CONTENTS

KEY TO MARK TYPES AND ABBREVIATIONS

MARK TYPES	DESCRIPTION
M	Mark is for method.
dM	Mark is dependent on one or more **M** marks and is for method.
R	Mark is for reasoning.
A	Mark is **dependent** on **M** marks and is for accuracy.
B	Mark is **independent** of **M** marks and is for method and accuracy.
E	Mark is for explanation.

ABBREVIATION	DESCRIPTION
ft	Follow through from previous incorrect result.
AG	Answer given in question.
SC	Special case.
'their'	Indicates that credit can be given from previous incorrect result.
CAO	Correct answer only.
OE	Or equivalent
PI	Possibly implied
CSO	correct solution only.
AWFW	Anything which falls within.
AWRT	Anything which rounds to.
ACF	Any correct form.
NMS	No method shown.
SCA	Substantially correct approach.
s.f.	Significant figures.
d.p.	Decimal places.

Examiners Should Consistently Apply The Following General Marking Principles

No Method Shown

- Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.
- Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award full marks. However, the obvious penalty to students showing no working is that incorrect answers, however close, earn no marks.
- Where a question asks the student to state or write down a result, no method need be shown for full marks.
- Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns full marks, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains no marks.

  Otherwise we require evidence of a correct method for any marks to be awarded.

Diagrams

- Diagrams that have working on them should be treated like normal responses.
- If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked.
- Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.
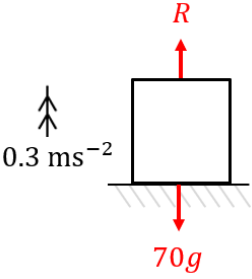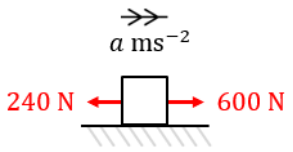
Work Erased Or Crossed Out

- Erased or crossed out work that is still legible and has not been replaced should be marked.
- Erased or crossed out work that has been replaced can be ignored.
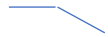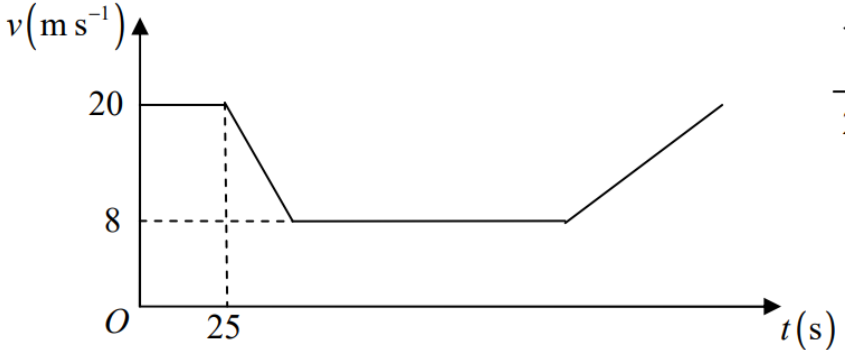
Choice

- When a choice of answers and/or methods is given and the student has not clearly indicated which answer they want to be marked, only the last complete attempt should be awarded marks.

SECTION A – STANDARD EXAM STYLE QUESTIONS

Q1	Marking Instructions	Marks	Typical Solution
1.	Sight of $70g$ or 686	B1	
	Sight of 70×0.3 or 21	B1	
	Attempt to form a three-term force equation involving two forces and ma.	M1	
	Correct answer	A1	
		4 marks	

