1)

(a)	(i)	X = right atrium ; Y = aorta ; Z = (left) pulmonary artery ;	3	**Mark the first answer for each letter.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 **marks** ACCEPT right atria IGNORE RA IGNORE PA
(a)	(ii)	*left ventricle* 1 (more muscle to create) more force ; 2 (needs to create) higher pressure ; 3 push blood against greater , resistance / friction ; 4 (left ventricle) pumps blood further / pumps blood to all parts of body / supplies systemic circulation ;	3 max	Assume answer refers to left ventricle unless otherwise stated. ACCEPT ORA for left atrium throughout 1 IGNORE more powerful contraction ACCEPT stronger contraction 2 IGNORE withstanding or maintaining pressure 4 ACCEPT pumps blood , all round body / greater distance IGNORE pumps blood to the body DO NOT CREDIT references to , right ventricle / lungs
(a)	(iii)	1 ventricular systole or ventricle , wall / muscle , contracts ; 2 (ventricular contraction) raises ventricular pressure ; 3 (ventricular pressure) higher than atrial pressure ; 4 *idea of* (pressure / movement of blood, generated by ventricular contraction) pushes valve shut ; 5 chordae tendinae prevent inversion ;	max 2	DO NOT CREDIT statements that refer to right atrium or right ventricle 1 IGNORE ref to atrial contraction 4 DO NOT CREDIT 'valve shuts' alone DO NOT CREDIT in context of blood flowing from atrium to ventricle resulting in pressure increase to close valve 5 ACCEPT valve tendons / tendinous cords
(b)		aorta / (named) artery / arteries / arteriole(s) ; blood / plasma ; capillary / capillaries / capillary wall / (capillary) endothelium ;	3	**Mark the first answer for each role.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 **marks** ACCEPT smooth muscle / elastic tissue / collagen / narrow lumen DO NOT CREDIT valves

2)

(a)	(i)	1 *idea of* not breathing through nose ; 2 subject breathes , evenly / normally / regularly ; 3 *idea of* (measure) height / amplitude , of waves (from trace) ; 4 measure at least three waves and calculate mean ; 5 detail of how spirometer works ;	max 3	1 e.g. subject wears nose clip / plug or holds nose 2 IGNORE at rest 3 ACCEPT (measure) difference between peak and trough ACCEPT annotated diagram / annotations on graph 5 e.g. as breathe in lid goes down / as breathe out lid goes up e.g. movement of lid recorded , on trace / by data logger e.g. pen attached to lid moves up/down as breathe DO NOT CREDIT description of water level changing IGNORE ref to using mouthpiece, soda lime, oxygen
(a)	(ii)	10 further waves drawn with similar heights ; trace falls ;	2	Look for 10 extra peaks and 10 extra troughs ***Note*** 'similar' means no wave drawn for vital capacity – all waves should be approximately same height
(a)	(iii)	1 measure , volume of oxygen used / decrease in volume in chamber ; 2 one detail of how to measure volume change ; 3 measure time taken (to use this oxygen) ; 4 divide (volume) by time taken ;	3	1 ACCEPT annotations on graph ACCEPT 'measure how much the trace has gone down' or 'measure decrease in trace' 2 e.g. draw line along tips of , peaks / troughs e.g. find difference in height from one , peak / trough , to another 3 ACCEPT (measure volume of oxygen used) in a given time 4 ACCEPT unit stated to indicate rate has been calculated e.g. dm^3s^{-1} / dm^3min^{-1} ***NOTE*** 'draw line along tips of, peaks / troughs **and** calculate gradient of line' = **3 marks (mark points 1, 3 & 4)**
(b)		1 check health of volunteer ; 2 oxygen used ; 3 new / sterilised / disinfected , mouthpiece (for each volunteer); 4 *idea of:* soda lime working ; 5 sufficient oxygen in chamber ; 6 water level not too high / water must not enter tubes ; 7 ensure valves working correctly ;	max 2	**Mark the first *two* factors.** 1 e.g. check medical history of volunteer ask about asthma / TB / pneumonia / flu / bronchitis / emphysema 3 IGNORE clean mouthpiece 4 CREDIT need to remove CO_2 / CO_2 accumulates 5 IGNORE enough air in chamber 6 IGNORE general ref to leaks

3)

