Question			Expected response	Max mark	Additional guidance
2.	(a)		$F = ma$ **(1)** $1{\cdot}15\times10^5 = (9{\cdot}75\times10^4 + 3{\cdot}56\times10^4)\times a$ **(1)** $(F = ma)$ $F = 3{\cdot}56\times10^4 \times \left(\frac{1{\cdot}15\times10^5}{1{\cdot}331\times10^5}\right)$ **(1)** $F = 3{\cdot}08\times10^4\,\text{N}$ **(1)**	**4**	Accept 3·1, 3·076, 3·0759 $F = ma$ anywhere, 1 mark
	(b)	(i)	$f_0 = f_s\left(\frac{v}{v \pm v_S}\right)$ **(1)** $531 = 511\left(\frac{340}{340 - v_S}\right)$ **(1)** $v_S = 13\ \text{m s}^{-1}$ **(1)**	**3**	Accept $f_0 = f_s\left(\frac{v}{v - v_S}\right)$ Accept 10, 12·8, 12·81
		(ii)	Not correct/incorrect **(1)** The passenger and engine are travelling at the same velocity. **(1)**	**2**	MUST JUSTIFY Accept: The passenger is travelling at the same speed and in the same direction as the whistle/engine. The distance between the whistle/engine and passenger remains constant.

Q2(a) **Maximum mark: 4**

Response A

Marks

$F = ma$

$F = 1.15 \times 10^5 N$

$m = 1.33 \times 10^5 kg$

$a = ?$

$a = \frac{m}{F}$

$a = \frac{1.33 \times 10^5}{1.15 \times 10^5}$

$a = 1.1565...$

$a = 1.16 ms^{-2}$

$F_T = ma$

$F_T = ?$

$m = 3.56 \times 10^4$

$a = 1.16$

$F_t = 3.56 \times 10^4 \times 1.16$

$Ft = 41180 N$

Response B

total mass $= 133.1 \times 10^3 kg$

$F = ma$

$1.15 \times 10^5 = 133.1 \times 10^3 \times a$

$a = \frac{1.15 \times 10^5}{133.1 \times 10^3} = 0.86 ms^{-2}$

$F = ma$

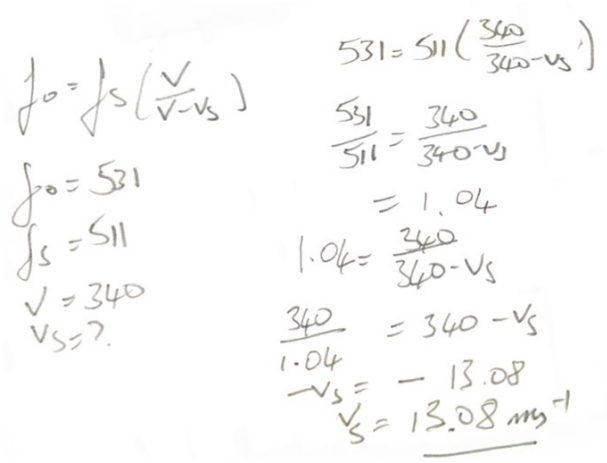
$= 3.56 \times 10^4 \times 0.86$

$= 30.6 \times 10^3 N$

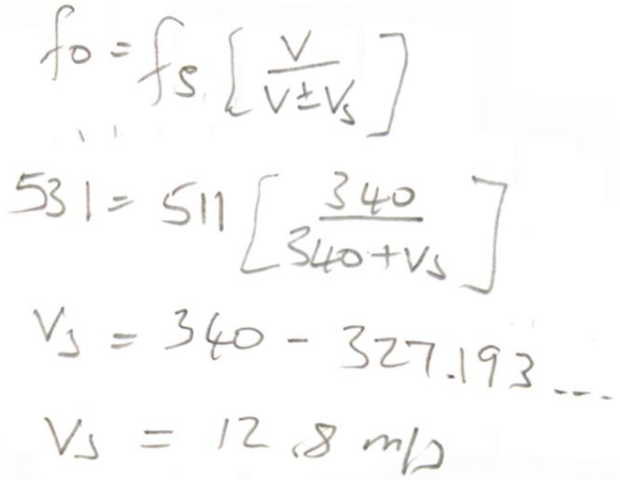
Q2(b)(i) Maximum mark: 3

Response 1

Marks



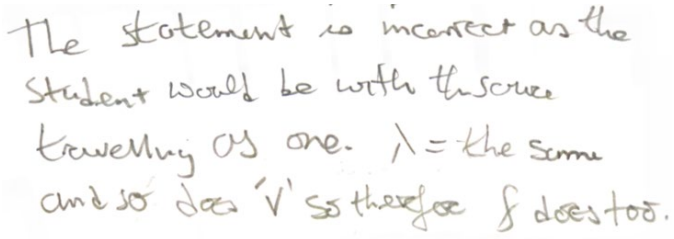
Response 2



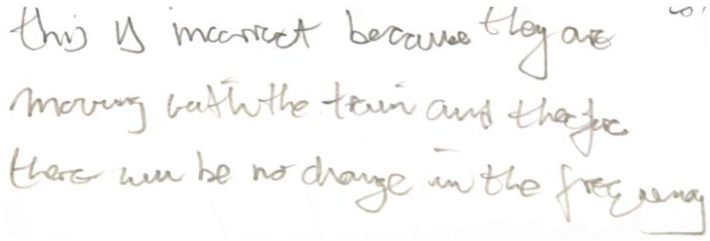
Q2(b)(ii) Maximum mark: 2

Response A

Marks



Response B



2(a)	A	4	1	The candidate has selected an appropriate relationship but has not correctly substituted values due to incorrect transposition ($a = \frac{m}{F}$ rather than $a = \frac{F}{m}$).

Question	Candidate response	Max mark	Mark awarded	Commentary
	B	4	3	The candidate has selected an appropriate relationship and has correctly substituted values in both uses of the relationship. The candidate's final answer, however, is not acceptable, due to rounding at the intermediate stage. The mark for the final answer is not awarded.
2(b)(i)	A	3	2	The candidate has selected an appropriate relationship, and correctly substituted values. The candidate's final answer, however, is not acceptable, due to rounding at the intermediate stage. The mark for the final answer is not awarded.
	B	3	1	The candidate has selected an appropriate relationship but has substituted values into the incorrect version of the selected relationship (presumably $f_o = f_s\left[\frac{v}{v+v_s}\right]$ rather than $f_o = f_s\left[\frac{v}{v-v_s}\right]$).
2(b)(ii)	A	2	1	The candidate has made a correct statement. The language of the justification, while not incorrect, is not sufficiently precise for the second mark to be awarded.
	B	2	1	Again, this candidate has made a correct statement. The language of the justification, while not incorrect, is not sufficiently precise for the second mark to be awarded.