Chapter 13: Answers to Questions Rev D

Chapter 1		Answer	Remarks
1	i	10m North	The direction must be stated
	ii	10m East	The direction must be stated
	iii	10m South	The direction must be stated
	iv	20m West	The direction must be stated
	v	0 m (this is the start point)	
	vi	14.1m Northeast	The direction must be stated
	vii	14.1m Southeast	The direction must be stated
	viii	22.4m at a bearing of 243°	The direction must be stated
2	a	+2 x5 = +10m	Note the positive sign
	b	+6m	Note the positive sign
	c	-10m	Note the **negative** sign
	d	0m	
	e	40/50 = 0.8 m/s	
	f	Displacement/time = 0/50 = 0m/s	
3	a	Speed = distance/time = 100/60 = 1.67 m/s	
	b	velocity = displacement/time = 100/60 = 1.67 m/s North	The direction must be stated
	c	2.35m/s	
	d	2.35m/s SE	The direction must be stated
	e	1.17m/s	
	f	1.17m/s SW	The direction must be stated
	g	241/120 = 2.01m/s	Speed = distance / time
	h	100mE/120 = 0.83m/s E	Velocity = change in **displacement** / time The direction must be stated
Chapter 2			
1	a	300m	
	b	600m in total (300m out and 300m back)	
	c	velocity = change in displacement/time = 200m/20s = 10 m/s	
	d	velocity = change in displacement/time = 100m/20s = 5 m/s	
	e	velocity = change in displacement/time = -300m/20s = - 15 m/s (note the minus sign)	
	f	Max speed = 15 m/s (the max velocity, ignoring the sign)	
	g	Constant speed for 20s (travelling at 10m/s) Decelerates to 5m/s Constant speed of 5m/s until 40s Turns round Constant speed of 15m/s back to the start point	
2	a	30m	
	b	velocity = change in displacement/time = 30m/3s = 10 m/s	
	c	It is stationary / does not move / stands still	
	d	Straight line from (0,0) to (3s, 15m)	
Chapter 3			
1	a	0.5 m/s^2	Note metres per second SQUARED
	b	Straight line from (50s, 15m/s) to (60s, 20m/s)	
	c	Straight line from (60s, 20m/s) to (80s, 20m/s)	
	d	Straight line from (80s, 20m/s) to (100s, 0m/s)	
	e	0.5 m/s^2	

	f	-1 m/s^2	Note the sign
2	*a*	Increasing	
	b	Initially v increases rapidly (high acceleration) Later v increases slowly (smaller acceleration)	
	c	10m/s^2	unit
	d	5m/s^2	unit
	e	2.25m/s^2 (allow 2.0 to 2.5 m/s^2)	unit
Chapter 4			
Graph A	*a*	32m	
	b	v = change in displacement/time = (40 – 0)/5 = 8 m/s	
	c	v = change in displacement/time = (40 – 40)/5 = 0 m/s	
	d	v = gradient of line = - 40 / 2.5 = - 16 m/s	(negative)
Graph B	*a*	15m/s	Use the whole of the straight line from t=0 to t=10s. t-5s is half way along so gives a velocity of 15 m/s
	b	40m/s	
	c	a = change in velocity / time = (30 – 0) /10 = 3 m/s^2	unit
	d	a = change in velocity / time = (40 –40) /20 = 0 m/s^2	unit
Graph C	*a*	v = change in displacement/time = (40 – 0)/20 = 2 m/s	
	b	v = gradient of line = (80-40) / 10 = 4 m/s	
	c	v = change in displacement/time = (60 – 80)/30 = - 0.67 m/s	(negative)
Graph D	*a*	10 m/s	(constant velocity)
	b	a = change in velocity / time = -10 / 20 = -0.5 m/s^2	(note the sign and unit)
Chapter 5			
	1	$\Delta v = a \Delta t$	
	2	$\Delta t = \frac{\Delta v}{a}$	
	3	v = u + at	
	4	$t = \frac{v-u}{a}$	
	5	$a = \frac{\Delta v}{\Delta t} = \frac{20}{8} = 2.5$ m/s^2	
	6	$\Delta v = a\Delta t$ = 2x6 = 12 m/s	
	7	v = u + at = 20 + 3x5 = 35 m/s	
	8	$a = \frac{v-u}{t} = \frac{10-30}{40} = -0.5$ m/s^2	Note: the minus sign because it is decelerating
Chapter 6			
1		200m	
2	*a*	1200m	
	b	1600m	
	c	1800m	
3	*a*	500m	
	b	562.5m	
	c	687.5m	
Chapter 7			
1		The floor	

