Examiner only

Answer **all** *questions.*

Answer the following questions in your own words. Direct quotes from the original article will not be awarded marks.

(a) **Experiment 1** - Draw diagrams showing the stationary wave patterns for the lowest frequency (first harmonic) and the next lowest frequency (third harmonic) in the hollow cardboard tube (Paragraph 2). [2]

(b) **Experiment 1** - Calculate the frequency and wavelength for the third harmonic in the 1.800 m tube (Paragraph 2). [2]

(c) **Experiment 2** - Explain qualitatively why the variation in light intensity detected by the smart phone is as shown in Figure 3 (see Paragraphs 4 & 5 and Figure 2 also). Do not refer to Malus's law or the $\cos^2 \theta$ dependency. [4]

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(d) **Experiment 2** - In paragraph 5 it is claimed that the results plotted in Figure 3 are in excellent agreement with the law $I = I_0 \cos^2\theta$.

(i) Show clearly that for these results, using the arbitrary units of the graph scale, I_0 = 340. [1]

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(ii) Check whether or not the point plotted in Figure 3 for θ = 140° is in agreement with the law $I = I_0 \cos^2\theta$. Show all steps in your working. [2]

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(e) **Experiment 3** - Some textbooks claim that "rubber tyres have patterns of grooves or tread: these patterns increase the roughness and give better grip." Evaluate whether the data in Table 1 (Paragraph 8) disproves this theory or whether this result is due to experimental uncertainty. [3]

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(f) **Experiment 4** - According to the writer, the results in Table 2 (Paragraph 9) suggest that B depends on r according to an inverse cube law, that is a law of the form:

$$B = \frac{K}{r^3} \qquad \text{(Paragraph 10)}$$

Justify this statement. [2]

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Examiner only

(g) **Experiment 5**

(i) For the car, starting from rest, whose acceleration-time graph is given in Figure 6, calculate the velocity at t = 25 s. [1]

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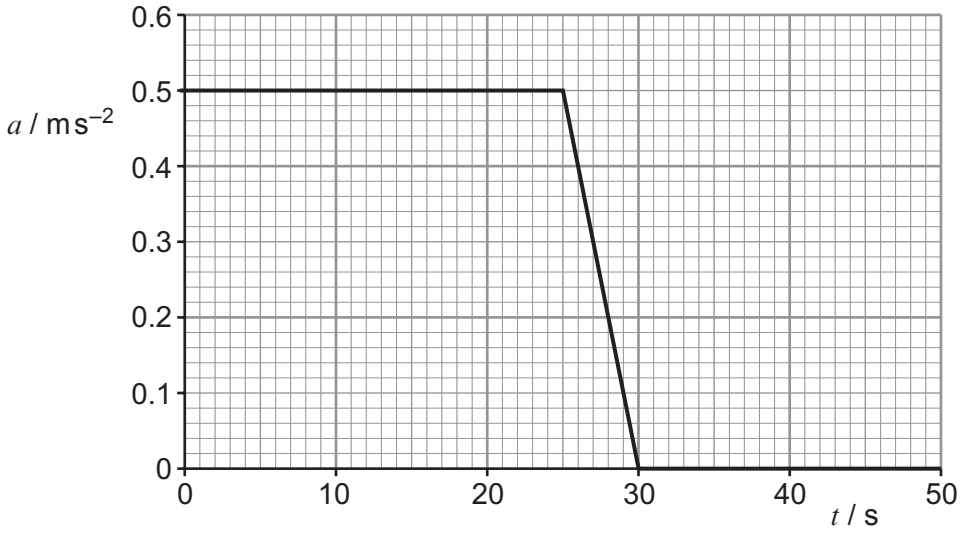
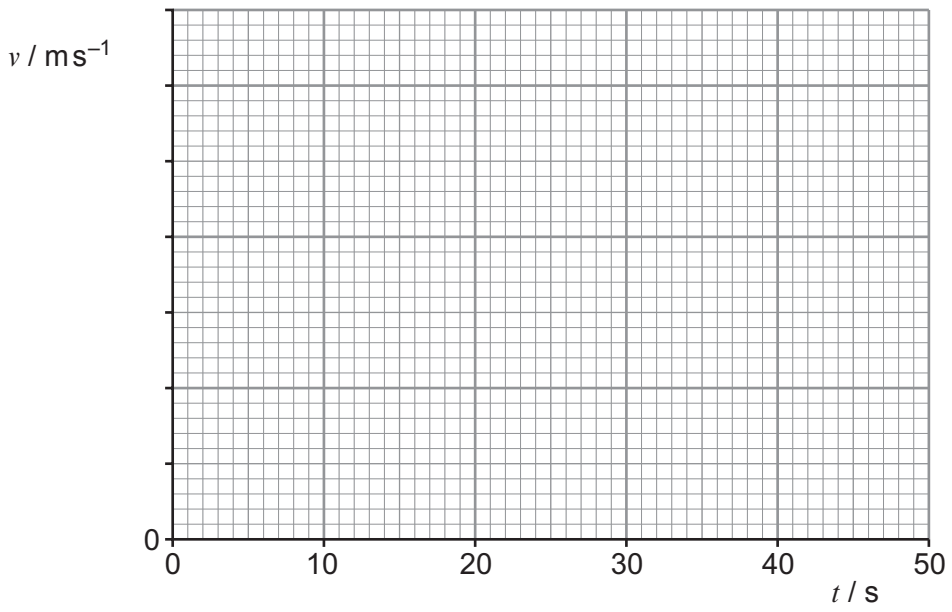
(ii) Sketch a velocity-time graph for the car, on the blank grid below. Put a scale on the vertical axis. (A copy of Figure 6 is provided so that you can refer to it easily.) [3]





END OF PAPER

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