7. Waves

7.3 Doppler effect for sound waves

Paper 2

Marking Scheme

Q1.

(a)	sketch: approximately horizontal line above horizontal dashed line from $t = 0$ to $t = t_1$ **and** approximately horizontal line below horizontal dashed line from $t = t_1$ to $t = t_2$	**A1**

Q2.

(b)(i)	(frequency varies as) vehicle moves relative to (stationary) observer	**C1**
	(vehicle) moving towards (observer) gives higher (observed) frequency (than 1.2 kHz) and (vehicle) moving away (from observer) gives lower (observed) frequency (than 1.2 kHz)	**A1**
(b)(ii)	Doppler effect	**B1**
(b)(iii)	position of vehicle labelled 'X' at top (12 o'clock) position on track	**B1**
(b)(iv)	position of vehicle labelled 'Y' at right-hand edge (3 o'clock) position on track	**B1**
(c)	maximum frequency = 1.40 (kHz) **or** 1.40×10^3 (Hz)	**C1**
	$1.40 = (1.2 \times 320) / (320 - v)$	**C1**
	$v = 46$ m s^{-1}	**A1**
	or	
	minimum frequency = 1.05 (kHz) **or** 1.05×10^3 (Hz)	**(C1)**
	$1.05 = (1.2 \times 320) / (320 + v)$	**(C1)**
	$v = 46$ m s^{-1}	**(A1)**

Q3.

(a)(i)	decrease(s)	**B1**
(a)(ii)	increase(s)	**B1**
(b)	$f_o = f_s \, v / (v + v_s)$ $= 925 \times 338 / (338 + 12)$	**C1**
	$= 893$ Hz	**A1**

Q4.

(d)	$f_o = f_s \, v / (v - v_s)$ $480 = f_s \times 340 / (340 - 14)$	**C1**
	$f_s = 460$ Hz	**A1**

Q5.

(f)	$f_o = f_s v / (v - v_s)$ $= 3000 \times 340 / (340 - 22)$	**C1**
	$= 3200$ Hz	**A1**

Q6.

(e)(i)	$f_0 = (900 \times 340) / (340 + 12)$	**C1**
	$= 870$ Hz	**A1**
(e)(ii)	speed/velocity (of sledge) decreases and (so) frequency increases	**B1**