Physics

HSC Course

2012

Year 12 Trial HSC Examination

Total marks 100

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours

- Attempt all questions
- Write using blue or black pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your I.D. number on each answer sheet
- Liquid paper must NOT be used on this paper

- For your convenience, the multiple choice answer sheet and the data sheets at the back may be removed from the rest of the paper

Total marks – 100
Section I
75 marks
This section has two parts, Part A and Part B

Part A – 20 marks
Attempt questions 1-20 (multiple choice)
Allow about 35 minutes for this part.

Part B – 55 marks
Attempt questions 20-33
Allow about 1 hour and 40 minutes for this part

Section II – Medical Physics Module
25 marks
Attempt question 34
Allow about 45 minutes for this part.
Answer this section in a separate booklet.

Teachers: Mr Coombes, Mr Robson, Mr Trotter

Task Weighting: 40 %

Multiple-choice Answer Sheet
Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ⬭ (B) ⬬ (C) ⬭ (D) ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ⬬ (B) ⊗ (C) ⬭ (D) ⬭

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows:

correct ↓

(A) ⊗ (B) ⊗ (C) ⬭ (D) ⬭

Section I – Part A

1. Which statement is correct about a satellite in orbit around the Earth?

   (A) The gravitational acceleration is zero.
   (B) The gravitational acceleration of the satellite is equal to $9.8ms^{-2}$.
   (C) The direction of gravitational acceleration is perpendicular to the satellite's velocity.
   (D) The gravitational force acting on the satellite is independent of the mass of the satellite.

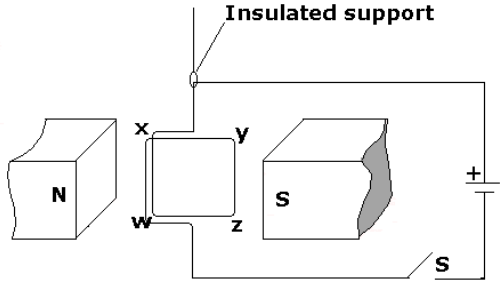
2. Three identical moons, X, Y and Z orbit the same planet. The moons have identical orbital speeds and masses of M, 9M and 25M respectively. Which response correctly shows the ratio of the orbital radii of the moons?

	Moon X	Moon Y	Moon Z
A	R	R	R
B	R	3R	5R
C	R	9R	25R
D	R	R/3	R/5

3. If air resistance is neglected, which of the following statements about projectile motion is correct?

   (A) v_x and v_y remain constant
   (B) v_x and a_y remain constant
   (C) v_x is constant and a_y is zero
   (D) v_y may change direction and a_y must change direction

4. A coil, wxyz, was connected to a battery and suspended in a magnetic field between two magnets as shown. The coil is free to move in any direction or rotate.



Which of the following statements describes the response of the coil when the switch S connecting the coil to a DC voltage supply is closed?

(A) The entire coil moves into the page.
(B) The whole coil moves out of the page
(C) The coil rotates so that YZ moves out of the page
(D) The coil rotates so that XW moves out of the page

Questions 5 and 6 refer to the following experiment.

A student conducted an investigation to determine the relationship between variables A and B. The student altered variable A and then measured the corresponding changes in variable B. This was repeated three times for each magnitude of variable A. The following table was constructed from the investigation.

Variable A	Variable B (1)	Variable B (2)	Variable B (3)	Variable B (average)
5	7.4	7.5	7.3	7.4
10	30.3	30.2	30.4	30.3
15	67.4	67.6	67.5	67.5
20	121	122	120	121

5. What do the results indicate about the relationship between variables A and B?

(A) Variable B is the dependant variable and the measurements in the table are valid
(B) Variable B is the dependant variable and the measurements in the table are reliable
(C) Variable B is the independant variable and the measurements in the table are valid
(D) Variable B is the independant variable and the measurements in the table are reliable

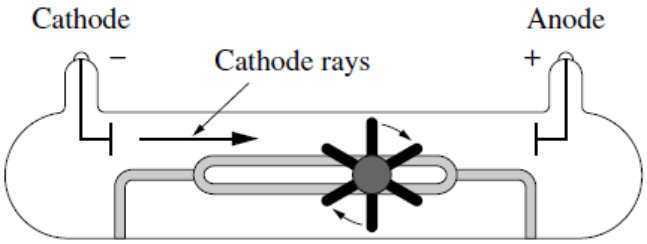
6. The results in the table indicate that the relationship between the variables could be

(A) Variable A is directly proportional to variable B.
(B) Variable A is inversely proportional to variable B.
(C) Variable A is directly proportional to variable B squared.
(D) Variable B is directly proportional to variable A squared.

