

But Paper 3 physics markscheme (Unofficial)

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If you arent sure about an answer please highlight it in **green**

What do we think the grade boundaries are gonna be? predictions??

A*: 182-185 for astro

A:

B: 137

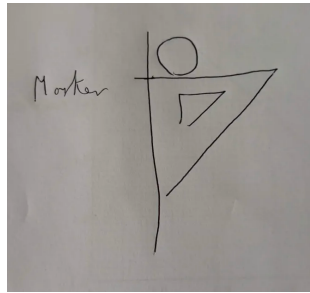
Can smne do astrophys pls

Similar to last year. Maybe like 2-3 marks higher for each paper

Likely similar to last year maybe ~183-186

Anyone do medical please help a brother out

Section A

Question	Marks	Answer
1.1. Set square	1	
1.2 Why is pulse broader	1	Pulse is shorter due to the velocity of the ball being greater at the 2nd light gate so it passes through in a smaller time.
1.3 New pulses on graph. Fiducial marker at top of the ball	3	Someone drew this. I think both to the left and both are wider. I got this too. The gap between both new pulses is wider too. I did second on to the left with the gap between them still being

		wider. Idk if this is wrong but this is probs third mark
1.4 Time between both pulses	1	160ms
1.5 Find h	2	0.354 for h?. I thought you would find h/t using t and just multiply by t. Just multiply h/t by 160×10^{-3} I calculated the area under the graph but idk if that is what u were supposed to do
Find G	3	Gradient= 4.35. $2 \times 4.35 = 9.7$ I got this but they asked to explain and i dont think i was detailed enough - gradient * 2 should be sufficient
Base units for k and explanation of it being constant	3	ms ⁻¹ + explanation (what was the explanation was it that it was y-intercept which is always constant?) it is because it is the speed that the ball passes by the first light gate at , which is a fixed height below the fiducial marker, therefore it is constant. OH So doomed i thought it was the gradient
How to tell if A_n is exponentially proportional to n	Whats the marks on this? 2	Is it not $A_3/A_2 = A_2/A_1$ for same change in n (works with any 3 points)? - if you plot $\ln(A_n)$ against n and it a straight line that means it exponential growth Mark-scheme style • Straight line means $\ln A$ is proportional to n. • $\ln A = mn + c$. • Taking the exponential of both sides gives $A = A_0 e^{mn}$. • Therefore A grows exponentially with n if $m > 0$. • If $m < 0$, A decreases exponentially with n.

		If A_n is exponentially proportional u get equation like $A_n = A_0 \cdot e^{-k(n-1)}$ must have k because I think it is just proportional not directly although k could = 1 so doesn't affect if you put k Ln both sides $\ln(A_n) = \ln(A_0) - k(n-1)$ so when plotting if gradient = -k then proportional exponentially
Electricity table and graph	3	Graph was linear with no massive outliers, so if u got that u prob got it right
Emf from the graph	2	Y intercept 4.45
EMF uncertainty	2	Plot G_{max} G_{min} using error bars. Find range of emf and divide by 2
Resistor question 18 Ohm	1	1,6,7 open 2,3,4,5 closed
Show f is 0.6Hz	1	Find time period for 8 oscillations and divide by 8. Got smth like 0.63 Hz - Dont even need to do that, it says approximately shm or something along those lines so time period is constant you don't need to count 8 bc time period is constant had 8 small boxes peak to peak so 8 times 0.2 is 1.6 $1/1.6 = 0.62\text{hz}$ ish I counted 7
A0 and A3 amplitude	2	125 and 105

