

Eduqas Physics GCSE
Topic 4.2: Forces, accelerations
and Newton's laws of motion
Mark Schemes for Questions by topic

1.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
	6	<p>Indicative content: According to Newton's 1st law for the rocket to change its state of motion it must have been acted on by a resultant force when the engines are fired. According to Newton's 3rd law the gases that are pushed out of the rocket creates an equal and opposite force on the rocket. This is the thrust force. Newton's 2nd law tells us the relationship between the resultant force and the acceleration is given by $F = ma$ or force equals rate of change of momentum. The resultant force arises because the thrust is bigger than the weight.</p> <p>5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>			
TOTAL	6				

2.

Question		Marking details	Marks
2.	(a)	$\frac{(800-200)(1)}{80(1)} = 7.5 \text{ (1-ans) [m/s}^2\text{]}$ <p>Award 1 mark for 600 anywhere</p>	3
	(b) (i)	<p>Indicative content:</p> <p>When the parachute is opened, a big air resistance force is produced that acts upwards. This is bigger than the person's weight (downwards), the resultant force is upwards and so the person decelerates. As the speed decreases, the air resistance (or resultant force) decreases and the deceleration decreases. Eventually the speed becomes so low that the air resistance and weight become equal and the person falls at a (low) constant speed.</p> <p>5 – 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.</p>	6
	(ii)	<p>Bigger parachute / surface area (1) To give a bigger air resistance / upward force (1) To equal the [bigger] weight (1) Either the 2nd mark must be linked to the 1st mark or the 3rd mark must be linked to the 2nd mark.</p> <p style="text-align: right;">Question total</p>	3
			[12]

3.

Question		Marking details	Marks
6.	(a)	Rocket exerts force on exhaust gases (1) which exert [equal but opposite] force on rocket causing it to take-off (1) Do not credit a statement of N's 3 rd law out of context.	2
	(b)	(i) Indicative content: [Ignore changes to g] Using $F = ma$, $(1.5 \times 10^7 - 9.5 \times 10^6) = 9.5 \times 10^5 \times a$ so $a = 5.789 \text{ [m/s}^2\text{]}$. The acceleration increases because the weight decreases as fuel is used up, thus increasing the resultant upward force (thrust remains constant). The acceleration is directly proportional to the resultant force. The acceleration also increases because the mass decreases (acceleration is inversely proportional to mass). 5 – 6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.	6
		(ii) $mg\Delta h = 320 \times 1.35 \times 120000 [= 51\,840\,000 \text{ J}]$ Correct value for m (320 kg)(1), correct value for $g \times 1.35$ (1), correct value for $\Delta h \times 120\,000$ (1). No mark for answer. Award 3 marks for 51 840 000 Award 2 marks for 51 840 or 1.54×10^{11} or 1.14×10^{12} Award 1 mark for 384 000 or 1.54×10^8 or 1.14×10^9	3
		(iii) Energy is converted / transferred / changed (1) (not <u>lost</u> , but accept <u>lost and changes</u>) to <u>work being done against friction</u> [in the atmosphere] / increasing the heat energy or temperature <u>of the</u> atmosphere and/or probe or parachute (1) Either mark can be awarded on its own but only award 2 marks if they are linked.	2
		Question total	[13]
		HIGHER TIER PAPER TOTAL	[60]

4.

Question			Marking details	Marks
3.	(a)	(i)	D	4
		(ii)	C	
		(iii)	C	
		(iv)	D	
	(b)		50 x 70 (1 – substitution) = 3 500 [kg m/s] (1) ALTERNATIVE: 55 x 70 = 3 850 and 5 x 70 = 350 (1) 3 500 [kg m/s] (1)	2
Question total				[6]

5.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	The <u>water</u> exerts a <u>force</u> (1) which is <u>equal and opposite</u> / which is <u>equal and to the left</u> (1)	Statement of N3L award 1 mark only		
(b)	(i)	$a = \frac{v-u}{t} = \frac{14-2}{8}$ (1-subst) = 1.5 [m/s ²] (1-ans) $F = ma = 60 \times 1.5$ (ecf) (1-subst) = 90 [N] (1-ans)			
	(ii)	I	1	An arrow drawn appreciably horizontally to the right somewhere near the water skier.	
		II	2	It is bigger (1) because it equals resultant force + drag / because of resistive forces acting (1) [friction / air resistance / water resistance / drag]	
(c)	(i)	3	Speeding up for <u>8 seconds</u> (1) From <u>2 to 14 m/s</u> (1) Constant speed for <u>7 seconds / up to 15 seconds</u> (1) In absence of values or incorrect values award 1 mark for speeding up then constant speed	Terminal velocity for constant speed Speeding up for 8 seconds to a constant speed award 1 mark only Steady pace for constant speed	Reference to value of acceleration Accelerates at a constant speed
	(ii)	2	FT (14 x 7) (1) = 98 [m] (1)		
	(ii)	3	HT 16 (1) + 48 (1) + 98 (1) = [162 m] OR 64 (2) + 98 (1) = [162 m] OR 30 (1) + 48 (1) + 84 (1) = [162 m] OR 30 (1) + 132 (2) = [162 m]	162 m on the answer line award 3 marks	
	(iii)	2	Any line from (15,14) to (25,0) < 1 small square tolerance (1) Any curve of decreasing gradient with time starting from (15,14) (1)		

6.

Question		Marking details	Marks	
4.	(a)	<p>Equal and opposite forces (1) acting on different objects (1) Equal and opposite forces acting on the same object – award 1 mark Award 2 marks for action and reaction are equal and opposite</p>	2	
	(b)	(i)	<p>Force = 5 [N](1) accept 4.9 [N] upwards (1)</p>	2
		(ii)	<p>$\Delta v = a \times t = 10 \times 0.8$ (1-sub+manip) = 8 [m/s](1-ans)</p>	2
		(iii)	<p>EITHER: $a = \frac{8(\text{ecf})}{0.2} = 40$ [m/s²](1) $F = ma = 0.5 \times 40$ (ecf) (1) = 20 [N] (1)</p> <p>OR: $F = \frac{\Delta p}{t} = \frac{[0-]0.5 \times 8(\text{ecf})(1)}{0.2(1)} = 20$ [N] (1)</p> <p>OR: Momentum [change] = 0.5 × 8 (ecf)(1) = 4 $F = \frac{4}{0.2}$ (1) = 20 [N] (1)</p>	3
		Question total	[9]	

7.

(a) (i) zero

accept nothing

1

speed is zero

accept not moving

1

(ii) A

1

largest mass or weight

accept heaviest luggage

do not accept largest luggage

1

(iii) momentum does change

accept yes

1

direction is changing

accept velocity is changing

do not accept answers in terms of speed changing

1

(iv) kg m/s

1

[7]

8.

(a) (i) 10800

allow 1 mark for correct substitution i.e. 900×12

2

(ii) arrow pointing towards the left

allow anywhere on the diagram or at bottom of the page

1

(b) zero

accept 0 / none / nothing

1

velocity is zero

accept speed for velocity

accept stopped / not moving

accept a calculation i.e. $900 \times 0 = 0$

1

[5]

9.

(a) (i) 16 000

allow 1 mark for correct substitution ie 3200×5

2

(ii) 16 000 or their (a)(i)

1

(iii) less than

1