7. Which of the following statements best describes the function of the laminated iron core used in a transformer?
   (A) It minimises eddy currents and increases the magnetic flux.
   (B) It insulates the primary coil from the secondary coil.
   (C) It absorbs heat produced by the coils and intensifies the primary coil's field.
   (D) It maintains a balance between the input and output voltages.

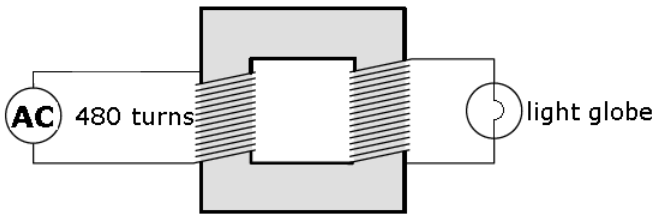
8. What assumption did Planck make that enabled him to make predictions consistent with the radiation curves produced by hot objects?
   (A) Matter is converted into energy according to the equation $E = mc^2$.
   (B) Radiation emitted and absorbed by black body radiators is quantised.
   (C) Radiation is emitted and absorbed as waves with energy proportional to their frequencies.
   (D) As the temperature of a black body increases, the total energy radiated increases and the wavelength at which most energy is emitted decreases.

9. Which of the following statements is not an inference that can be made using a Paddle Wheel tube?



   (A) Cathode rays possess energy.
   (B) Cathode rays have momentum.
   (C) Cathode rays travel in straight lines.
   (D) Cathode rays have a negative electric charge.

10. This diagram shows a transformer that converts 240 volts to 12 V with a maximum secondary current of 10 A. The current through the 24 W 12 V light globe connected to the secondary coil is 2 A.



Four identical light globes are connected to the secondary coil. Each light globe has the same power as the original globe. Which statement is correct if the input voltage is 240V?

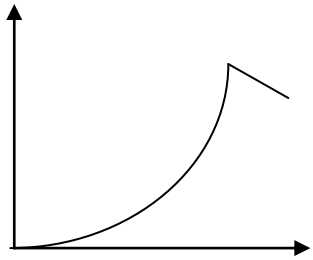
(A) The number of turns on the secondary would have to be increased to 96 turns.

(B) The current through the primary coil of the transformer would be greater.

(C) The current through the secondary coil would not change.

(D) The voltage output of the secondary coil would be 48 volts.

11. The following graph demonstrates the motion of a rocket for the first 2 minutes after launch.



What variable should be placed on the vertical axis of this graph?

(A) Displacement
(B) Velocity
(C) Acceleration
(D) G-force

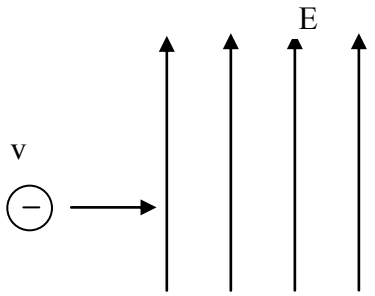
12. A planet has a larger mass than the Earth but has a lower gravitational acceleration at the surface. Which combination from the table best predicts the planets mass and radius compared to Earth.

	Mass (M)	Radius (R)
A	$2M_E$	$\frac{1}{2} R_E$
B	$2 M_E$	$2 R_E$
C	$4 M_E$	$\frac{1}{2} R_E$
D	$4M_E$	$2 R_E$

13. Which of the following statements related to g-forces is most correct?

(A) Astronauts have different tolerances for g-force but not other forces.
(B) G-forces are stronger during launch because the crafts acceleration is positive.
(C) Different astronauts experience different g-forces because of their different mass.
(D) G-forces acting on an astronaut increase as the craft re-enters the atmosphere.

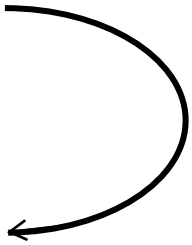
14. A negatively charged particle enters a region with a uniform electric field. The direction of the particle's velocity and the electric field are shown in the diagram



Which diagram best represents the subsequent path of the particle in the magnetic field?