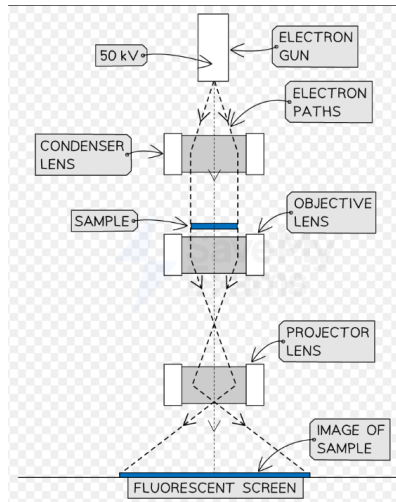
Markings of frequency on graph	1	Scale was 1.1 cm per 0.2 Hz the peak was 0.6.
Half mass and high damping graph	4	Peak to the right with lower and wider peak. Isn't the peak to the left? Mass halves, so Time P down by $\sqrt{2}$ so frequency up by $\sqrt{2}$. When it's damped, peak shifts to the left not right? Peak you divide by root 2 tho. No, $t = 2\pi \sqrt{m/k}$ so t is times by $1/\sqrt{2}$ so frequency increases by $\sqrt{2}$ because $f = 1/t$
Suitable way to plot shape of max amplitude?	1	<u>$\ln(A_{\text{naught}})$ against (n) should give a straight line with negative gradient</u> since $A_{\text{naught}} = ae^{(-bn)}$ where a and b are constants Was this not just take 10 readings between e.g 0.5 and 0.7 Hz so it's an accurate shape near the peak which it asked for I said take multiple reading around the max A value and do repeats of the experiment calculating a mean I put use a data logger to graph the it which is probably wrong.. I wrote that you should take readings with a smaller interval of frequency using the signal generator so you can have more precision.
what is the displacement of X (above the two springs) during its oscillations	1	5? the value at the start of the graph when $f=0$
Why is student wrong. Radioactive source is safe when facing away	1	Radiation spreads out equally in all directions, like a sphere

		Long range Inverse square Law Reflection from walls, and other dense objects
MCQ	1	D – Was that -e on the x axis or y axis? X axis I thought it was A since u rearrange and have $1/\sqrt{x^2 + e^2}$ or smth I got A as well, e was positive on the y intercept for A (e was above 0) A no? e was positive and y-intercept no? I think it is c because c checks out with the units (as e is on the x axis) i also thought c because of the units
2 procedures to stay safe from source Why is it not safe when the source is not pointing at a person Im pretty sure it said procedures to reduce exposure	2	Long tongs to handle radioactive source Keep in lead box or separate room while not handling (this aint right bc its when using it so you cant put it in a box when using it) ALARA regulations No open wounds without gloves surely this is just distance and time minimisation? Us disposable hand gloves for the practical? Like for changing the distance) cant you also simply mention keeping the source sealed when not using it
New count rate. Changed distance $C_{initial} = 1.7$	2	Inverse square law - 5.07(I think) Yeah i did something like 300 +

		30 for the first one then 150 +30 for second after finding k 5.7 ✓ ^ agree
Why for background count rate is it done over long period of time	1	Reduce <u>percentage uncertainty</u> in reading of time . Background radiation varies due to random nature of particle decay maybe accept to avoid anomalies?
When detector is placed vertically instead of horizontally. Effect on count rate	2	Option1: Count rate decreases since some of the gamma radiation is absorbed. Also the source is no longer pointed toward the counter therefore the ionised gas particles will not all be detected. Option 2: Count rate will increase since the distance to counter decreases (and gamma radiation used so it will penetrate the thin metal of the cylinder) (counter is at the end of tube) I ain't an examiner but I calculated the count rate after it was 2.06 so about a 21% increase, and for the metal to counteract that you need about 2-3 cm of aluminum (Not Thin metal very thick) to absorb (17%) of the new count rate Count rate increases as it says detector made of thin metal, so the rays pass through. Then as the surface area is greater for the same distance, the number of ions made inside the detector will increase and so count rate will increase. (agreed)

		^ more ionisation takes place
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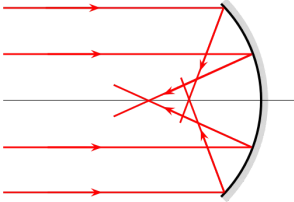
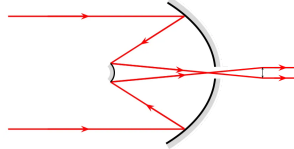
Turning points

Question	Marks	Answer
1.1	2	$eV/d = Bev$ $B \text{ field} = E \text{ field} \times \text{speed}$ Make sure u cancel e value since they dont allow it
1.2 Show that acceleration is 5×10^{14}	2	5.1×10^{14} Using suvat
1.3 Find specific charge	2	$1.73 \times 10^{11} \text{ ma} = QV/d$ rearrange for Q/m
1.4 Why specific charge changes at high speeds	4	I got mass increases by 25% therefore specific charge decreases (used relative equations) $\Lambda = 1.25$
2.1 Draw electron beam	3	 The diagram illustrates the components and operation of an electron microscope. At the top, an 'ELECTRON GUN' is connected to a '50 kV' source. Below it, 'ELECTRON PATHS' are shown as dashed lines. The beam passes through a 'CONDENSER LENS', then a 'SAMPLE' (represented by a blue horizontal bar), followed by an 'OBJECTIVE LENS'. Further down is a 'PROJECTOR LENS', and finally, the beam hits a 'FLUORESCENT SCREEN' at the bottom, creating an 'IMAGE OF SAMPLE'. If your lines at the end didn't cover the entire distance of the screen would you drop marks? No, because some TEM have it so they reach the screen in a straight path. Mark scheme might be mean tho

