Question	Answer	Marks
3(a)(i)	September;	1
3(a)(ii)	*any two of:* shorter duration / 2 months difference; 4 months versus 6 months; August to November versus July to December;	2
3(b)(i)	*any three of:* ozone protects from / absorbs UV rays from, the Sun; (protects from) skin cancer / sunburn; (protects from) cataracts / eye damage; (protects from) (DNA) mutations; (protects from) damage to the immune system; reduction in ozone / more UV, decreases photosynthesis reducing rates of crop growth;	3
3(b)(ii)	chlorofluorocarbon / CFC / halon / methyl bromide / methyl chloroform / HCFC / tetrachloroethane / trichloroethane / NO / NO_2 / N_2O / NO_X;	1
3(c)	*any three of:* not all countries, may enforce the ban / agree the ban; CFCs / halogens / chemicals, that destroy ozone are, stable / stay in the atmosphere a long time; last 40–120 years (accept any figure in between); some products made before the ban are still in use; HCFCs only slowly being phased out;	3

Question	Answer	Marks
3(a)(i)	28 Sept / 29 Sept / 30 Sept / 1 Oct / 2 Oct / 3 Oct;	1
3(a)(ii)	*any two from:* ozone amounts (generally) are only a little higher than the lowest recorded levels; were the same as the lowest recorded levels at times; at lowest recorded levels, two / three times / on days in, July and August; are (well) below the highest levels;	2
3(b)	*any four from:* Montreal Protocol / many countries agreed to take action to protect ozone; 1989 more countries agreed to act; stopped use of CFCs; stopped use of halons; replacements used in, refrigerators / aerosols / air conditioning; national / government, legislation; use of catalytic converters linked to oxides of nitrogen; reduced use of, aerosols / air conditioning;	4
3(c)	*any three from:* CFCs / halons were widely used; CFCs escaped into the atmosphere when aerosols were used / when refrigerators were broken up etc.; travelled round the world, in the atmosphere / by wind / air currents; there are no international boundaries in the atmosphere; poorer countries could not afford / needed financial assistance from other countries, to switch to using less harmful chemicals;	3

Question	Answer	Marks
5(a)(i)	16 (km); –74 (°C);	2
5(a)(ii)	*any three from:* temperature increases, to the stratopause / in the stratosphere / to 50 km / –74°C to –19°C; temperature decreases, to the mesopause / in the mesosphere / to 85 or 86 km / –19°C to –95°C; temperature increases, in thermosphere / –95°C to +80°C; (initial) further (small) decrease in temperature, in thermosphere / to 91 km;	3
5(a)(iii)	any indication across diagram between 20 and 30 km;	1
5(a)(iv)	*any two from:* ozone layer absorbs / protects, from UV radiation / light; which is damaging / harmful, to organisms; which causes, skin cancer / mutations / cataracts;	2
5(a)(v)	*any four from:* CFCs / halons (released into atmosphere); from, spray cans / aerosols / fridges / air conditioning / fire extinguishers; travel to / winds carry CFCs, to Antarctica; where they accumulate; reacts / act as catalysts destroying ozone; reaction of O_3 to O_2; exist in atmosphere for a long time;	4
5(b)(i)	sun heats Earth's surface, which heats air above it;	1
5(b)(ii)	*any two from:* normally temperatures decrease with height; in temperature inversion, temperature increases with height; to create a warm layer at height / warm layer trapped between cold layers;	2

Question	Answer	Marks
5(b)(iii)	*any three from:* pollutants from city released into atmosphere; inversion / warm layer, stops air rising; so pollutants, trapped / can't escape / reflected back; while more pollutants, are added over time / accumulate;	3
5(c)(i)	bar drawn to correct length (21.0%);	1
5(c)(ii)	15.6(%);	1
5(c)(iii)	*both electricity generation and agriculture must be covered for maximum credit:* carbon dioxide; methane; is a / are, greenhouse gas(es); *electricity generation:* burn, carbon-based fuels / fossil fuels / coal / oil / gas; *agriculture:* rice growing / decaying vegetation, gives off methane; cattle / other livestock, give off methane; tractors / trucks for transport of farm produce, burn petrol / diesel / oil; burning of, forest / crop residues;	5
5(c)(iv)	*any three from:* increased use of, renewables / alternative sources; solar / wind / HEP / geothermal / other example; increased use of nuclear power; improving energy efficiency / example of; reducing energy wastage; legislation; education;	3
5(d)(i)	(pH) 5.0–5.6;	1

Question	Answer	Marks
5(d)(ii)	*any three from:* in 1990 most of the country had rainfall of pH greater than 7.0; by 2005, general decrease (in pH) / rain is more acidic; larger area affected by acid rain; SE / NE / NW pH has fallen to less than 5.0; largest area less than 5.0 on SE; no change in, West / North;	**3**
5(d)(iii)	*any two from:* increase in industry; increase in vehicles; increase in electricity generation; increase in release of SO_2; increase in release of nitrogen oxides;	**2**

