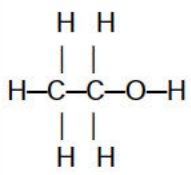
Question number				Answer	Notes	Marks
1	a	i		zymase	Accept yeast	1
		ii		$2CO_2$		1
	b			any value in range 250 – 350 (°C)	If range given, it must lie inside 250-350 Accept equivalent answers in other units, if the unit is given	1
	c		**M1**	(reaction 1) fermentation	Accept decomposition Ignore anaerobic respiration	2
			M2	(reaction 3) hydration	Accept addition Ignore references to continuous process	
	d			Any two of: • product is pure(r) / product is (more) concentrated • reaction is fast(er) • continuous process is more efficient • greater atom economy	Accept does not need separating from impurities	2

Question number			Answer	Notes	Marks
1	e		sugar cane (is readily) available **OR** no crude oil (to obtain ethene from) **OR** sugar cane is renewable /sugar cane is sustainable / crude oil is finite	Accept (large area of) land on which to grow sugar cane Ignore references to glucose Accept have a suitable climate for growing sugar cane Accept crude oil is (too) expensive Accept maize in place of sugar cane	1
	f	i	$C_2H_5OH \rightarrow C_2H_4 + H_2O$	Accept displayed/structural formulae) Accept word equation If both word and chemical equation given both must be correct	1
		ii	dehydration / elimination		1
					Total 10 marks

Question number			Answer	Notes	Marks
2	a		<u>fractional</u> distillation / fractionation	Ignore just distillation Reject simple distillation	1
	b		(they have) different boiling points/boiling temperatures / boil at different temperatures OR ethanol has a lower boiling point (than water) /water has a higher boiling point (than ethanol))	Ignore references to melting point Ignore references to condensing Accept one boils at 78(°C), the other at 100(°C) Accept ethanol boils/evaporates first Ignore boils/evaporates faster	1
	c		to keep the jacket full of water /to make sure there is no air in the jacket /to surround the whole tube OR (for B) not enough water in the condenser / water not in contact with tube for long enough /water runs straight out	Accept tube/condenser in place of jacket Accept reverse arguments relating to B Ignore references to rate of cooling or condensing Ignore so that more ethanol /vapour/gas condenses / to make sure all the ethanol/vapour/gas condenses Ignore references to glass breaking	1

Question number			Answer	Notes	Marks
2	d		(ethanol/it) has a lower boiling point/is more volatile (than water) OR boils/evaporates first/before water	Accept weaker forces of attraction between ethanol molecules Accept reverse arguments for water Accept boiling point (of ethanol) reached first Ignore incorrect difference eg 12°C lower Ignore boils/evaporates faster Ignore references to rate of evaporation /boiling/condensation Ignore ethanol condenses first	1

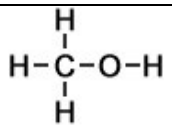
(Total for Question 2 = 4 marks)

Question number			Answer	Notes	Marks
3	a	i	Any two of • (same) general formula • same/similar <u>chemical</u> properties /behaviour/characteristics OR same/similar reactions • gradation/gradual change/trend /increase/decrease in physical properties • same functional group • (successive) members differ by CH_2	Apply list principle Ignore specific general formula Ignore specific chemical properties, eg combustion Ignore trend etc. in chemical properties Accept reference to specific physical property, eg boiling point Reject same/similar physical properties Ignore differ by M_r = 14	2
		ii		All atoms and bonds must be shown OH group can be in any position Ignore bond angles	1

Question number			Answer	Notes	Marks
3	b		batch process slower /continuous process faster	Accept batch process slow AND continuous process fast	1
			batch process less pure / continuous process purer	Accept batch process gives impure product AND continuous process gives pure product Ignore references to yield	1
			batch process uses renewable/sustainable/non-finite resources resources that do not run out AND continuous process uses finite resources OR unambiguous reference to one process (eg only the batch process uses renewable resources)	Accept OWTTE, eg sugar used in batch process can be grown again, crude oil is not being replaced Ignore uses plant material for renewable and uses crude oil for finite Accept references to fermentation/sugars in place of batch, and hydration/ethene in place of continuous	1