		You push down on the floor. In accordance with Newton's 3rd Law, the floor pushes up on you with an equal but opposite force	
2		It is true that the front of the car was colliding with air particles, but this describes how there is a force on the air particles. Air resistance (drag) is a force on the car, which will be equal but opposite to the force on the air particles added together. He should have said that drag was caused by air particles hitting the front of the car.	
3		Newton's 2nd Law The path may be a straight line in plan, but the surface of the Earth is curved, so the plane is travelling in a (vertical) curve. Therefore its (vertical) direction is changing, so it is accelerating. Hence Newton's 2nd Law applies.	
4	*a*	You cannot tell the direction of travel. All you can tell is that there is a push of the ground backwards on the car. This may be because the car is reversing and accelerating backwards... ..or... it may be travelling forwards and braking... ...or it may be stationary, but just about to start moving backwards	The direction of the resultant force only tells you the direction of acceleration. NOT THE DIRECTION OF TRAVEL
	b	Again, you cannot tell the direction of travel. All you can tell is that there is a forwards push of the road on the car. It could be moving forwards and accelerating forwards. It may be reversing and braking i.e. moving backwards but accelerating forwards. It may be stationary and about to move forwards.	The direction of the resultant force only tells you the direction of acceleration. NOT THE DIRECTION OF TRAVEL
Force Diagrams	*Force A*	• Drag/air resistance • Push • Air particles	
	Force B	• (Horizontal) push of the road on the car • Push • The road	Not acceleration (which is not a force) Not the engine
	Force C	• Weight / gravitational pull / gravitational attraction / gravitational force • Pull • The Earth	Not gravity Not mass
	Comment on diagram	• The car would accelerate forwards since Force B is shown larger that Force A, therefore there is a resultant force to the right • The car would accelerate downwards if only these forces acted since Force C is the only vertical force shown • There SHOULD BE a vertical push of the road upwards on the car (reaction force or normal contact force), BUT THIS HAS BEEN MISSED OUT • The diagram is incorrect	

Chapter 8			
1		10 + 6 - 4 = 12N right	Unit and direction
2		32.3 N	Check the unit
3		F = ma = 0.8 x 7.6 = 6.1N 45 – R = 6.1 R = 45 – 6.1 R= 38.9 N	
4	*a*	Δv = v – u = 4.5 – (- 5.0) = - 9.5 m/s	final velocity – initial velocity taking downwards as positive
	b	a= Δv/Δt = -9.5/0.05 = -190 m/s^2 or 190 m/s^2	
	c	F = ma = 0.25 x 190 = 47.5 N upwards	Should state the direction
	d	Push of ground on ball  Weight/gravitational attraction	**Do not allow 'gravity'**
	e	W = mg = 9.81 x 0.25 = 2.45N Push of ground – weight = 47.5 N Push of ground – 2.45N = 47.5N Push of ground = 47.5 + 2.45 = 49.95 N	
Chapter 9			
1		W = F x s = mg x s = 10 x 9.81 x 1.2 = 118 J	
2	*a*	900 J	
	b	75 W	
3	*a*	14.7 kN	
	b	64.7m	
	c	Work done = weight x Δheight = 950 kJ	
	d	Power = 23.8 kW	
4	*a*	P = work / time = average force x displacement /time But displacement / time = velocity So P = Fv	
	b	P = Fv = 90 x 10^3 x 15 = 1.35 x 10^6 W or 1.35 MW	
Chapter 10			
1		• Current is the same at all points in a series circuit • At a junction: total current entering the junction = total current leaving the junction	Not: current stays the same (if a cell is running down the current will be reducing over time – but it will still be the same at all points at a particular time)