$R(\uparrow): \quad R - 70g = 70 \times 0.3$

$$R = 70 \times 0.3 + 70g$$
$$= 707 \text{ N}$$

0.3 ms^{-2}

R

$70g$

Q2	Marking Instructions	Marks	Typical Solution
2. (a)	Note: AG Attempt to form a three-term force equation involving two forces and ma.	M1	 $R(\rightarrow):\ 600 - 240 = 900a$ $a = 0.4\ \text{ms}^{-2}$ $a\ \text{ms}^{-2}$ 240 N ← □ → 600 N
	Arrives at correct answer **from correct force equation.** (correct force equation must be seen)	A1	
		2 marks	
2. (b)	Correct use of $v = u + at$ (values must be in correct places)	M1	$s = ?$ $9 = 5 + 0.4t$ $t = 10\ \text{s}$ $u = 5\ \text{ms}^{-1}$ $v = 9\ \text{ms}^{-1}$ $9^2 = 5^2 + 2(0.4)s$ $a = 0.4\ \text{ms}^{-2}$ $56 = 0.8s$ $t = ?$ $s = 70\ \text{m}$
	Obtains $t = 10\ \text{s}$	A1	
	Correct use of $v^2 = u^2 + 2as$ **or** $s = ut + \dfrac{1}{2}at^2$ **or** $s = \dfrac{1}{2}(u + v)t$ (values must be in correct places)	M1	
	Obtains $s = 70\ \text{m}$	A1	
		4 marks	

Q3	Marking Instructions	Marks	Typical Solution
3. (a)	Correct use of $v^2 = u^2 + 2as$	M1	$s = h$
	Obtains $s = 19.6$ m	A1	$u = 19.6 \text{ ms}^{-1}$ $\qquad$ $0 = 19.6^2 + 2(-9.8)h$
	Notes:	2 marks	$v = 0 \text{ ms}^{-1}$ $\qquad$ $19.6h = 19.6^2$
	M1 is for a complete method (which could involve use of two suvat equations) for finding height.		$a = -9.8 \text{ ms}^{-2}$ $\qquad$ $h = 19.6$ m $\quad$ $t = ?$
3. (b)	Correct use of $s = ut + \dfrac{1}{2}at^2$ to form a three-term quadratic using $u = 19.6$, $v = 0$ and $a = \pm 9.8$ or their $h - 14.7 = \dfrac{1}{2}gt^2$	M1	$s = ?$ $u = 19.6 \text{ ms}^{-1}$ $\qquad$ $14.7 = 19.6t + \dfrac{1}{2}\left(-9.8\right)t^2$ $v = 0 \text{ ms}^{-1}$ $\qquad$ $0 = -4.9t^2 + 19.6t - 14.7$ $a = -9.8 \text{ ms}^{-2}$ $\qquad$ $t = 3, \ t = 1$ $t = ?$ $\qquad$ Time above $14.7 \text{ m} = 3 - 1 = 2 \text{ s}$
	Obtains $0 = -4.9t^2 + 19.6t - 14.7$ (OE) or $4.9 = 4.9t^2$ (OE)	A1	
	Attempt to solve *their* three-term quadratic or Solves *their* $h - 14.7 = \dfrac{1}{2}gt^2$ to find t.	dM1	
	Correctly obtains $t = 1$ or $t = 3$	A1	
	Final answer of $t = 2$ s	A1	
		5 marks	

Q4	Marking Instructions	Marks	Typical Solution
4. (a)	Correct shape for 1st section of graph	B1	
	Correct shape for 2nd section of graph	B1	
	Completely correct graph with $v = 20$, $v = 8$ and $t = 25$ labelled.	A1	
		3 marks	
4. (b)	Correct use of $v = u + at$ with $v = 8$, $u = 20$ and $a = \pm0.4$	M1	
	Obtains $t = 30$ s	A1	
		2 marks	

Typical Solution for 4. (a):

Typical Solution for 4. (b):

