OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



MARK SCHEME

P1.3 PRESSURE

SCORE	PERCENTAGE
/52	%

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Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	**1**	
2			D	1	
			Total	**1**	
3			B	1	
			Total	**1**	
4	a		Water is much denser than air / AW (1)	1	
	b		Pressure increases as depth increases (1) Each 10 metres of depth increases pressure by 1 AW (1)	2	**ALLOW** direct / linear relationship
	c		It is the pressure of the atmosphere / AW (1)	1	
	d		Recall of 'g' (1) Substitution into equation (1) 364 / 360 (1) 2 significant figures quoted / 360 (1)	4	9.8 or 10 m/s^2 **ALLOW** 356.72 (3)
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
5			**any two from** (fast air) particles hit bag (causing force) [1] (more) frequent collisions (with wall of bag) [1] **change** in momentum causes a force / pressure [1] **BUT** change in momentum of **particles** (hitting the bag) causes a force / pressure [2]	2	**ignore** collisions between air particles **ignore** references to momentum of **car** **allow** $\text{force} = \frac{\text{change in momentum}}{\text{time}}$ [1] **Examiner's Comments** This answer relied on a qualitative understanding of how particles create pressure on the walls of an air bag. Most candidates did not refer to collisions with the bag and very few gave the idea of increased collisions. Momentum changes were rarely mentioned with clarity. Weaker answers mixed up the collision of the car with the particles in the bag. They often thought that the momentum from the car crash directly filled the air bag with gas. Good answers described the particles as colliding with the walls of the bag and this change in momentum provided a force which pushes the bag out. Some used the formula force = rate of change of momentum and structured their answers around it.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
6	a		idea that the force is caused by the seat belt **slowing** the dummy down [1]	1	**allow** air bag or steering wheel or dash board or windscreen stops slows down the dummy [1] Examiner's Comments This about the action of safety features in a car was not well answered across the ability range Very few recognised that the force applied by the seat belt or air bag slowed he passenger down. Many answers were poorly described in terms of the dummy jolting forwards.
	b		particles move/ AW or spread out [1] particles hit inside (surface) of airbag / AW [1]	2	**allow** moving particles push the bag outwards [2] Examiner's Comments This about the action of safety features in a car was not well answered across the ability range Most candidates had little idea about the kinetic theory of gases when applied to an air bag. This area was very unfamiliar to almost all candidates.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
7	a		particles hit rocket walls / AW (1) causing force / thrust / AW (1)	2	But particles colliding **with each other** (0) Allow particles collide with each other and walls (1) **ignore** pressure / upthrust Reward higher level answers in terms of action and reaction: eg particles move downwards to produce an equal and opposite force on the rocket (2) **Examiner's Comments** Many mentioned collisions of gas particles but avoided the key idea of particles colliding with the rocket walls [1] thereby producing a force [1].
	b		more force and acceleration because of: • more frequent collisions / more energetic collisions / twice as many collisions (1) or • faster particles / more particles / more energy / more momentum (1)	1	**but** more frequent collisions between gas particles scores (0) **allow** more frequent collisions between gas particles and walls (1) **allow** higher level answers in terms of kinetic theory (1) **ignore** pressure **ignore** more gas **allow** force applied for longer giving greater acceleration (1) **Examiner's Comments** Most gained the mark here by explaining in terms of more particles or energy [1].
			Total	3	
8			**B ✓**	1 (AO1.2)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
9		i	FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 100 (Pa) award 3 marks pressure = force ÷ area ✓ = 10 ÷ 0.1 ✓ = 100 (Pa)✓	3 (AO1.2) (AO2.1) (AO2.1)	Examiner's Comments Many candidates were not able to recall the equation *P = F/A*. Some candidates did recall the equation and correctly calculated the pressure in the fluid as 100 Pa. A common misconception was using the equation *P = F × A* to calculate the pressure as 1 Pa.
		ii	at right angles/perpendicular/90° (to the plunger)	1 (AO1.1)	ALLOW to the left opposite to the force from the plunger Examiner's Comments Many answers here bore no relationship to the diagram: Any clear indication of direction including 'left' or 'at right angles' or 'perpendicular/90° to the plunger' were accepted. Ambiguous and inappropriate directions such as 'to the east' were not credited.
			Total	4	
10			D ✓	1 (AO1.2)	Examiner's Comments About two thirds of candidates gave the correct answer D. A common incorrect response was 'C'.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
11			Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. **Level 3 (5–6 marks)** Detailed description of the structure of the Earth **AND** Detailed explanation of the trends in **Table 22.1.** *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Description of the structure of the Earth. **AND** Explanation of the trends in **Table 22.1.** **OR** Detailed description of the structure of the Earth. **OR** Detailed explanation of the trends in **Table 22.1.** *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** **A basic description of the structure of the Earth.** **OR** A basic description of the trends in **Table 22.1.** *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	6 (AO 2×3.1a) (AO 2×3.2a) (AO 2×2.1)	**AO3.1a Analyse information and ideas to interpret some basic trends in data** • density increases as depth increases • speed (of P/S waves) increases as density increases • speed (of P/S waves) increases as depth increases **AO2.1 Apply knowledge and understanding of scientific ideas to explain trends in the data** • Earth contains layers • velocity changes at a boundary • as density changes at a boundary • particles more tightly packed • P is longitudinal, S is transverse **AO3.2a Analyse information and ideas to make judgements about the structure of the Earth** • core has highest density • core has highest speed for P waves • S waves do not travel through the core • so the outer core is a liquid • pressure highest in core / P = ρgh • pressure and so density increase with depth • large change in density between mantle and outer core Examiner's Comments This was the Level of Response question, targeted up to Grade 9, and assessed AO2 and AO3. There was a wide range of marks achieved and the question discriminated well. Very few candidates did not achieve any credit. The majority of candidates were able to describe some basic trends in the table for density and speed of P and S waves. More detailed responses also included a description of the structure of the Earth for Level 2.

