PART I

This part carries 33% of the total examination marks.

You should attempt **ALL ELEVEN** *questions in this Part.*

Pencil your answers on the CME form provided. Detailed instructions for completing it are printed opposite. Note that each question requires you to pencil across a definite number of cells. No marks will be given for answers where more than the required number of cells have been selected. There are no penalty marks for incorrect answers.

Q1 Figure 1 shows the velocity–time graph of a particle of mass 4.0 kg that is moving along the x-axis. What is the total force F_x acting on this particle at time $t = 1.0$ s? Choose one correct option from key for Q1, and pencil across *one* cell in row 1.

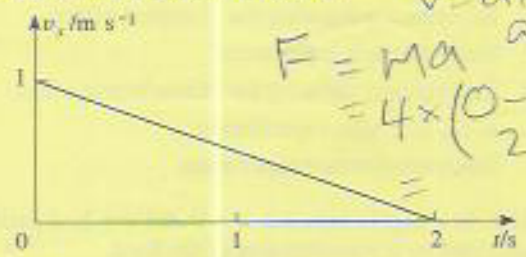

Figure 1

KEY for Q1

A 1.0 N
B 2.0 N
C 3.0 N
D 4.0 N
E −1.0 N
F −2.0 N
G −3.0 N
H −4.0 N

Q2 A toboggan starts from rest at the top of a steep slope. How fast is it travelling when it passes a point that is a vertical height 10 m below its starting point? You may ignore frictional effects and air resistance. Choose one correct option from the key for Q2, and pencil across *one* cell in row 2.

KEY for Q2

A 4.4 m s^{-1}
B 7.0 m s^{-1}
C 9.9 m s^{-1}
D 14 m s^{-1}
E 196 m s^{-1}
F Impossible to say since the mass of the toboggan is not given.
G Impossible to say since the angle of the slope is not given.

Q3 A bicycle wheel has a moment of inertia about its central axis $I = 0.60$ kg m^2. It rotates at a constant angular speed of 30 rad s^{-1}. What is the magnitude and direction of its angular momentum with respect to the centre of the wheel? Choose the one correct answer from the key for Q3, and pencil across *one* cell in row 3.

KEY for Q3

A 18 kg m^2 s^{-1} tangential to the rim of the wheel
B 18 kg m^2 s^{-1} from the rim to the centre of the wheel
C 18 kg m^2 s^{-1} along the axle of the wheel
D 270 kg m^2 s^{-2} tangential to the rim of the wheel
E 270 kg m^2 s^{-2} from the rim to the centre of the wheel
F 270 kg m^2 s^{-2} along the axle of the wheel

Q4 Figure 2 shows two Maxwell speed distributions plotted on the same horizontal axis. Given that the masses of molecules are such that $m_{\text{oxygen}} > m_{\text{hydrogen}}$, choose from the key for Q4 the one correct statement, and pencil across *one* cell in row 4.

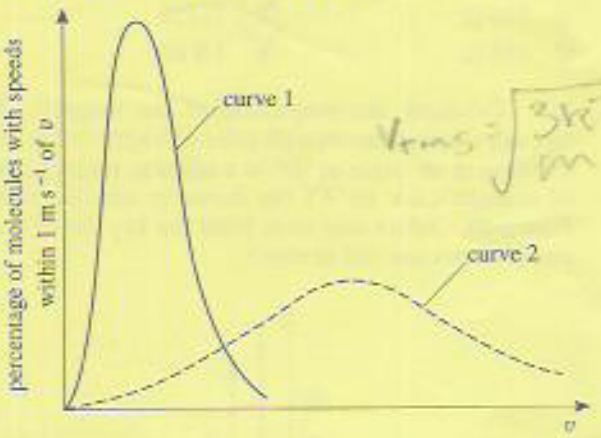

Figure 2

KEY for Q4

A If curve 1 represents hydrogen at 27 °C, then curve 2 could represent oxygen at 27 °C.
B If curve 1 represents hydrogen at 27 °C, then curve 2 could represent oxygen at −10 °C.
C If curve 1 represents oxygen at 27 °C, then curve 2 could represent hydrogen at 27 °C.
D If curve 1 represents oxygen at 27 °C, then curve 2 could represent oxygen at −10 °C.
E Curve 1 could represent both oxygen and hydrogen at −27 °C.

Q5 The key for Q5 contains five statements about vibrations, only *one* of which is correct. Choose the *correct* statement and pencil across *one* cell in row 5.

KEY for Q5

A In simple harmonic motion, there is a phase difference of half a period between the displacement and the velocity.
B In simple harmonic motion, the position of maximum displacement coincides with the position of the maximum magnitude of the velocity.
C In simple harmonic motion, the magnitude of the acceleration is proportional to the displacement from the equilibrium position.
D Damping reduces the period of simple harmonic vibrations.
E If damping is less than a critical value, no oscillations occur.