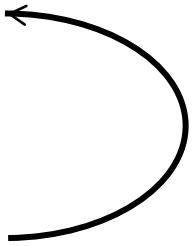
(A)

(B)



(C)

(D)



15. A photon of light has a wavelength of 580nm. What is its energy in Joules?

(A) 3.43×10^{-19}

(B) 3.43×10^{-28}

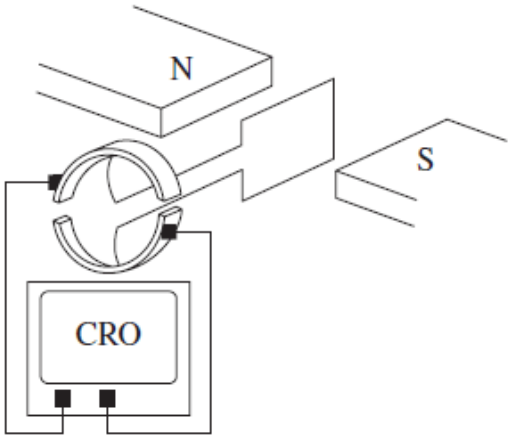
(C) 3.84×10^{-40}

(D) 3.84×10^{-31}

16. Why is high voltage used to transmit electrical energy from the power station to users?

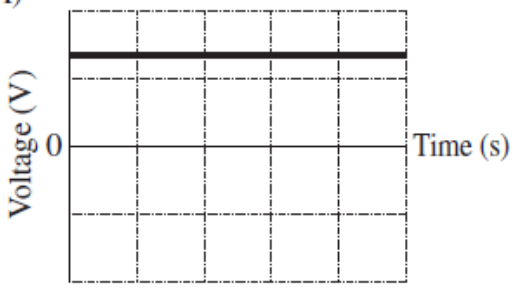
(A) High voltages result in lower currents which are safer.
(B) It allows supporting structures to have smaller insulators.
(C) It minimises the effects of the electrical resistance of the wires.
(D) It ensures that, even with voltage losses that 240V still reaches the user.

17. The diagram shows a DC generator connected to a cathode ray oscilloscope(CRO).

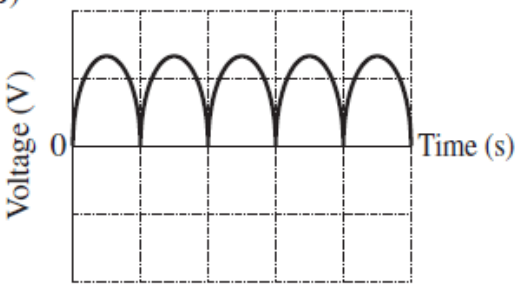


Which response best shows the voltage signal displayed on the oscilloscope?

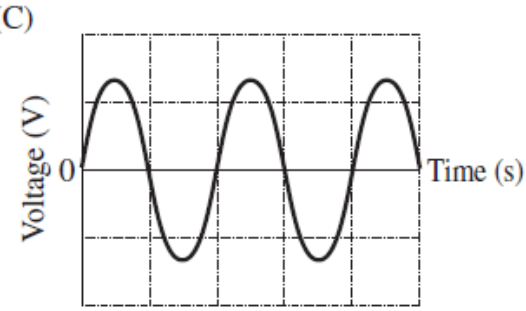
(A)



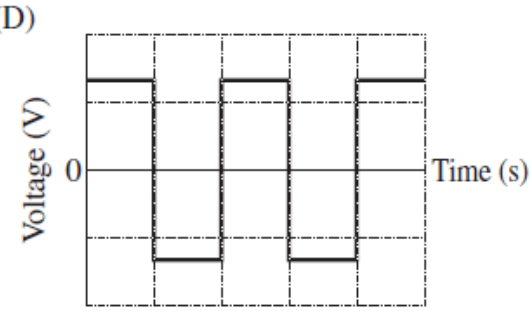
(B)



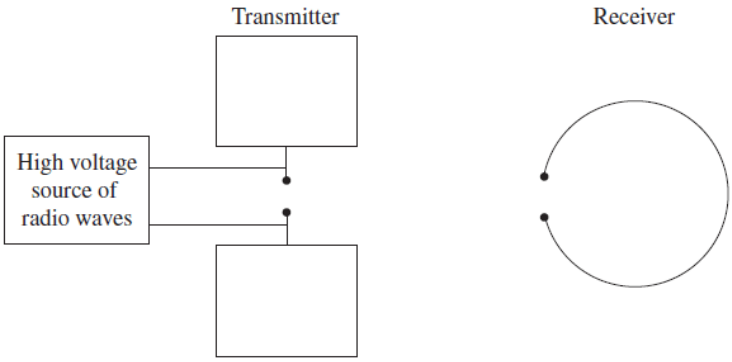
(C)



(D)



Use the following information to answer questions 18 and 19.
Heinrich Hertz used a set-up similar to the one shown below to measure the speed of radio waves.



