

COMPONENT 1 – Concepts in Physics

HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (except for the extended response questions).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao	=	correct answer only
ecf	=	error carried forward
bod	=	benefit of doubt

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
1	(a)		Alternating / oscillating (1) since it is marked with a frequency of 50 Hz (1)	2			2		
	(b)	(i)	Manipulation of $P = VI$ (1) Current = 11.3 A (1) Fuse choice = 13 A (1) Should be used as others would constantly melt (1)		1 1	1 1	4	2	
		(ii)	Prevents fire (1) By melting if too high a current flows (1)	2			2		
		(iii)	In case of a fault provides low resistance path to earth (1) Preventing electric shocks (1)	2			2		
	(c)	(i)	Selection of $\Delta Q = mc\Delta\theta$ (1) Substitution $\Delta Q = 1.5 \times 4200 \times 80$ (1) Energy = 504 000 [J] (1)	1 1		1	3	2	
		(ii)	For every 1 J of energy transferred to the kettle only 0.92 J is transferred to the water (1) Remaining energy is transferred to other things e.g. body of kettle / surroundings (1)			2	2		
	(d)		Less efficient since more energy lost to surroundings (1) Therefore there are greater CO ₂ emissions / more mining / more transport of fuel involved(1)			2	2		
			Question 1 total	8	5	4	17	4	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)		Friction between moisture and ice (1) Exchange of electrons (1) So ice becomes negatively charged / moisture becomes positively charged (1)	1 1			3		
					1				
	(b)	(i)	Electrons repelled (1) To Earth through lightning conductor (1)		2		2		
		(ii)	Positive ions attracted to bottom of cloud (1) Which combine with negative charge / help to neutralise bottom of cloud (1)		2		2		
		(iii)	Reduces size of charge on cloud (1) Lightning travels through conductor (1)		2		2		
	(c)		Recall of $Q=It$ (1) Substitution of 3000×0.005 (1) Answer = 15 (1) Unit = C or Coulomb (1)	1 1 1		1	4	2	
			Question 2 total	5	8	0	13	2	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)	AB has a steeper gradient		1		1	1	
		(ii)	Calculation of area under line for BC and CD attempted (1) Correct values of 3 000 for BC and 5000 for CD (1) Conclusion that distance is greater for CD so student's conclusion is correct (1)			3	3	2	
		(iii)	Acceleration identified as rate of change of velocity (or gradient)(1) $a = \frac{10}{250}$ (1) $a = 0.04 \text{ [m/s}^2\text{]} (1)$	1 1	1		3	2	
		(iv)	Resultant force proportional to acceleration (stated or implied)(1) Greatest acceleration and force from AB (1) As line steepest (1) Zero acceleration and resultant force from BC (1)			4	4	1	
	(b)		Selection of $v^2 = u^2 + 2ax$ (1) Substitution: $0 = 25^2 - 2 \times 0.4 \times x$ (1) Distance = 781.[25] m (1) The actual stopping distance is close to driver's estimate and hence consistent	1 1	1	1	4	2	
	(c)		B (1) Since stopping distance is greatest at steepest ascending part of track (1)			2	2		
			Question 3 total	4	3	10	17	8	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		Any 2 correctly named from radio waves, microwaves, infra-red, ultraviolet, X-rays, gamma rays	1			1		
	(b)		Focus or foci correctly positioned (1) Object shown of correct size and scaled position (1) Ray drawn parallel to principal axis passes through the focus (either ray) (1) Ray drawn through the optical centre continues un-deviated (1) Image located 15 [cm] from lens on other side (1) Image size = 1 [cm] (1)		6		6	6	6
	(c)	(i)	Transverse waves have vibrations at 90° to direction of wave motion (1) Whereas in longitudinal waves the vibrations are in the same direction (1)	2			2		
		(ii)	The external vibrations in the air are collected by the outer ear (pinna) (1) And are channelled towards the inner ear to the ear drum. The <u>ear drum</u> is made to <u>vibrate</u> (1) And these <u>vibrations are magnified</u> by the three small bones of the middle ear (ossicles)(1) The <u>cochlea in the inner ear changes the sound vibrations into an electrical signal</u> that is sent to the brain via the auditory nerve (1)	4			4		
		(iii)	Components of the ear / ossicles / hair cells (1) Do not respond to high frequencies (1)	2			2		
			Question 4 total	9	6	0	15	6	7

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)	Increase speed (1) Increase speed (1) Change direction (1)	1 1	1		3		3
		(ii)	Selection of $F = BIl$ (1) Manipulation i.e. $l = \frac{F}{BI}$ or $l = \frac{9 \times 10^{-2}}{(30 \times 10^{-3} \times 1.5)}$ (1) Length = 2 [m] (1) Length of side AB = $\frac{2}{40} = 0.05$ [m] (1)	1	1 1 1		4	3	4
	(b)		Substitution: $10 = I^2 \times 40$ (1) Manipulation: $I^2 = \frac{10}{40}$ (1) Current = 0.5 (1) A (1)	1 1	1 1		4	2	4
			Question 5 total	5	6	0	11	5	11