$s = ?$

$u = 20 \text{ ms}^{-1}$ $8 = 20 - 0.4t$

$v = 8 \text{ ms}^{-1}$ $-12 = -0.4t$

$a = -0.4 \text{ ms}^{-2}$ $t = 30$ s

$t = ?$

Q4c	Marking Instructions	Marks	Typical Solution
4. (c)	Clear attempt to find area under *their* graph (must include an unknown, e.g. t) and equate to 1960.	M1	**Method 1:** $$1960 = 20 \times 25 + \frac{1}{2} \times \left(20 + 8\right) \times 30 + 8 \times 60 + \frac{1}{2} \times \left(8 + 20\right)T$$ $$1960 = 1400 + 14T$$ $$T = 40 \text{ s}$$ Time from A to $B = 115 + 40 = 155$ s
	Correct calculation for area under the graph – deduct one mark for each numerical error or missing part in each of the 4 sections. Useful calculations: $20 \times 25 = 500$, $\frac{1}{2} \times (20 + 8) \times 30 = 420$, $60 \times 8 = 480$ $\frac{1}{2}(8 + 20)T$	A1A1A1	**Other correct calculations:** $$1960 = 20 \times 25 + 30 \times 8 + \frac{1}{2} \times 30 \times 12 + 60 \times 8t + \frac{1}{2} \times 12 \times t$$ $$1960 = \left(25 \times 20\right) + \left(30 \times 8\right) + \left(\frac{1}{2} \times 30 \times 12\right) + \left(60 \times 8\right) + 8 \times t + \frac{1}{2} \times t \times 12$$
	Sums *their* areas to produce a single term.	dM1	
	Correctly simplifies to obtain a correct equation (equation should solve to give either $T = 40$ or $t = 155$	A1	
	Attempts to solve for total time.	dM1	
	Obtains $t = 155$ s	A1	
		8 marks	

Q5	Marking Instructions	Marks	Typical Solution
5. (a) (i)	Correct use of $v = u + at$	M1	$9.3 = 8.5 + 0.2t$ $t = 4 \text{ s}$
	Obtains $t = 4 \text{ s}$.	A1	
		2 marks	
5. (a) (ii)	Correct use of a constant acceleration to obtain displacement.	M1	$s = \dfrac{1}{2} \times \left(8.5 + 9.3\right) \times 4$ $s = 35.6 \text{ m}$
	Obtains $s = 35.6 \text{ m}$.	A1	
		2 marks	
5. (b) (i)	Sight of $\dfrac{180}{8.8}$	M1	Sam's time $= \dfrac{180}{8.8} = 20.45 \text{ s}$ Tom's time $= 4 + \dfrac{190 - 35.6}{9.3} = 20.6 \text{ s}$
	Correctly obtains 20.45 s for Sam's time.	A1	
	Attempt to calculate Tom's remaining time using *their* answers from (a)(i) and (a)(ii). Must see evidence of a calculation of the form $\dfrac{\textit{their} \text{ remaining distance}}{9.3}$	M1	
	Correct calculation for Tom's time.	A1	
	Completes a rigorous argument, concluding that Sam wins the race. Note: Must have been awarded previous 4 marks. Note: Clear communication used throughout: • Calculations must be related to the runners o e.g. Sam's time = …., Tom's time = ….	R1	
		5 marks	
5. (b) (ii)	(*their* time for Tom − *their* time for Sam) × 9.3 (with correct answer for *their* calculations)	B1ft	$(20.6 - 20.45) \times 9.3 = 1.40 \text{ m}$
		2 marks	