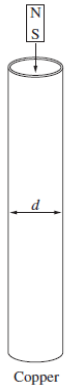
18. What vital piece of equipment is missing from the apparatus shown?

(A) A screen
(B) A voltmeter
(C) A galvanometer
(D) A metal reflector

19. A glass sheet was placed between the transmitter and receiver.
Which of the following observations is consistent with the photoelectric effect that Hertz produced?

(A) Radio waves were blocked when the glass sheet was in place.
(B) Ultraviolet waves were blocked when the glass sheet was in place.
(C) The maximum spark length was longer when the glass sheet was in place.
(D) The maximum spark length was shorter when the glass sheet was in place.

20. A bar magnet is dropped through a long copper tube as shown. It was observed that the magnet hit the ground in 5 seconds.

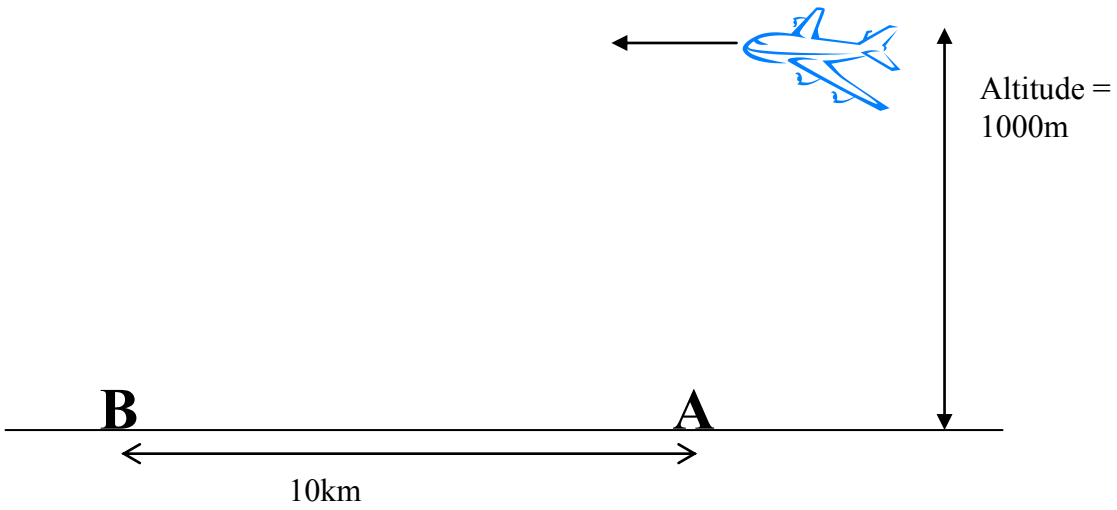


Which modification to the experiment will most significantly decrease the time it takes the magnet to hit the ground?

(A) Cut vertical laminations in the tube.
(B) Double the diameter of the tube.
(C) Use a plastic tube instead of a copper tube.
(D) Propel the magnet downwards with an initial velocity of $5ms^{-1}$.

Section I – Part B

21. A bomber travels at 200 km/hr horizontally above its desired target as shown below. The bomber needs to hit 2 targets which are a distance of 10km apart. The targets are labelled A and B as follows. If the first bomb is released at exactly 1:00pm and hits target A, then at what time must the second bomb be released in order to hit target B? (4 marks)



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22. (a) With reference to one device studied in each of the core units of the course, identify the major energy transformation that occurs in each device. (3 marks)

Core Unit	Device	Energy Transformation
Space		
Motors and Generators		
Ideas to Implementation		

(b) Account for Lenz's law in terms of the law of conservation of energy. (3 marks)

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23. (a) Recount the method used in the Michelson-Morley experiment. (4 marks)

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(b) A student concludes that the Michelson-Morley experiment was a waste of time because they did not achieve the aim of the experiment. Assess the conclusion made by the student.
(3 marks)

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24. You carried out an investigation of the striation patterns in a discharge tube.