2		• The length of resistance wire in the circuit increases • The resistance increases • The current reduces • The bulb shines less brightly	
3		• This increases the cross sectional area between A and B • The overall resistance will reduce • The current will increase	
4		• This increases the length of resistance wire • The total resistance increases • The current reduces	
5		• The voltage provided by the cells is lost around the circuit • Branches in parallel have the same voltage drop across them	$V_C = V_B$ $V_C = V_M + V_L$ $V_B = V_M + V_L$
6		P = 12.3 W Energy used = 3680 J (to 3 sig fig)	
Current in a wire	*1a*	5.0 C	
	1b	5.0 C	
	1c	22.5 C	
	1d	1.44×10^{20}	
	2a	0.02 A	
	2b	1.94 minutes	
Kirchoff's 1st Law	*1*	$I_1 = 0.56 - 0.26 = 0.30$ A $I_2 = 0.56$ A $I_3 = 0.56$ A	In series with the 0.56A In series with the 0.56A
	2	$I_3 = 0.15$A $I_4 = 0.15$A $I_5 = 0.10$A $I_1 = 0.55$A $I_6 = 0.55$A	The branch with 2 bulbs has twice the resistance of the branch with 1 bulb, so the current will be 0.15A The branch with 3 bulbs has 1/3 of the current as the branch with 1 bulb $I_1 = I_2 + I_3 + I_5$ I_6 and I_1 are in series with each other so are equal.
	3	$I_4 = 0.08$A $I_3 = 0.03$A $I_7 = 0.21$A $I_8 = 0.21$A $I_1 = 0.21$A	At junction B $I_2 = I_4 + I_6$ At junction C $I_3 + I_4 = I_5$ At junction D $I_5 + I_6 = I_7$ I_8 and I_1 are in series with I_7
Kirchoff's 2nd Law	*1*	pd = 1.7 V	Emf = sum of pds pd = 3.00 - 0.15 - 0.92 - 0.23 V
	2	$V_1 = 1.50$ V $V_2 = 0.37$ V $V_4 = 0.83$ V	Route through left hand branch : 1.50V emf is all used up by the variable resistor Route through middle branch : 1.50V emf, 1.13 V is dropped across the bulb so 0.37 V must be dropped across the motor Route through right hand branch : 1.50V emf, 0.67 V is dropped

			across the bulb (V_5) so 0.83 V must be dropped across the motor
	3	emf = 12 V V_2 = 6.4 V V_3 = 4.8 V	Route through right hand branch : emf = $V_1 + V_5 + V_6$ Route through left hand branch : 12V emf , but 5.6 V is dropped across the top resistor(V_1), so the remainder is dropped across the variable resistor, V_2 Route through middle branch : 12V emf , but 5.6 V is dropped across the top resistor(V_1), and 1.6 V is dropped across the bulb (V_4) so the remainder is dropped across the motor
Chapter 11			
1	*a*	I = 3.4 A R = 1.76 Ω	
	b	I = 4.2 A R = 2.38 Ω	
2		4.4×10^{-7} A or 0.44 μA	
3		131,600 V	
4		Min resistance = 95% x 150 kΩ = 142.5 kΩ I = 1.05×10^{-5} A (max)	
Chapter 12			
1	*a*	67/230 = 0.291 A	
	b	67 x 35 x 60 = 144,720 J = 144 kJ	
2	*a*	32.4 W	
	b	117 kJ	
3	*a*	0.040 A	
	b	0.040 / 1.6×10^{-19} = 2.5×10^{17} per second	