SECTION B – MORE CHALLENGING EXAM STYLE QUESTIONS

Q6ab	Marking Instructions	Marks	Typical Solution
6 (a)	Note: AG Uses $v^2 = u^2 + 2as$ with $a = \pm 9.8$ and $u = 0$ or $v = 0$	M1	$s = h$ $u = 8.4 \text{ ms}^{-1}$ $\qquad 0^2 = 8.4^2 + 2(-9.8)h$
	Obtains $0^2 = 8.4^2 + 2(-9.8)h$ (OE)	A1	$v = 0 \text{ ms}^{-1}$ $\qquad 19.6h = 8.4^2$ $a = -9.8 \text{ ms}^{-2}$ $\qquad h = 3.6 \text{ m}$
	Obtains 3.6 m from correct working.	A1	$t = ?$
		3 marks	
6 (b)	Uses $v^2 = u^2 + 2as$ with $a = \pm 9.8$ and $s = 1.6$	M1	$s = 1.6$ $u = ?$ $\qquad 0^2 = u^2 + 2(-9.8)(1.6)$
	Obtains $u = 5.6 \text{ ms}^{-1}$	A1	$v = 0 \text{ ms}^{-1}$ $\qquad u^2 = 31.36$
		2 marks	$a = -9.8 \text{ ms}^{-2}$ $\qquad u = 5.6 \text{ ms}^{-1}$ $t = ?$

Q6c	Marking Instructions	Marks	Typical Solution
6. (c)	Note: Alternate method is given below. Obtains expressions of the form $s = ut + \dfrac{1}{2}gt^2$ for both P and Q and attempts to equate them, taking into account the difference in starting positions. e.g. *their* $s_P = $ *their* $s_Q + 2$	M1	Finding the displacement of each particle **from the ground:** $$s_P = 8.4t - 4.9t^2$$ $$s_Q = 5.6t - 4.9t^2 + 2$$ The particles are at the same height when: $$8.4t - 4.9t^2 = 5.6t - 4.9t^2 + 2$$ $$2.8t = 2$$ $$t = 0.714... \text{ s}$$ Calculating the velocities of the particles: $$v_p = 8.4 - 9.8(0.714...)$$ $$v_p = 1.4 \text{ ms}^{-1}$$ $$v_Q = 5.6 - 9.8(0.714...)$$ $$v_Q = -1.4 \text{ ms}^{-1}$$
	Obtains $8.4t - 4.9t^2 = 5.6t - 4.9t^2 + 2$ (OE)	A1	
	Obtains $t = 0.714...$ (or $t = \dfrac{5}{7}$)	A1	
	Uses *their* values for t to calculate v_P and v_Q using $v = u + at$	dM1	
	Obtains $v_p = 8.4 - 9.8(0.714...)$ and $v_Q = 5.6 - 9.8(0.714...)$	A1	
	Obtains $v_P = 1.4$ and $v_Q = -1.4$	A1	
		6 marks	

Q6c	Marking Instructions	Marks	Typical Solution
6. (c) Alt 1.	Attempt to calculate time when at same speed in opposite directions (must see evidence of $v = u + at$ for both particles).	M1	Speeds are the same but in opposite directions: $$v_P = 8.4 - 9.8t$$ $$-v_Q = 5.6 - 9.8t$$ $$8.4 - 9.8t = 9.8t - 5.6$$ $$19.6t = 14$$ $$t = 0.714...$$ Displacement of particles at $t = 0.714...$: $$s_P = 8.4(0.714) + \frac{1}{2}\left(-9.8\right)\left(0.714...\right)^2$$ $$= 3.5 \text{ m}$$ $$s_Q = 5.6(0.714) + \frac{1}{2}\left(-9.8\right)\left(0.714...\right)^2$$ $$s_Q = 1.5 \text{ m}$$ $$\therefore \ s_P = s_Q + 2 \text{ as required}$$
	Obtains $v_P = 8.4 - 9.8t$ and $-v_Q = 5.6 - 9.8t$	A1	
	Obtains either $v = 1.4$ or $t = 0.714...$ or $t = \dfrac{5}{7}$	A1	
	Subsitutes $t = 0.714...$ into $s = ut + \dfrac{1}{2}at^2$ for both particles.	dM1	
	Obtains $s_P = 8.4(0.714) + \dfrac{1}{2}\left(-9.8\right)\left(0.714...\right)^2$ and $s_Q = 5.6(0.714) + \dfrac{1}{2}\left(-9.8\right)\left(0.714...\right)^2$	A1	
	Obtains $s_P = 3.5$ and $s_Q = 1.5$	A1	
		6 marks	