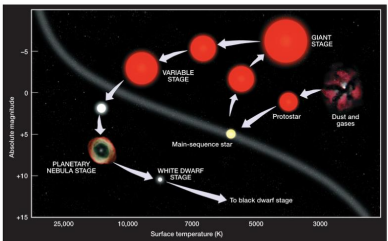
		wasnt the electron path pointing inwards at the start in the diagram given?
2.2 MCQ	1	First one (Condenser, Objective)
2.3 Forces on electrons in lenses	3	Electrons down the centre not deflected. Electrons at edge deflected $F = Bev$ electrons at centre repel each other bc like charges?
Range of speeds of electrons	3	Different force due to magnetic field $F = Bev$, different de brogue wavelengths due to speed. Different resolution areas due to different wavelengths
2.4 electron with 80keV kinetic energy	3	Wavelength is 4×10^{-12} . I think this means it is small enough to resolve since $< 0.1 \text{ nm}$ however i saw a question where 10^{-12} is too small
3.1 Name of Newtons theory of light	1	Corpuscular theory
3.1 Horizontal component of light (show that its 2×10^8)	1	1.93×10^8 $3 \times 10^8 \times \sin 40$
3.2 Speed in water of glass using corpuscular theory	2	Speeds up. 4.7×10^8 Yes its corpuscular theory
3.3 Why was Newton's theory preferred and why was wave theory eventually accepted	3	Newton had reputation for his discovery of gravity and laws of motion Wave theory accepted due to Young's double slit. At that time no apparatus to show interference which is property of wave Later confirmed by maxwells formula and fizeus speed of light being the same Speed of light in water measured and being slower than speed in air. Foucault Wasn't fully accepted after Young's double slit just yet

4.1 Muon relativity	6	This question was so bad, icl was banking on good calculation marks for this -4 half lifes for non relative calculation. -2 half lives for relative calculation -Length for muons is half what was observed to be. Time is also half.
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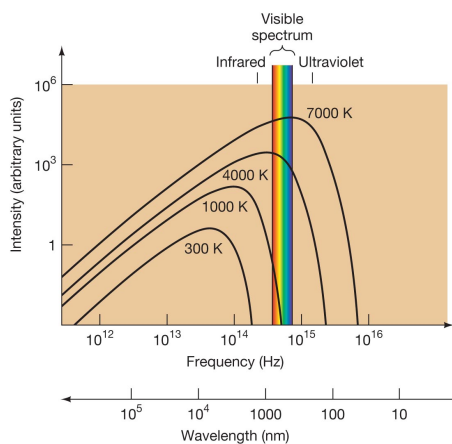
Astrophysics

Astro	Marks	
1.1 Spherical abberation	2	
1.2 Effect on Image	1	Blurry image
1.3 Cassegrain arrangement	3	
3.3.Black hole?	6	<u>Some possible points (used Chat GPT)</u> Before formation • Massive star in hydrostatic equilibrium (gravity balanced by pressure from fusion). • Fusion produces heavier elements until an iron core forms. • Iron fusion does not release energy, so pressure drops. During formation • Core collapses under gravity. • Electron degeneracy pressure is overcome. • Electrons combine with protons to form neutrons: $p + e^- \rightarrow n + \bar{\nu}_e$ $\bar{\nu}_e + e^- \rightarrow n + \nu_e$ • Neutrinos are released.

