Uses Ohm's law correctly to support the answer</li> </ul>	5
<ul style="list-style-type: none"> <li>Provides a sound explanation of how the voltage drop at the relay will affect the horn operation</li> <li>Uses Ohm's law to support the answer</li> </ul>	4
<ul style="list-style-type: none"> <li>Provides an explanation of how the voltage drop at the relay will affect the horn operation</li> <li>Refers to Ohm's law</li> </ul>	3
<ul style="list-style-type: none"> <li>Demonstrate an understanding of voltage drop at a relay</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

**Sample answer:**

Excessive voltage drop at the relay will result in a reduced performance of the horn due to a reduction in current flow.

Ohm's law states that the relationship between voltage, current and resistance is proportional to each other. Therefore, with an increase in resistance in the circuit and voltage remaining constant, the current flow will decrease.

## Section III

### Question 22 (a)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides a sound description of the operation of a rack and pinion steering system</li> </ul>	3
<ul style="list-style-type: none"> <li>Provides some description of the operation of a rack and pinion steering system</li> </ul>	2
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

**Sample answer:**

The driver rotates the steering wheel which is connected to and rotates the steering column shaft.

Rotational force is then transferred to the rack gear to convert rotary movement into linear movement. The pinion gear and the rack gear are constant mesh and provide a 'reduction' to assist the driver's effort in turning the steering wheel.

Connected to the rack gear each side are the tie rods and then the tie rod ends. The tie rod ends are then connected to the steering knuckles to move the wheels side to side.

## Question 22 (b)

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides a comprehensive explanation of how the use of electronics in steering systems has improved vehicle safety and handling</li> </ul>	10–12
<ul style="list-style-type: none"> <li>Provides a sound explanation of how the use of electronics in steering systems has improved vehicle safety and handling</li> </ul>	7–9
<ul style="list-style-type: none"> <li>Provides an explanation of how the use of electronics in steering systems has improved vehicle safety and handling</li> </ul>	4–6
<ul style="list-style-type: none"> <li>Demonstrates some understanding of how the use of electronics in steering systems has improved vehicle safety and handling</li> </ul>	2–3
<ul style="list-style-type: none"> <li>Provides some relevant information</li> </ul>	1

### **Answers could include:**

Manufacturers are improving the safety and handling of vehicles by incorporating electronics into vehicle steering systems.

This includes systems such as:

- Electrically assisted steering – this system uses an electric motor, torque sensor and ECU to provide the required steering assistance to the driver. As the assistance is provided by an electric motor greater assistance can be provided at low road speeds or when parking.
- Self parking – this feature allows the vehicle to use sensors to identify a suitable parking spot and automatically turn the steering wheel to park the vehicle.
- Lane Departure Assist – this system keeps the vehicle between the two white lines on the road. If the vehicle starts to drift the steering wheel will turn to keep the vehicle in between the white lines.
- Fatigue warning – during a long drive if the vehicle detects that the driver is becoming tired it can vibrate the steering wheel to alert the driver to take a break.
- Steering modes – the electric power steering system is able to adjust the amount of assistance provided to the driver as well as feedback from the road. The driver can select a sport or comfort mode depending on the type of driving. In Sport mode the steering will provide less assistance whereas in comfort mode it will provide a greater amount of assistance.

## Section IV

### Question 23

Criteria	Marks
<ul style="list-style-type: none"> <li>Provides an extensive explanation of how manufacturers have incorporated new technologies into internal combustion vehicles to minimise fuel consumption and meet emission standards</li> <li>Provides a logical and cohesive response</li> <li>Integrates relevant workplace examples and industry terminology</li> </ul>	13–15
<ul style="list-style-type: none"> <li>Provides a thorough explanation of how manufacturers have incorporated new technologies into internal combustion vehicles to minimise fuel consumption and meet emission standards</li> <li>Provides a cohesive response</li> <li>Uses relevant workplace examples and industry terminology</li> </ul>	10–12
<ul style="list-style-type: none"> <li>Provides a sound explanation of how manufacturers have incorporated new technologies into internal combustion vehicles to minimise fuel consumption and meet emission standards</li> <li>Provides a structured response</li> <li>Uses some industry terminology and workplace examples</li> </ul>	7–9
<ul style="list-style-type: none"> <li>Provides some explanation of how manufacturers have incorporated new technologies into internal combustion vehicles to minimise fuel consumption and meet emission standards</li> <li>Provides a clear response</li> <li>Uses basic industry terminology and/or workplace examples</li> </ul>	4–6
<ul style="list-style-type: none"> <li>Demonstrates some understanding of how manufacturers have incorporated new technologies into internal combustion vehicles and/or minimising fuel consumption and/or for emissions</li> </ul>	1–3