(a) Identify the independent and dependent variables and two variables that were kept constant in this investigation. (2 marks)

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(b) Outline a safety precaution necessary when conducting investigations that use an induction coil. (1 mark)

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25. Triplets (Dave, Bill and Tim) are born in the 22nd century. Dave and Bill are astronauts and both head off on a mission in opposite directions. Tim stays behind on Earth. Dave travels away from the Earth at 0.9c relative to Tim. Bill travels in the opposite direction at 0.95c, also relative to Tim.
(a) Of the triplets who will Tim observe to be ageing most quickly? (1 mark)

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(b) From Bill's perspective it takes him 1 month to reach his destination. How long will Tim observe Bill's trip to take? (2 marks)

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(c) A local newspaper reports that Dave and Bill are moving away from each other at 1.85 times the speed of light. Assess this statement. (3 marks)

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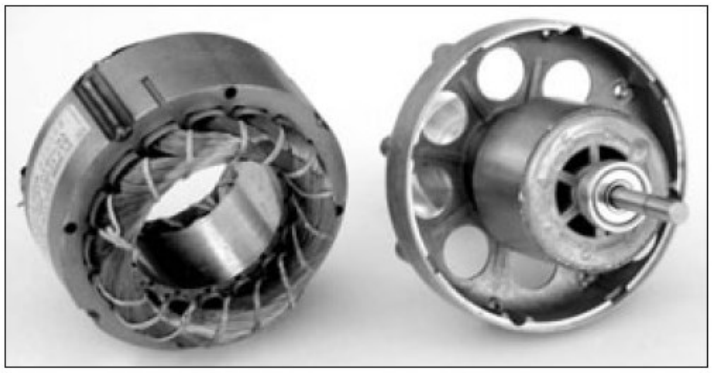
26. The following shows a picture of an AC induction motor.



(a) Compare the structure of this motor with a synchronous AC motor. (4 marks)

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(b) Recount the experiment that you conducted in class to demonstrate the principal by which the AC induction motor works. (3 marks)

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27. Three long, straight, parallel wires; X, Y and Z are positioned as shown below. Each wire is 1m long and the current in wire Z runs in the opposite direction to both wire X and Y.

Calculate the force on wire Y, due to the other two wires. **(3 marks)**

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28. JJ Thomson conducted an investigation to measure the charge to mass ratio of cathode rays. In one part of his experiment he ensured that the cathode ray passed through the discharge tube undeflected. Describe how he was able to do this and explain why this enabled him to measure the velocity of the cathode rays he was observing. **(5 marks)**

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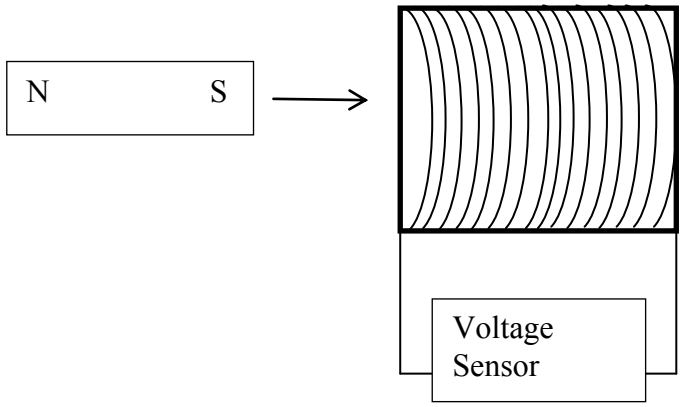
29. An astronaut in the international space station (satellite) conducts an investigation. During this investigation a magnet is allowed to pass through a solenoid connected to a voltage sensor and data logger. As the magnet approaches the solenoid it has a constant velocity and is not being forced in any way be the astronaut. The magnet passes through the solenoid and out the other side



Sketch a graph of induced voltage vs time for this experiment.(3marks)

30. Analyse the relationship between the work done by Einstein and Planck and the shift in scientific thinking about the nature of light. **(7 marks)**

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31. Explain why the discharge tube pictured below was not able to resolve the debate as to whether cathode rays were charged particles or a form of electromagnetic radiation. **(4 marks)**

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End of Part B

Section II – Medical Physics

25 Marks

Allow about 45 minutes for this section. Answer all parts of this question in a writing booklet.