Question	Answer	Marks
5(e)	*Level of response marked question:* Level 3 [5–6 marks] The response will reach a conclusion that will agree with the statement. The answer will provide details of actions that may be taken internationally, supported with relevant examples or demonstrate an understanding of the difficulties in developing international implementation. Level 2 [3–4 marks] The response will agree with the statement and describe how atmospheric pollution is an international problem, identify examples of air pollution sources or impacts, but lack additional detail. Level 1 [1–2 marks] Basic descriptive points with little or no reasoning. May just be a list of for and / or against. Answers at this level may include discussion of some of the causes of air pollution and / or may suggest basic information on resolving the problems. No response or no creditable response [0]. *Level of response marking indicative content:* Candidates will most likely discuss sources of atmospheric pollution. Better answers will look at how atmospheric pollution spreads from source areas through winds and so reach a conclusion that it is necessary to have international cooperation to overcome the problems. Examples of the problems are likely to include global warming, CFCs and the ozone layer, and acid rain. The best answers will include ideas on actions that can be taken at an international level and include examples.	**6**

Question	Answer	Marks
3(a)	– **AND** 281 ;;	**2**
3(b)	2005 to 2015;	**1**
3(c)	*any two from:* CO_2 is a greenhouse gas; concerns about, (enhanced) greenhouse effect / global warming; international climate change agreements; sanctions / fines; public pressure;	**2**

Question	Answer	Marks
1(a)	*allow answer within range* 31–33;	**1**
1(b)	*country* China **AND** *percentage of greenhouse gas emissions allow answer within range* 21–25;	**1**
1(c)	*any two from:* water vapour; carbon dioxide; methane; oxides of nitrogen; CFCs / HCFCs; ozone;	**2**
1(d)	*any three from:* (many) people are poor / poor country / LEDC / developing country; vehicle ownership low / use public transport; electricity not available for many; less ownership of energy-using equipment, e.g. TVs, central heating; limited industry / not as technologically advanced;	**3**

Question	Answer	Marks
4(a)	(*the source*) burning fossil fuels / industry / factories / vehicles; (*the reaction*) soot / particulates and water vapour / reaction with sunlight / UV light; (*other conditions*) urban areas / high pressure / calm conditions / lack of airflow due to hills or mountains or temperature inversion;	**3**
4(b)	*any two from:* breathing problems / asthma / bronchitis / COPD / respiratory disease / respiratory problems; eye irritation / named example; lung cancer;	**2**

Question	Answer	Marks
6(a)(i)	12.5;	1
6(a)(ii)	*any three from:* less legislation / fewer controls on air pollution; use of more polluting technologies; types of, industry / work done / more factories; use of open fires for cooking indoors; greater population density; poor housing / lack of ventilation; older / poorly maintained, vehicles; cannot afford less polluting technologies; abundance of fossil fuels;	3
6(a)(iii)	5.9 : 7 **or** 1 : 1.186 **or** 1 : 1.2;	1

Question	Answer	Marks
6(b)	*any two from:* asthma / bronchitis / breathing problems / breathing difficulties / COPD; lung cancer; eye irritation; cardiac problems;	2
6(c)	*any four from:* difficult to pass / enforce, legislation; may impact on the economy; not popular with the public; difficult to restrict individual / company, activity; pollution produced by neighbouring countries / air pollution exceeds international boundaries; needs international agreement; people cannot afford technologies to reduce air pollution;	4

Question	Answer	Marks
2(a)	*any three from:* volatile organic compounds (from industrial processes); atmospheric pollution from vehicle emissions / from industry; temperature inversion layer / cold air, traps the air pollution; sea wind blows air pollution inland; mountains act as a barrier to prevents air movement;	3
2(b)	*any three from:* irritation to eyes; increase in asthma; particles increase risk of lung cancer; breathing difficulties / named condition; heart problems / stroke;	3

Question	Answer	Marks
2(c)	*any two from:* increase / introduce, legislation / taxation to control vehicle emissions; increase availability of public transport; encourage switch to electric / hybrid / hydrogen cell vehicles; restrict access of vehicles to city centre; car sharing incentives;	2

Question	Answer	Marks
4(a)	respiration; combustion / burning;	2
4(b)	(the) Sun / (sun)light;	1
4(c)	methane; water vapour;	2