**Answers could include:**

With strict emission standards being imposed on vehicle manufacturers, there is a need to develop and incorporate new technologies into internal combustion engines. There is still a large demand for internal combustion vehicles, with a strong focus on fuel efficiency and minimal environmental impact.

The main technologies that are being incorporated into vehicles focus on fuel efficiency, emission control, hybrid powertrains, minimising vehicle weight, reducing engine capacity and increasing engine efficiency.

Manufacturers have developed various technologies into their engine systems which allow for dynamic changes to engine timing, recirculation of exhaust gases and cylinder deactivation under certain driving conditions. By utilising those technologies, the combustion chamber temperatures are reduced to lower the emissions produced by the combustion process, unburned fuel can be returned to the combustion chamber to be reburned and cylinders can be deactivated completely to reduce the amount of fuel being used by the engine.

Other technologies used by manufactures to reduce fuel consumption and vehicle emissions include:

- Smaller engines (smaller capacity with forced induction)
- Forced induction (increased volumetric efficiency of engine)
- Higher compression ratios
- Weight reduction (power to weight ratio)
- Tyre design (low rolling resistance)
- Hybrid powertrains
- Regenerative braking
- Stop/start technology (idling increases fuel consumption)
- Emission control technology (variable valve timing, cylinder deactivation)
- LED lighting (less load on electrical system).

# 2023 HSC Automotive Mapping Grid

## Section I

Question	Marks	HSC content – focus area
1	1	Safety – safe work procedures and practices – page 29
2	1	Sustainability – environmentally sustainable work practices – page 34
3	1	Working in the industry – operation of automotive tools and equipment – page 46
4	1	Troubleshooting and problem-solving – troubleshooting processes – page 37
5	1	Safety – safe work procedures and practices – page 29
6	1	Automotive systems and components – electrical fundamentals – page 23
7	1	Working in the industry – automotive tools and equipment – page 46
8	1	Sustainability – environmental compliance – page 34
9	1	Automotive systems and components – electrical fundamentals – page 23
10	1	Working in the industry – automotive workers – page 44
11	1	Automotive systems and components – principles of operation – page 22
12	1	Troubleshooting and problem-solving – troubleshooting processes – page 37
13	1	Automotive systems and components – testing electrical circuits, wiring systems and components – page 25
14	1	Automotive systems and components – principles of operation – page 21
15	1	Troubleshooting and problem-solving – troubleshooting processes – page 37

## Section II

Question	Marks	HSC content – focus area
16 (a)	1	Safety – work health and safety – page 27
16 (b)	3	Safety – safe work practices and procedures – page 29
17 (a)	2	Automotive systems and components – principles of operation – page 21
17 (b)	3	Automotive systems and components – principles of operation – page 22
18 (a)	2	Sustainability – environmental issues and sustainability – page 33
18 (b)	3	Automotive systems and components – principles of operation – page 22
19	3	Working in the industry – nature of the industry – page 42
20 (a)	2	Troubleshooting and problem-solving – troubleshooting processes – page 37
20 (b)	6	Troubleshooting and problem-solving – troubleshooting processes – page 38
21 (a)	2	Automotive systems and components – vehicle electrical systems and components – page 25
21 (b)	3	Automotive systems and components – testing electrical circuits, wiring systems and components – page 25
21 (c)	5	Automotive systems and components – electrical fundamentals – page 24

**Section III**

<b>Question</b>	<b>Marks</b>	<b>HSC content – focus area</b>
22 (a)	3	Automotive systems and components – principles of operation – page 22
22 (b)	12	Working in the industry – technology – page 45

**Section IV**

<b>Question</b>	<b>Marks</b>	<b>HSC content – focus area</b>
23	15	Working in the industry – technology – page 45