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Question			Answer/Indicative content	Marks	Guidance
					Many excellent responses from the more able candidates at Level 3 included: • trends in the data identified and explained • linking facts about P and S waves to an explanation of why the outer core is liquid. Poor quality of communication, including contradictions or the same facts repeated a number of times, prevented some candidates from achieving a higher mark. **Exemplar 2** Describe what information the data in **Table 22.1** gives about the structure of the Earth. In your answer you should explain any trends in the data in **Table 22.1**. P waves are longitudinal and travel through both solid and liquids but S waves are transverse and only travel through solids. There is no data for the wave speed of S waves through the top of the outer core and the bottom so the core must be made of liquid, however both waves can travel through the crust and the mantle as there is data for it so these must be made of solid. the density of the layers at the earth decreases down the table so the density of the earth must decrease from the surface of the crust to the centre of the inner core. The speed of both P waves and S waves increase down the table as well. P waves travel faster in more dense [6] 22 material as the particles are close together so they carry the wave to each other faster, which the data therefore backs up that the density of the earth increases towards the centre. This response achieved Level 3, 6 marks. The candidates included a detailed description of the structure of the Earth, including ideas about density and the liquid outer core. There is also a detailed explanation of the trends shown in the table.
			Total	6	
12			D ✓	1 (AO1.1)	<u>Examiner's Comments</u> This was well known by nearly all candidates who gave D as their answer.
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
13	a		Pressure is inversely proportional to volume OR ρV = constant for a particular gas OR for any of the gases calculation of p x V ✓ For gas B: 10 x 0.4 = 4 and for gas C: 20 x 0.2 =4 OR Pressure of C is double the pressure of B and volume of C is half the volume of B ✓ B and C ✓	3 (AO3.2b) (AO3.1a) (AO3.2b)	**NOTE** could be written next to table Examiner's Comments This question required candidates to use the data in the table which was generally well answered by all candidates. Higher ability candidates clearly stated that pressure is inversely proportional to volume and then went on to state that pressure × volume = constant. Most candidates then calculated for each gas pressure × volume before stating that B and C were the same. A few candidates demonstrated that doubling the pressure halved the volume and gained full credit with the appropriate conclusion.

