

PART I

This part carries 33% of the total examination marks.

You should attempt **ALLELEVEN** 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 only **ONE** answer. No marks will be given for questions where more than one answer has been selected from the key. There are no penalty marks for incorrect answers.

Q1 A particle moves along the x -axis. During the period between $t = 0.0$ s and $t = 3.0$ s, its position x depends on time as shown in Figure 1. Which of the items in the key for Q1 most accurately describes the times for which the velocity v_x of the particle is positive? Pencil across *one* cell in row 1.

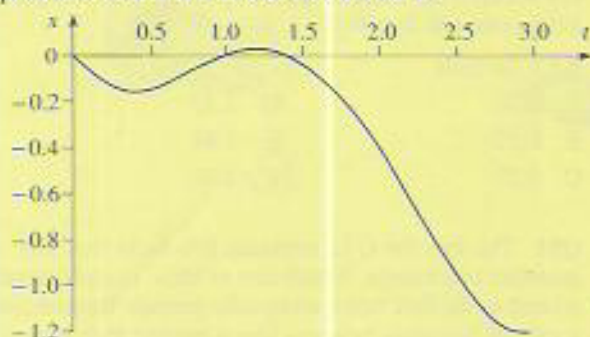


Figure 1

KEY for Q1

- A t between 0.4 s and 1.2 s.
- B t between 1.0 s and 1.4 s.
- C t between 0.0 s and 1.0 s.
- D t between 0.7 s and 2.3 s.
- E t between 0.0 s and 0.7 s and t greater than 2.3 s.

Q2 A motor-driven winch is used to pull a vehicle clear of a bog. The force supplied by the tow rope has magnitude 1.0×10^4 N and acts at 30° above the horizontal. The vehicle is pulled through a horizontal distance of 10 m. Assuming that all the energy consumed is used in overcoming resistance to motion, what is the energy used? Choose the response from the key for Q2 closest to your own answer, and pencil across *one* cell in row 2.

KEY for Q2

- A 1.0×10^5 J
- B 8.7×10^4 J
- C 5.0×10^4 J
- D 1.0×10^4 J
- E There is insufficient information to answer the question.

Q3 What are the correct SI units for the magnitude of angular momentum? Select *one* answer from the key for Q3, and pencil across *one* cell in row 3.

KEY for Q3

- A kg m s^{-1}
- B rad s^{-1}
- C N s^{-1}
- D rad kg m s^{-1}
- E $\text{kg m}^2 \text{s}^{-1}$
- F kg m s^{-2}

S271/Specimen

Q4 What is the average translational kinetic energy of an oxygen molecule in air at room temperature (taken as 300 K)? Choose the response from the key for Q4 that is closest to your own answer. Pencil across *one* cell in row 4.

KEY for Q4

- A 5.59×10^{-20} J
- B 2.76×10^{-21} J
- C 6.21×10^{-21} J
- D Impossible to say without knowing the relative proportions of oxygen and nitrogen in air.
- E Impossible to calculate without knowing the mass of an oxygen molecule.

Q5 The key for Q5 contains five statements about vibrations. Select the one **WRONG** statement from the key, and pencil across *one* cell in row 5.

KEY for Q5

- A When a travelling wave on a string is reflected at a fixed end, the reflected wave is inverted.
- B When a light wave travelling through a medium of low refractive index is reflected at a boundary with a medium of high refractive index, the reflected wave is inverted.
- C When a wave crosses a boundary at which its speed increases, the wave is refracted towards the normal to the boundary.
- D Interference effects are a direct consequence of the principle of superposition.
- E The smaller the spacing between the lines in a diffraction grating, the wider the spread of the diffraction pattern.

Q6 Figure 2 shows three charges positioned on a horizontal frictionless surface. Charges M and N are fixed in place. Particle P (of charge $+1$ C) is initially stationary but is free to move. Which path will it take? Choose the response from the key to Q6 that most closely approximates the correct path, and pencil across *one* cell in row 6.

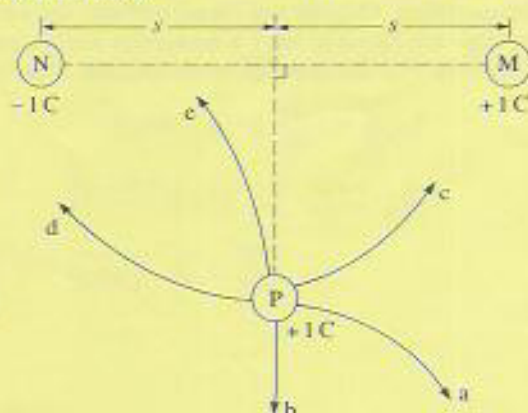


Figure 2

KEY for Q6

- A Path a
- B Path b
- C Path c
- D Path d
- E Path e
- F Charge P will not move.

TURN OVER