Question number			Answer	Notes	Marks
3	c	i	$\frac{3600 \times 1000}{180}$		1
			= 20 000 (mol)	CQ on M1 20 000 with or without working scores 2 marks 20 mol scores 1/2	1
		ii	(c)(i) × 2 / 40 000 (mol)		1
		iii	(c)(ii) × 24		1
			= 960 000 dm^3	Correct or consequential answer with or without working scores 2 marks	1

(Total for Question 3 = 11 marks)

Question number	Answer	Notes	Marks
4 a i	sugar(s)	Accept carbohydrate(s)	1
ii	fermentation		1
iii	zymase	Accept enzyme(s) / yeast	1
iv	hydration	Accept addition	1
b i		Accept O−H in any position All atoms and bonds must be shown	1
ii	propanol/propan-2-ol/2-propanol	Reject propan-1-ol / 1-propanol	1
c	phosphoric acid / phosphoric(V) acid / H_3PO_4	Accept sulfuric acid / H_2SO_4 Ignore references to dilute Reject phosphoric(III) acid/phosphorous acid If both name and formula given, both must be correct	1
	300 (°C)	Accept a value, or any range, within the range 250-350 (°C) Accept equivalent value in other units, but unit must be given	1

4 d i			needs more oxygen (to react)	Accept needs 3 instead of 2.5 O_2 Accept reverse argument Ignore references to flammability	1
	ii	M1	carbon monoxide / CO	If both name and formula given, both must be correct	1
		M2	poisonous / toxic / causes death IGNORE dangerous/harmful		1
		M3	reduces capacity of blood to carry oxygen	Accept correct reference to haemoglobin IGNORE references to suffocation/cannot breathe IGNORE blood carries no oxygen M2 & M3 can be awarded if M1 is missing or is a near miss (eg carbon dioxide)	1
4 e i			may explode / gas may leak / cylinder might break / pipe might burst / may catch fire (if gas leaks)		1
	ii		$C_2H_5OH \rightarrow C_2H_4 + H_2O$	Accept CH_3CH_2OH or displayed formula Ignore state symbols Reject C_2H_6O	1

(Total for Question 4 = 14 marks)

Question number				Answer	Notes	Marks
5	a	(i)	M1	(cane) sugar/ sugar beet	Do not accept any named sugar	1
		(ii)	M1	(conc / syrupy) phosphoric acid / H_3PO_4	Accept (conc) sulfuric acid / H_2SO_4 If both name and formula given, both must be correct Ignore oxidation numbers Penalise dilute acid Accept wrong spellings, eg phosphuric acid / phospheric acid	1
		(iii)	M1	(to prevent) zymase/enzyme being denatured	Accept zymase/enzyme work best at these temperatures / this is the optimum temperature for zymase/enzyme Accept yeast/zymase/enyme killed/destroyed	1
	b			reaction 1 reasons	Accept reaction 2 reasons	
			M1	gives pure(r) product / higher (percentage) yield /ethanol is the only product	gives impure product / lower (percentage) yield OR contains solid/sediment/yeast/water Ignore more ethanol produced	3
			M2	reaction fast(er)	reaction 2 slow(er)	
			M3	ethene/C_2H_4 available (from oil refinery)		
			M4		needs land to grow sugar (cane)	
			M5		needs warm climate	
			M6	reaction continuous	reaction batch	
					Any three for 1 each Ignore references to cost / efficiency	

Question number				Answer	Notes	Marks
5	c		M1	$C_2H_5OH \rightarrow C_2H_4 + H_2O$	Equation must be balanced Accept reversible arrow Accept structural/displayed formulae Accept word equation	1
			M2	dehydration	Accept elimination / (thermal) decomposition Treat other reaction types (eg reduction) as contradictions	1
						Total 8 marks