(a)	(i)	human immunodeficiency virus / HIV ;	1	DO NOT CREDIT if there is any ref to AIDS
(a)	(ii) 1	(infective agent), in blood / body fluids ;		1 ACCEPT any infective agent even if incorrect as question asks for *mode of transmission*
	2	*idea of:* used needles are contaminated ; ora		2 ACCEPT e.g. 'used needles are infected' 2 ACCEPT e.g. 'new needles are sterile' 2 DO NOT CREDIT 'dirty' / 'clean' needles
	3	reduces chance of sharing needles ; ora	2 max	3 IGNORE 'prevents' / 'stops'
(b)	(i)	amino acid(s) ;		*Answers must be on correct line* ACCEPT phonetic spelling for both
		nucleotide(s) ;	2	DO NOT CREDIT if ref to DNA / 'nucleosides' ACCEPT 'ribonucleotides'
(b)	(ii) 1	reverse transcriptase in (host) nucleus ;		
	2	viral DNA, (inserted) in (host), chromosome / DNA ;		
	3	*idea of:* (viral) RNA / mRNA produced / transcribed ;		
	4	(to) code for / make / translate, viral proteins ;	2 max	4 IGNORE 'different protein'

(c)	(i)			Mark the first three answers only regardless of which line they are on
	1	not vaccinated against TB ;		1 IGNORE general refs to lack of medical care
	2	weakened immune system ;		
	3	(lifestyle) e.g. poor diet / lack of protein / malnourished / smoking / alcoholism ;		3 DO NOT CREDIT 'alcohol' unqualified IGNORE 'poor health'
	4	homelessness ;		
	5	poor ventilation (of housing) / AW ;		
	6	overcrowding ;		
	7	close contact with people from / visiting, area where TB is common ;		7 ACCEPT area where those with TB are not quarantined
	8	close / prolonged, contact with individual(s) with TB ;		
	9	consumption of milk or beef, from infected cattle / in developing countries ;	3 max	

(c)	(ii) 1	cytokine / interleukin / receptor has, specific / unique, shape ;		1 DO NOT CREDIT 'cytokine is specific to receptor' as this is implied in question
	2	(cytokine / interleukin), binds / attaches / bonds to / fits into, receptor ;		
	3	receptor on (cell surface) membrane (of B lymphocyte) ;		3 DO NOT CREDIT 'antibodies' (on cell surface)
	4	(receptor and cytokine have) complementary shapes ;		
	5	activates / stimulates, clonal expansion / mitosis ;	3 max	5 ACCEPT activates / releases 2nd messenger

4)

(a)	(i)			ACCEPT reference to numbers rather than breeding success throughout
	1	(all), sub-arctic / all 4 named sub-arctic, species / birds, show decrease ;		1 sub-arctic species = snow bunting + Lapland bunting + ptarmigan + dotterel
	2	(all / most), other / non sub-arctic / all 4 named non sub-arctic, species / birds, show, increase / no change ;		2 non sub-arctic species = red grouse + wheatear + meadow pipit + ring ouzel
	3	greater change / AW (in breeding success), in sub-arctic than in non sub-arctic species ;		
	4	comparative figs (in 1970 **AND** 2000) ;	3	4 number of young for one sub-arctic and one non sub-arctic species in 1970 and 2000 (or calculated subtraction between the two years) 4 DO NOT CREDIT if figures are not from 1970 and 2000

species	number of young raised per year		
	1970	2000	difference in number of young raised between 1970 and 2000
Snow bunting*	78	2	Down 76
Lapland bunting*	7	0	Down 7
Ptarmigan*	1280	876	Down 404
Red grouse	890	962	Up 72
Wheatear	209	231	Up 22
Meadow pipit	23	82	Up 59
Ring ouzel	23	26	Up 3
Dotterel*	45	35	Down 10

(a)	(ii)			
	1	climate change / global warming ;		1 IGNORE greenhouse effect 1 DO NOT CREDIT 'it is too warm' or 'it is not cold enough' without reference since 1970
	2	(environmental) change too rapid for adaptation ;		
	3	change in, flora / plants / food supply / insects / prey / predators / human activity ;		3 ACCEPT camouflage no longer appropriate / reduction in size of habitats
	4	disease (that affects sub-arctic species more than others) ;		
	5	sub-arctic species, less well-adapted than / have been outcompeted by, non sub-arctic species / AW ;	2 max	5 ACCEPT ora
(b)	(i)	the number of species present (in a habitat) ;	1	DO NOT CREDIT range / amount

(b)	(ii)			**Mark the first three suggestions**
	1	*idea of:* unbiased method to selecting sampling area ;		**1 ACCEPT** e.g. random selection of, areas / coordinates OR use of transect **1 IGNORE** 'random sampling' unqualified
	2	sample many times / AW, and calculate mean / average ;		
	3	standardised sweeping procedure ;		3 e.g. same type of movement / same length of time same number of sweeps **3 ACCEPT** sample at same time of day **3 IGNORE** same collector **3 IGNORE** refs to using alternative collecting techniques in order to collect more insect species
	4	ensure insects do not escape (before being identified) ;		**4 ACCEPT** use of pooter
	5	method to prevent recounting ;		5 if ref to mark-release-recapture, **IGNORE** 'release and recapture' and look for idea for preventing recounting
	6	sample at different times of, day / month / year / weather conditions ;		
			3 max	