		• Neutron degeneracy pressure resists collapse. • If the core is massive enough, neutron degeneracy pressure is also overcome. • Collapse continues and an event horizon forms. • A black hole is created. Mass loss • Outer layers are expelled in a supernova. • Neutrinos carry away energy. • Some mass is lost, so the black hole is less massive than the original star. Other stellar remnants Low-mass stars • Become white dwarfs. • Supported by electron degeneracy pressure. More massive stars • Undergo supernova. • Become neutron stars. • Supported by neutron degeneracy pressure. Most massive stars • Neutron degeneracy pressure fails. • Form black holes. None of this is on spec bro (most of this is in the CGP book + i have seen this in one of the past paper markscheme about quasars)
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3.1) HR digram	Draw on the diagram the star with an apparent magnitude of like 8? About 4000 light years away. 3	H-R diagram showing stellar evolution  Figure 24.11
3.2	4 marks	$m-M=5\log d/10$, gives $M=-2.83$ Spectral class is O or B hence top left of diagram
3.3) Black hole radius	2 marks	Mass was 21 solar masses; sub into $2GM/c^2$ you get 62km
3.4		This was the black hole question but sm1 put it upwards smh
2.1	1	You had to state the justification on why the telescope is in orbit
2.2	3	Compare angle subtended by the telescope to rayleigh criterion M1 : workout angle using rayleigh criterion

		M2: Use SOH CAH TOA to work out angle by telescope A1: compare and give a right justification The student was incorrect
What was Q4?		
MCQ	1	All lines shifting right → Option 1
Find orbital velocity	3	6.2 km s^{-1}
Assumption in answer	1	I put that we assume that the star is in the line of sight from the earth
5.1	2	Stefan's law calculation
5.2	4	Frequency-radiation curve (Wein's Law) M1 : Relating the temperature to wiens law M2: Using wave equation to find maximum frequency M3: Correct shape of the graph M4 : Correct conversion with correct values and a correct scale



Engineering physics

Question		
1.1 find ω_{min}	2	I think it was ~ 497 rad/s Surely 68 rads? Nah 19000rpm, 1.8×10^7 J discharged. $\frac{1}{2} I \omega_{max}^2 - \frac{1}{2} I \omega_{min}^2 = 1.8 \times 10^7$ $I \sim 9.7 \text{ kg m}^2$ $\omega_{min} = 497 \text{ rad/s}$
1.2 how many needed	2	22
1.3 Describe how shape of flywheel affects energy stored Describe how materials used affect energy stored Describe how the design of the system makes it more efficient	6	explain $E_K \propto V$ for first bullet point $E_K \propto \rho$ for the second greater density of a material = heavier at the same V $I = mr^2$ moment of inertia will be greater. $E_K = \frac{1}{2} I \omega^2$ so E_K stored is greater Design: frictionless, magnetic repulsion: no work is lost through friction vacuum: no air resistance so flywheel can reach max ω No frictional torque acting in opposite direction.
2.1 what is the moment of inertia of the turntable	2	6×10^{-3}
2.2 A torque of 3.2×10^{-4} is applied to decelerate the two discs. T_1 = time to stop	2 if	433s 44? $T = I\alpha$ where I is turntable + A??
2.3 Another disc B is added with the same I as A. the same retarding torque is applied to slow in time t_2 . What is t_1 compared to t_2	30	$T_1 = t_2$ as the change in angular momentum is the same. $T \cdot \Delta t = \Delta(I\omega)$ and as T is the same, the time must be too.

3.1 Compressor Question. B–C is an adiabatic compression. Show that the adiabatic constant = 1.3	2	$\log_4(6)=1.29$
3.2 - Why can the cycles not be isothermal or adiabatic in the real engine?	3	
3.3 The engine completes 500 rev / min and each cycle is 251J. What is the power output	2	$500/60 * 251 = 2083$
3.4 Efficiency = work done per cycle of isothermal compression / work done in real cycle	3	$141/251 = 0.68$ Each square was 0.4J
3.5 Double compressor with cooler thing. Give one advantage for the double compressor method and one disadvantage.	3	Adv: the compressor follows isothermal curve much more closely → increases efficiency Dis: way more complex and hard to maintain → costly
5.1 MCQ	1	COP ref increases if T_c increases
5.2 COPref is 4.2, input power is 650, how much energy is transferred to the surroundings in 1 second	3	$650 * 4.2 + 650 = 3380J$ 804J? $650/4.2 + 650 = Q_H = 804W$ $P = W/t$ $W = 804J$
5.3 The refrigerator can also be used as a heat pump. State and explain which will have a higher coefficient of performance.	3	$T_h > T_c$ Therefore: $T_h / (T_h - T_c) > T_c / (T_h - T_c)$ Therefore $COP_{HP} > COP_{Ref}$ Alternative method $COP_{HP} - COP_{Ref} = 1$. Therefore the coefficient of performance is always greater, as Q_h is equal to $w + Q_c$