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Vectors have direction, scalars don't	1			1		
		(ii)	Velocity constantly changes (1) As the direction changes (1)		2		2		
		(iii)	Substitution: $0.24 = \frac{d}{(30 \times 60)}$ (1) Manipulation: $0.24 \times (30 \times 60) = d$ (1) Circumference = 432 [m] (1)		3		3	3	
(b)	(i)	Use of principle of conservation of momentum (1) Substitution with signs correct e.g. $(6 \times 50) - (2 \times 50) = 50v + (50 \times 2)$ (1) Correct manipulation (1) Velocity, $v = 2$ m/s to the right (1)	1 1	 1 1		 4	 3		
		(ii)	Velocity of tennis ball is smaller / velocity of squash ball is bigger (1) By a factor of 2 (1)		2		2		
(c)		Low R value indicates most kinetic energy is 'lost' when a ball strikes a wall / floor / surface as noise & heat (1) Some of this energy causes air molecules inside the hollow ball to move more quickly raising its temperature and pressure. (1) As temperature of the ball increases the R value increases (1) Less kinetic energy is dissipated at higher temp when the ball is struck against a wall so it bounces back faster (than at the beginning of the game) (1)			4	4			
Question 6 total				3	9	4	16	6	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		The answer fails to relate the mass to a unit of volume (1) Density = mass per unit volume or density = $\frac{\text{mass}}{\text{volume}}$ (1)	2			2		
	(b)	(i)	Selection and substitution (ignore unit conversions for this marking point): $p = h\rho g$ (1) Unit conversions all correct (shown in substitution)i.e. [$205 \times 10^3 - 101 \times 10^3 = 1024 \times 10 \times h$] (1) Depth = 10.2 [m] (1)	1	1 1		3	3	
		(ii)	Pressure is greater at lower depths (1) Difference in pressure results in a force (1)		2		2		
		(iii)	Percentage = $920 \times 100/1024$ (1) (selection & substitution) = 89.8% / 90% (Do not accept 89%) (1)	1	1		2		
			Question 7 total	4	5	0	9	3	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)	Selection of 220 [nm] (1) Substitution into $c = f\lambda$: $3.00 \times 10^8 = f \times 220 \times 10^{-9}$ [ignore slip on nm] (1) Conversion of nm (1) Manipulation: $f = \frac{3 \times 10^8}{220 \times 10^{-9}}$ (1) Frequency = 1.36×10^{15} [Hz] / accept 1.4×10 [Hz] Allow ecf - accept answer to 2 or 3 significant figures	1	1 1 1		5	4	
		(ii)	220 nm = 0.220 μm - shorter wavelength (1) (both points needed to award the mark) Therefore ultraviolet (1)		2		2		
	(b)	(i)	Similar shape (1) Peak moved to the right (1) Smaller intensity (1)			3	3		
		(ii)	Forces of radiation pressure and gravitation (1) Are balanced (1)	2			2		
	(c)	(i)	In this case the fission of a uranium atom by a single neutron releases 3 further neutrons (1) which can go on to create fission reactions with 3 more atoms of the fuel and so the process escalates (1)	1		1	2		
		(ii)	Two alpha – this causes mass to drop 8 units and atomic number 4 units (1) Zero beta particles – this causes no change in mass number or atomic number (1)			2	2		
			Question 8 total	4	6	6	16	4	0

Question			Marking details	Marks available					
				AO1	AO2	AO3	Total	Maths	Prac
9			<p>Indicative content: Absorption spectra from distant galaxies consist of coloured light crossed with black lines when compared with light from similar sources in the laboratory The reason for this is that the galaxies are moving away from us and is an example of the Doppler effect applied to em waves. The amount of red shift changes with the galaxy's distance from us and the speed with which they are moving away from us. Those that show the biggest red shift are those that are furthest way and moving away fastest. This suggests that the universe began its existence at a single point in an explosion called the Big Bang and has expanded outwards ever since and is still expanding today.</p> <p>5 – 6 marks A detailed description of red shift is given that includes all factors in the indicative content above. This must include a description of an absorption spectrum, reference to wavelength or frequency changes of the lines. The fact that galaxies must recede from us to produce this effect and that it happens to different degrees depending on distance and speed of recession from us. Finally, a link to a possible explosion called the Big Bang must be made. <i>There is a sustained line of reasoning which is coherent, substantiated and logically structured. The information included in the response is relevant to the argument.</i></p>	6			6		

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>3 – 4 marks A general account is provided which leaves out some important aspects. An outline of red shift in terms of movement of lines towards the red end of the spectrum should be included (without relating it to wavelength or frequency shift). An attempt to relate this to either distance or speed of recession is made but not both. A mention of the Big Bang is made probably without the link between distance or speed with a single point explosion (singularity). It is unlikely that expansion in the past and at present would be mentioned. <i>There is a line of reasoning which is partially coherent, supported by some evidence and with some structure. Mainly relevant information is included in the response but there may be some minor errors or the inclusion of some information not relevant to the argument.</i></p> <p>1 – 2 marks A basic description only is given. Light is shifted towards the red end. Galaxies move away from us and this forms evidence for the Big Bang theory. <i>There is a basic line of reasoning which is not coherent, supported by limited evidence and with very little structure. There may be significant errors or the inclusion of information not relevant to the argument.</i></p> <p>0 marks No attempt made or no response worthy of credit.</p>						
				Question 9 total	6	0	0	6	0	0