Marking Criteria

M/C: 1 D 2 B 3 D 4C 5D 6A 7A 8A 9A 10B 11C 12B 13D 14B 15D

16a. Criteria	Mark/s
Arrow used to indicate the force acting from the satellite is towards the centre of the earth	1

16b. Criteria	Mark/s
Correctly calculates the initial E_p and final E_p using the appropriate radii including units (-1.209×10^{14} J and -1.164×10^{14}J respectively AND the difference between the final and initial values (4.5×10^{12}J)	3
Calculates the initial E_p and final E_p and the difference between them but uses incorrect radii (including incorrect unit conversions) OR Correctly calculates the initial E_p and final E_p using the appropriate radii including units but not the difference between them	2
Correctly calculates the initial E_p or final E_p	1

17a. Criteria	Mark/s
Correctly calculates the radius of orbit of 55 cancri b (1.5×10^{10}m) and the orbital velocity (7.42×10^4 m s^{-1})	2
Correctly calculates the radius of orbit of 55 cancri b	1

17b. Criteria	Mark/s
Correct calculation of the ratio using Kepler's law of periods (441.71:1)	2
Determines the period of 55 Cancri d (6493.21 days)	1

18. Criteria	Mark/s
Correctly calculates the length of conductor in the field (1.41 m) and calculates the magnitude of the force using F = BIlSinθ where θ = 90º (0.14N). Note; direction not in marking criteria	2
Correctly calculates the length of conductor but does not use θ = 90º in force calculation OR calculates the magnitude of the force using F = BIlSinθ where θ = 90º using incorrect length	1

19a. Criteria	Mark/s
Identifies the theory as classical wave theory OR the aether model AND clearly outlines a significant effect on the theory (eg results brought into question the existence of the aether which was essential to explain how light could move through space AND therefore brought into question the validity of the theory which now required re-evaluating, modifying.	3
Identifies the theory as classical wave theory OR the aether model but does not clearly outline a significant effect on the theory OR the response contains contradictory or incorrect information	2
Identifies the theory as classical wave theory OR the aether model	1

19b. Criteria	Mark/s
Response identifies the theory as Special relativity AND clearly describes at least one predictions (time dilation, length contraction etc) AND states that these predictions could not be tested at the time because the required technology had not been invented (atomic clocks etc) AND therefore the theory could not be validated at the time	4
Missing one of the above	3
Missing two of the above	2
Response identifies the theory as Special relativity	1

20a. Criteria	Mark/s
Subsitutes correctly into the formula to give a correct final answer (78.4m)	2
Uses the correct formula	1

20b. Criteria	Mark/s
Correctly calculates the initial vertical velocity (39.2 m s^{-1}) and uses a vector diagram and/or appropriate calculations to determine the final answer including the angle (46.49 m s^{-1} at 57.47º to ground)	3
Correctly calculates the initial vertical velocity (39.2 m s^{-1}) and uses a vector diagram and/or appropriate calculations to determine the magnitude OR direction of the final velocity	2
Correctly calculates the initial vertical velocity	1

21. Criteria	Mark/s
Correctly calculates the electric field strength (4,000 N C^{-1}) and substitutes appropriately into F = qE to determine the final answer (-6.40×10^{-16} N)	3
Substitutes appropriately into F = qE to determine the final answer but does not correctly calculate F	2
Correctly calculates the electric field strength (4,000 N C^{-1})	1

22. Criteria	Mark/s
Field represented using arrows that are in the correct plane AND field lines are in the correct direction (vertically down the page).	2
	1

23. Criteria	Mark/s
Graphs indicate a changing DC voltage that is higher in frequency and amplitude for the fast turning generator.	3
Two of the three characteristics outlined above	2
One of the three characteristics outlined above	1

24a. Criteria	Mark/s
Kinetic to light	1

24b. Criteria	Mark/s
Two significant precautions related to the high voltage source, production of X-rays or the possible implosion of the tube.	2
One significant precaution.	1

25. Criteria	Mark/s
A clear answer which relates the position and size of the peaks on the graph to the position of the magnet and its increasing velocity as it passes through the solenoid.	4
Answer relates the peaks on the graph to the position of the magnet only	1-2

26. Criteria	Mark/s
Two relevant properties outlined	2
One relevant property outlined.	1

27. Criteria	Mark/s
Two of the following pieces of evidence outlined : * Deflection by magnetic or electric fields * Momentum as demonstrated by the paddle wheel experiment * Measured velocity less than that of light.	2
One property outlined.	1