(b)	(iii)			
	1	(measures), abundance / numbers, of individuals in each species ;		
	2	species evenness is more quantitative than species richness ; ora		
	3	high(er) species evenness indicates high(er) biodiversity ; ora		
	4	low species evenness indicates, dominance by / high abundance of, one / few, species ; ora		
	5	used to calculate (Simpson's) Index of Diversity ;		
	6	example used to illustrate explanation of mp 3 or 4 ;		6 e.g. "Two areas have the same number of species. One with 90% of 1 species has less biodiversity than one where all species have an abundance of 5-20%"
			3 max	

5)

(a)	1	free from, disease / illness ;		1 **ALLOW** infection **CREDIT** 'not just the absence of disease'
	2	physical **and** mental **and** social wellbeing / AW ;		2 **DO NOT CREDIT** 'state' / 'condition'
	3	good nutrition ;		3 **ACCEPT** balanced diet
	4	suitably housed ;	2 max	4 **ACCEPT** ref to economic wellbeing

(b)				**Mark first F mark on line and assume explanation relates to that** **ACCEPT** named example(s) of pathogen or parasite **CREDIT E** marks if a reasonable, but non-creditworthy, attempt at an **F** mark has been made, e.g. 'lining of nasal passages' for **F2**
	F1 **E1**	skin ; *idea of:* physical barrier to prevent entry of microorganisms ;		**E1 ACCEPT** 'pathogens cannot pass through cells' **E1 ACCEPT** antibacterial effects of sebum or sweat **E1 DO NOT CREDIT** physical barrier unqualified
	F2 **E2** OR **F2** **E2**	mucous membrane(s) / goblet cells ; (produce) mucus to trap, pathogens / parasite ; mucus ; traps pathogens ;		
	F3 **E3**	cilia / ciliated epithelium ; remove, pathogen / parasite, laden / AW, mucus ;		
	F4 **E4**	blood clotting ; prevents, pathogens / parasite, entering bloodstream ;		
	F5 **E5**	ear wax / nasal hairs ; traps, pathogens / parasite ;		
	F6 **E6**	lysozyme / tears / nasal secretions / saliva ; kills bacteria / contains antibacterial agent ;		**F6 IGNORE** lysosome(s) **E6 ACCEPT** contains antibodies
	F7 **E7**	gastric juice / stomach acid ; kills, pathogens / parasite ;	4 max	**F7 ACCEPT** 'enzymes in the stomach' or 'acid in vagina'

(c)	(i) 1	lives, on / in / in contact with, **and** harms host ;		1 living on / in must be stated, cannot be implied from feeding 1 **IGNORE** 'live off'
	2	takes nutrition from / feeds on (host) ;		
	3	warmth ;		3 **ACCEPT** 'incubate'
	4	protection / safe place / AW ;		
	5	allows transmission / spread, to a new host / AW ;	4 max	5 **ACCEPT** 'distributed' / 'passed on' as implies new host
(c)	(ii) 1	wash / clean / disinfect / sterilize, hands ;		
	2	not, scratching / touching, of anus ;		2 **ACCEPT** method to prevent scratching e.g. cutting nails 2 **IGNORE** 'wash anus'
	3	drugs to, kill / remove, parasite / eggs ;	2 max	3 **DO NOT CREDIT** 'antibiotics' 3 **IGNORE** 'anti-bacterial'

6)