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Question			Answer/Indicative content	Marks	Guidance
	b		For an increase in temperature / heating of gas: gas particles / molecules / atoms have a higher (average) speed / more (kinetic) energy ORA✓ They collide more frequently / often with the walls (of container) / container AW✓ Bigger force (over same area) equals greater pressure ✓	3 (AO3 x1.1)	**Direction of temperature change must be clear** **ALLOW** move faster for higher (average) speed **ALLOW** linked to increase/decrease of KE if temperature change not explicit **ALLOW** bigger change in momentum Examiner's Comments There were a range of marks in this question. Candidates needed to be able to explain either how an increase in temperature affects the gas pressure or a decrease in temperature affects the gas pressure. The direction of the temperature change needed to be clear. Most candidates realised that an increase in temperature resulted in the gas molecules having more kinetic energy and thus a higher average speed. Candidates were then expected to state that the molecules collided more frequently with the walls of the container. Often, "frequently" was omitted from candidates' answers. The final mark was for stating that the more frequent collisions resulted in a large force over the same area which causes a greater pressure. Some candidates correctly explained the larger force in a greater rate of change of momentum. AfL Candidates should be encouraged to practise explaining physics concepts in terms of the effect of increasing a quantity on another quantity.

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Question			Answer/Indicative content	Marks	Guidance
	c		FIRST CHECK THE ANSWER ON ANSWER LINE If answer = 5500 (Pa) award 3 marks pressure due to a column of liquid (Pa) = height of column (m) x density of liquid (kg/m3) x g (N/kg) / P = hρg (no mark – on formula sheet) g = 10 (N/kg) ✓ P = 0.5 x 1100 x 10 ✓ P = 5500 (Pa) ✓	3 (AO1.1) (AO2.1) (AO2.1)	ALLOW three marks for 5390 Pa if g=9.8 N/kg or 5395.5 Pa if g=9.81 N/kg is used ALLOW 9.8(1) N/kg Examiner's Comments Most of the candidates correctly selected an equation from the data sheet and used an appropriate value for *g*. Candidates who did not gain credit for this question, tended to just multiply 0.5 by 1100. By understanding that the unit of pressure is Pa or N / m^2, candidates should be able to reason that m × kg / m^3 is not valid.
			Total	9	
14			C ✓	1 (AO1.1)	
			Total	1	
15			C ✓	1 (AO2.1)	
			Total	1	
16			A	1 (AO1.1)	
			Total	1	
17			B	1 (AO2.1)	
			Total	1	

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Question			Answer/Indicative content	Marks	Guidance
18			**Any three from:** Boat has bigger upthrust/buoyancy force (compared to weight of lump) / ORA / AW ✓ Upthrust on boat is equal to weight of boat / resultant force is zero / AW ✓ Weight of water displaced by the boat is equal to the weight of the boat / AW✓ (Overall) density of the boat includes the air / ORA /AW✓ (Overall) density of the boat (and air) is less than the density of the water / ORA / AW ✓	3 (AO3x2.1)	**ALLOW** upthrust on lump is less than weight of lump / there is a resultant force (acting downwards) **ALLOW** weight of water displaced by lump is less than weight of lump / AW **ALLOW** hollow for air **ALLOW** maximum of 1 mark for boat is hollow / contains air / ORA / AW
			Total	**3**	
19	a		Doubled ✓ Doubled ✓	2 (AO1.1 x 2)	
	b		**Any two from:** As temperature increases, pressure increases / AW✓ Linear /straight line relationship ✓ Higher temperature means more (frequent) collisions (between particles and container) / AW✓	2 (AO1.1.x 2)	**ALLOW** higher temperature means bigger pressure **DO NOT ALLOW** *T* & *P* in wrong order **DO NOT ALLOW** (directly) proportional relationship **ALLOW** pressure goes up at the same rate as temperature **IGNORE** idea of more collisions with other particles
			Total	**4**	

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