28. Criteria	Mark/s
One similarity and one difference in the structure and function using the correct text type.	4

One similarity and one difference in the structure and function using the incorrect text type OR three similarities/differences.	3
Two similarities/differences	2
One similarity or difference	1

29. Criteria	Mark/s
Three/four examples of the relationship between technology and advances in physics. Each link clearly explained and at least one example of technology leading to advances in physics and vice versa.	4
Three/four examples of the relationship between technology and advances in physics. Each link clearly explained.	2-3
One/two examples of the relationship between technology and advances in physics.	2
A correct statement about the relationship between technology and advances in physics.	1

30. Criteria	Mark/s
A positive/negative judgement of the impact/s AND Three significant impacts clearly related to the environment.	4
A judgement and two impacts OR Three impacts	3
Two impacts	2
One impact.	1

31a. Criteria	Mark/s
Induction motor	1

31b. Criteria	Mark/s
Any two relevant observations that are likely to be made in carrying out the experiment.	2
One relevant observation	1

32a. Criteria	Mark/s
Answer identifies the result (calculation of the speed of the waves) and relates this to the significance of the speed being the same as that of light.	2
Answer identifies the result.	1

32b. Criteria	Mark/s
Answer outlines the result (spark less intense) and explains this in terms of the photoelectric effect.	2
Result outlined.	1

33a. Criteria	Mark/s
States that human hearing range is typically 20 Hz to 20 kHz and ultrasound used for medical imaging typically is in the range 2 MHz to 10 MHz (not just above 20 kHz, this is not "medical")	2
States that higher frequency sound waves are used for medical imaging that can be heard by humans.	1

32b. Criteria	Mark/s
States that piezoelectric crystal distortions (or pressure) results in voltages being produced across opposite faces of the crystal.	3
States that ultrasound waves distort or apply varying pressure to the piezoelectric crystals OR that the crystals produce a voltage.	2
States that ultrasound is detected using a piezoelectric crystal	1

32c. Criteria	Mark/s
States that because the speed of ultrasound in human tissues is known and the time for the reflected pulse to return is measured, then the distance to the tissue boundary is s=(t/2) x speed	2
States that the distance can be calculated because both the speed and time are known quantities.	1

32d. Criteria	Mark/s
States that X-rays must be transmitted through the body whereas ultrasound is reflected back to the detector AND that X-ray image production relies upon different absorption of rays by different tissues (especially bone).	3
Contrasts either transmission/reflection or differential absorption/reflection due to impedance difference	2
Identifies a relevant interaction between body tissues and either ultrasound or X-rays	1

32e. Criteria	Mark/s
Describes braking (or acceleration/direction change) of electrons at anode (Bremsstahlung radiation) AND K-shell electron excitation by electrons in cathode ray	2
Describes one mechanism for X-ray production	1

32f(i). Criteria	Mark/s
Calculates the correct acoustic impedance and states the correct unit (1.7×10^6 rayls)	1

32fii). Criteria	Mark/s
Identifies the liver-muscle boundary because the acoustic impedance difference is least between these two tissues	2
Identifies the liver-muscle boundary without a reason or gives the correct reason but the incorrect boundary (due to a calculation error)	1

32g(i). Criteria	Mark/s
States that because acoustic impedance is the product of density and speed of sound, if the speed of sound in A is greater than in B then the density of tissue B must be greater than the density of tissue A	2
States only that the density of tissue B is greater than the density of tissue A	1

32g(ii). Criteria	Mark/s
Shows tissues A and B merged as one with the tumour visible, LABELLED, bone in spine visible front only (rear curved part not visible)	2
Shows tissues A and B merged as one with no distinction between them OR has the sector section correct showing tumour and bone in spine	1

32h. Criteria	Mark/s
Uses a diagram and description indicating that proton spins are randomly oriented before the application of the strong B field and that they align approximately parallel and antiparallel to the applied B field (but are not perfectly aligned)	2
Describes alignment fully without a diagram or uses a diagram that is not fully correct (e.g. spins aligned exactly to field) and has a deficient verbal outline.	1

32i. Criteria	Mark/s
Includes in the description: (1) The applied RF frequency is the same as the Lamor frequency which is explicitly related to precession (2) States that energy is absorbed from the RF signal by the proton (or states that the proton goes to a higher energy state) (3) States that the RF causes spin-flip and/or putting precession of protons into phase (not enough to just say "higher energy") (4) That energy is re-emitted by the proton after the RF pulse and that this is detected (best answers stated that the intensity of the emitted signal is related to the H-atom density in the tissue)	4
Three of the above	3
Two of the above	2
One correct statement about the MRI process that is related to the RF pulse.	1