Additional writing booklets are available if required.

(a)(i)Describe the Doppler effect(1 mark)

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(ii) Using an example of cardiac problem explain why Doppler ultrasound imaging can provide a diagnosis.(3 marks)

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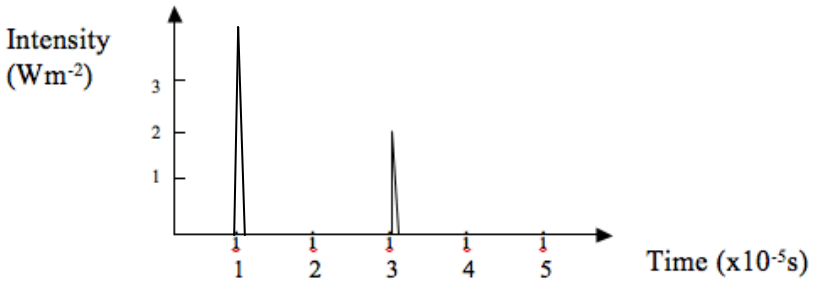
(b) An A-scan ultrasound is used to assist in making a medical diagnosis. The ultrasound travels through soft body tissue and strikes an organ. Sound is reflected from both the front and back of the organ. Sound travels at an average speed of 1500ms^{-1} in soft body tissue. The A-scan record below shows the result of this process for ultrasound having an initial intensity 100 W m^{-2}. The initial pulse was applied at t = 0 s.



Using the information in the graph determine the size of the organ being examined. (3 marks)

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(c)

Body Tissue	Density (kg m^{-3})	Velocity (m s^{-1})
Blood	1060	1570
Average Soft body	1000	1500
Brain	1025	1540
Fat	925	1450
Muscle	1075	1590

(i) Calculate the acoustic impedance of fat tissue. (1 mark)

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(ii) The acoustic impedance of air is 400 kg m^{-2} s^{-1}. Using a calculation explain why ultrasound is not an effective tool in imaging the lungs. **3**

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(d) Discuss the use of the diagnostic techniques used to produce the following images.(4 marks)

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(e) Many studies have found a link between CAT scans and an increased risk of brain cancers. Considering this risk, assess the impact of this type of imaging on society.**(5 marks)**

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(f) The following image is a CAT scan of the chest

(i) Describe the features of this image. (2 marks)

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(ii) Outline the process used to produce the image. (3 marks)

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END OF EXAM

HIGHER SCHOOL CERTIFICATE EXAMINATION

Physics

DATA SHEET

Charge on electron, q_e	-1.602×10^{-19} C
Mass of electron, m_e	9.109×10^{-31} kg
Mass of neutron, m_n	1.675×10^{-27} kg
Mass of proton, m_p	1.673×10^{-27} kg
Speed of sound in air	340 m s^{-1}
Earth's gravitational acceleration, g	9.8 m s^{-2}
Speed of light, c	3.00×10^8 m s^{-1}
Magnetic force constant, $\left(k \equiv \frac{\mu_0}{2\pi}\right)$	2.0×10^{-7} N A^{-2}
Universal gravitational constant, G	6.67×10^{-11} N m^2 kg^{-2}
Mass of Earth	6.0×10^{24} kg
Planck constant, h	6.626×10^{-34} J s
Rydberg constant, R (hydrogen)	1.097×10^7 m^{-1}
Atomic mass unit, u	1.661×10^{-27} kg 931.5 MeV/c^2
1 eV	1.602×10^{-19} J
Density of water, ρ	1.00×10^3 kg m^{-3}
Specific heat capacity of water	4.18×10^3 J kg^{-1} K^{-1}