Question	Answer	Marks
6(a)	**A** combustion; **B** respiration; **C** decomposition; **D** photosynthesis;	4
6(b)	*any two from:* fossils fuels take millions of years to form; they are finite; fuel is being used faster than being formed;	2
6(c)	*any three from:* idea that carbon dioxide uptake reduced (due to, deforestation / reduction of land plants); increased carbon dioxide (in atmosphere) (due to increased use of fossil fuels in cars, etc.); idea of, loss / exploitation of, carbon sinks; idea that hard surfaces reduce natural decomposition of, animal / plant, remains;	3

Question	Answer	Marks
8(a)	3 correctly plotted; 6 correctly plotted; use of appropriate key;	3
8(b)	*any three from:* SO_2; oxides of nitrogen; named acids produced; rise in the atmosphere; dissolve in, clouds / water vapour; pH of water reduced;	3
8(c)	*Level of response marked question:* Level 3 [5–6 marks] **A coherent response is given that develops and supports the candidate's conclusion using relevant details and examples.** Indicative content and subject-specific vocabulary are generally used precisely and accurately. Good responses are likely to present a balanced evaluation of the statement. Level 2 [3–4 marks] **Development and support of the conclusion is evident, though the response may lack some coherence and/or detail.** Irrelevant detail may be present. Indicative content and subject-specific vocabulary are used but may lack some precision and/or accuracy. Responses contain evaluation of the statement, but this may not be balanced. Level 1 [1–2 marks] **The response may be limited in development and/or support.** Contradictions and/or irrelevant detail may be present. Indicative content and subject-specific vocabulary may be limited or absent. Responses may lack structure or be in the form of a list. Evaluation may be limited or absent. No response or no creditable response [0 marks]	6

Question	Answer	Marks
8(c)	*Indicative content for:* We cannot allow the level of atmospheric pollution to continue increasing. International laws are needed to force countries to reduce their atmospheric pollution by at least 20% over the next 10 years. *agree:* levels of air pollution have grown due to, increased industrialisation / increase in population air pollution is toxic to, humans / other organisms air pollution not limited by international boundaries climate change will impact weather systems and food availability sea levels are rising due to global warming - loss of land cannot achieve a reduction without international, cooperation / laws *disagree:* difficult to get all countries to agree some countries are larger polluters than others 20% reduction for some countries will be large other countries will have little impact on global emissions some countries have already installed technology so a further 20% reduction is harder some countries cannot afford the technology 20% would impact countries developing, industry / economy some countries do not have access to natural resources to switch from fossil fuels other methods / strategies, to reduce emissions	

Question	Answer	Marks
1(a)(i)	nitrogen; 20%;	2
1(a)(ii)	*any two from: (list rule applied)* carbon dioxide; water vapour; argon / noble gas ; methane;	2
1(b)	plants / photosynthesis;	1

Question	Answer	Marks
1(a)	(troposphere) stratosphere mesosphere thermosphere two layers correct / all three correct; all three correct in correct order; 50-80 (km);	3
1(b)	letter **O** labelled in stratosphere layer / 2nd layer from Earth;	1
1(c)	*any two from:* absorbs (harmful) UV (radiation); prevents cataracts; prevents skin cancer; prevents damage to plants; enables the natural greenhouse effect / maintains temperature of Earth;	2

Question	Answer	Marks
7(a)(i)	0.4 and 0.6 plotted correctly; lines drawn to complete line graph;	2
7(a)(ii)	overall increase; from 1.3 to 4.35 billion tonnes / increase of 3.05 billion tonnes / levelling off from 2015 / increased production after 2004 / slow increase 1990 to 2004;	2
7(a)(iii)	(2.4 ÷ 4.1 × 100) = 58.5(%);	1

Question	Answer	Marks
7(b)(i)	*any three from:* damage to seabed; loss of habitat; death of / damage to, marine plants / (named) marine organism; disruption to food chain; noise / activity, scares off some organisms;	3
7(b)(ii)	*any two from:* difficult to, police / monitor / enforce; seas are large; high, demand / pressure, for, gravel / cement; limited supplies on land;	2
7(c)	*any three from:* increase recycling of existing materials; increase extraction efficiency; increase efficiency of use; use legislation;	3

Question	Answer	Marks
1(a)	A – combustion: B – respiration; C – photosynthesis;	3
1(b)	*Any two from:* Plants provide: oxygen; through photosynthesis / for respiration; food source; to provide energy; shelter; to provide protection / shade;	2

Question	Answer	Marks
3(a)	*Any two from:* carbon monoxide; NOx; hydrocarbons;	2
3(b)	*Any three from:* not 100% efficient; carbon dioxide is released into the atmosphere (still harmful / pollutant); more vehicles in use; there are other sources of air pollution; named air pollutant;	3
3(c)	*Any three from:* use electric vehicles; energy efficiency; transport policies / named policy / taxation; use of bicycles; (development of) public transport; car sharing / car pooling;	3