(a)		<table><tr><th>statement</th><th>DNA only (D) or RNA only (R) or both DNA and RNA (B)</th></tr><tr><td>contains thymine</td><td>D</td></tr><tr><td>contains ribose</td><td>R ;</td></tr><tr><td>consists of 2 chains connected to each other with hydrogen bonds</td><td>D ;</td></tr><tr><td>has a sugar-phosphate backbone</td><td>B ;</td></tr><tr><td>has 4 different nitrogenous bases</td><td>B ;</td></tr><tr><td>contains a pentose sugar</td><td>B ;</td></tr><tr><td>is found in the nucleus and cytoplasm</td><td>R ;</td></tr></table>	6	**Award** 1 mark for each correct row **DO NOT CREDIT** if more than one letter in a box
(b)	(i)			
	1	(information used to) decide which, group / taxon, organism / species / named example, fits in ;		**1** answers must refer to the information provided by the study of DNA, rather than simply the job of taxonomists, e.g. **ACCEPT** 'it can be used to put organisms into groups' **1 IGNORE** 'for classification' unqualified – look for idea of: groups **1 CREDIT** ref to belonging to same taxonomic group, e.g. 'to see if it belongs in the genus *Homo*'
	2	compare the proportion of (different) bases ;		**2 IGNORE** 'examine proportion of bases' **2 CREDIT** idea for looking at similarities / differences
	3	compare the DNA / genes / sequence of bases ;		**3 IGNORE** 'examine sequence of bases' **3 CREDIT** idea for looking at similarities / differences
	4	*idea of*: the more similar the, DNA / genes, the closer the relationship / AW ;	2 max	**4** Must contain reference to similarity of DNA
(b)	(ii)			**Mark the first <u>two</u> suggestions** **IGNORE** ref to genetics as DNA is 'biochemical'
	1	fossil record ;		
	2	anatomy / physiology / behaviour ;		**2 ACCEPT** AW for anatomy, e.g. observable / physical features / cell structure **2 ACCEPT** AW for physiology, e.g. method of reproduction
	3	embryology / AW ;	2 max	
(c)		J ; T ;	2	**DO NOT CREDIT** names
(d)	(i)			
	1	no DNA from living specimens in Wales analysed ;		
	2	population (may have) <u>evolved</u> / mutations have occurred / genetic variation, (since 1948) ;	1 max	**2 ACCEPT** description of evolved **2 DO NOT CREDIT** 'evolution' unqualified by context of pine marten population
(d)	(ii)			**ACCEPT** animals as AW for pine martens throughout answer
	1	(introduced) pine martens might not be adapted to local conditions / AW ;		**1 ACCEPT** not adapted to the habitat **1 DO NOT CREDIT** 'used to'
	2	(local) <u>habitat</u> might have changed / is no longer suitable (for any pine martens) / AW ;		
	3	introduced, pine martens, might <u>outcompete</u> native, population / pine martens ;		**3 ACCEPT** introduced pine martens might kill native / Welsh pine martens **3 IGNORE** 'compete' unqualified
	4	introduced pine martens might bring disease ;		
	5	Welsh pine marten would lose its, distinctiveness / identity, because of <u>interbreeding</u> ;	1 max	

7)

(a)	(i)	genes / genetic / mutation ; environment(al) ;	2	**Mark the first answer on each line** **IGNORE** inherited / DNA
(a)	(ii) 1	no defined categories ;		
	2	range of values / intermediate values ;		**2 ACCEPT** ref to bell-shaped curve / binomial distribution
	3	influenced by, environment / many genes / genes and environment ;		**3 ACCEPT** any ref to 3 or more genes
	4	quantitative / has to be measured / cannot be counted ;	3 max	**4 ACCEPT** metric
(a)	(iii)	B ;	1	**DO NOT CREDIT** if more than one letter is given
(a)	(iv) 1	growth too rapid ;		
	2	increased susceptibility to, disease / named abnormality ;		**2** e.g. bone / skeletal abnormalities or low immunity
	3	inbreeding ;		**3 DO NOT CREDIT** if implies inbreeding causes mutations
	4	reduces gene pool / genetic variation / genetic diversity ;	2 max	**4 IGNORE** refs to biodiversity
(a)	(v) 1	maintain biodiversity ;		
	2	aesthetic (reasons) / tourism ;		
	3	ethical (reasons) ;		**3 ACCEPT** religious
	4	part of a food chain / web ;		**4 ACCEPT** food source for local population
	5	maintain / increase gene pool ;		
	6	genetic resource / availability to breed with domestic chickens ;	2 max	**6 CREDIT** description, e.g. 'source of desirable genes' or 'source of genetic variation' **6 ACCEPT** specific example of genetic resource e.g. disease resistance / strong bones / longevity / heat tolerance / idea of domesticating wild population
(b)	(i) 1	reduces / prevents (infectious) disease ;		**Mark the first two answers only** **1 IGNORE** illness
	2	prevent, problems / named problem, with gut ;		**2** e.g. diarrhoea
	3	digest food more, efficiently / easily / quickly ;		
	4	greater proportion of, food / energy, can contribute to growth ;		**4 ACCEPT** faster growth as AW for contribute to growth **4 IGNORE** larger chickens
	5	reduce risk of transmitting, pathogens / named pathogen, to humans ;	2 max	**5 ACCEPT** 'meat less likely to be infected with bacteria'
(b)	(ii) 1	(antibiotic) resistant, pathogens / bacteria ;		**1 ACCEPT** microorganisms / microbes **1 IGNORE** germs **1 DO NOT CREDIT** immune
	2	antibiotics kill useful, bacteria ;		**2 DO NOT CREDIT** if any ref to viruses
	3	*idea of:* antibiotic passing into human food ;	1 max	