FORMULAE SHEET

$$v = f\lambda$$

$$I \propto \frac{1}{d^2}$$

$$\frac{v_1}{v_2} = \frac{\sin i}{\sin r}$$

$$E = \frac{F}{q}$$

$$R = \frac{V}{I}$$

$$P = VI$$

$$\text{Energy} = VIt$$

$$v_{av} = \frac{\Delta r}{\Delta t}$$

$$a_{av} = \frac{\Delta v}{\Delta t} \text{ therefore } a_{av} = \frac{v-u}{t}$$

$$\Sigma F = ma$$

$$F = \frac{mv^2}{r}$$

$$E_k = \frac{1}{2}mv^2$$

$$W = Fs$$

$$p = mv$$

$$\text{Impulse} = Ft$$

$$E_p = -G\frac{m_1 m_2}{r}$$

$$F = mg$$

$$v_x^2 = u_x^2$$

$$v = u + at$$

$$v_y^2 = u_y^2 + 2a_y\Delta y$$

$$\Delta x = u_x t$$

$$\Delta y = u_y t + \frac{1}{2}a_y t^2$$

$$\frac{r^3}{T^2} = \frac{GM}{4\pi^2}$$

$$F = \frac{Gm_1 m_2}{d^2}$$

$$E = mc^2$$

$$l_v = l_0\sqrt{1-\frac{v^2}{c^2}}$$

$$t_v = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$m_v = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

FORMULAE SHEET

$$\frac{F}{l} = k\frac{I_1 I_2}{d}$$

$$F = BIl\sin\theta$$

$$\tau = Fd$$

$$\tau = nBIA\cos\theta$$

$$\frac{V_p}{V_s} = \frac{n_p}{n_s}$$

$$F = qvB\sin\theta$$

$$E = \frac{V}{d}$$

$$E = hf$$

$$c = f\lambda$$

$$Z = \rho v$$

$$\frac{I_r}{I_0} = \frac{\left[Z_2 - Z_1\right]^2}{\left[Z_2 + Z_1\right]^2}$$

$$d = \frac{1}{p}$$

$$M = m - 5\log\left(\frac{d}{10}\right)$$

$$\frac{I_A}{I_B} = 100^{(m_B - m_A)/5}$$

$$m_1 + m_2 = \frac{4\pi^2 r^3}{GT^2}$$

$$\frac{1}{\lambda} = R\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$$\lambda = \frac{h}{mv}$$

$$A_0 = \frac{V_{\text{out}}}{V_{\text{in}}}$$

$$\frac{V_{\text{out}}}{V_{\text{in}}} = -\frac{R_{\text{f}}}{R_{\text{i}}}$$

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	79
Symbol of element	Au
Atomic Weight	197.0
Name of element	Gold

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] Technetium	44 Ru 101.1 Ruthenium	45 Rh 102.9 Rhodium	46 Pd 106.4 Palladium	47 Ag 107.9 Silver	48 Cd 112.4 Cadmium	49 In 114.8 Indium	50 Sn 118.7 Tin	51 Sb 121.8 Antimony	52 Te 127.6 Tellurium	53 I 126.9 Iodine	54 Xe 131.3 Xenon
55 Cs 132.9 Caesium	56 Ba 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 Tungsten	75 Re 186.2 Rhenium	76 Os 190.2 Osmium	77 Ir 192.2 Iridium	78 Pt 195.1 Platinum	79 Au 197.0 Gold	80 Hg 200.6 Mercury	81 Tl 204.4 Thallium	82 Pb 207.2 Lead	83 Bi 209.0 Bismuth	84 Po [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223] Francium	88 Ra [226] Radium	89–103 Actinoids	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 Gadolinium	65 Tb 158.9 Terbium	66 Dy 162.5 Dysprosium	67 Ho 164.9 Holmium	68 Er 167.3 Erbium	69 Tm 168.9 Thulium	70 Yb 173.0 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium

For elements that have no stable or long-lived nuclides, the mass number of the nuclide with the longest confirmed half-life is listed between square brackets.

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (October 2005 version) is the principal source of data. Some data may have been modified.

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Multiple-choice Answer Sheet

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample 2 + 4 = (A) 2 (B) 6 (C) 8 (D) 9

(A) ⬭ (B) ⬬ (C) ⬭ (D) ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

(A) ⬬ (B) ⊗ (C) ⬭ (D) ⬭

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word correct and drawing an arrow as follows:

correct ↓

(A) ⊗ (B) ⊗ (C) ⬭ (D) ⬭

Part A

1.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
2.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
3.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
4.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
5.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
6.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
7.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
8.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
9.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
10.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
11.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
12.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
13.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
14.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
15.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
16.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
17.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
18.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
19.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭
20.	(A)	⬭	(B)	⬭	(C)	⬭	(D) ⬭

Marking Criteria

M/C: 1 B 2 C 3 A 4(na) 5C 6D 7D 8B 9B 10B 11A 12B 13A 14B 15B 16C 17B 18D 19D 20C

21. Criteria	Mark/s
Correctly calculates 1:03pm as time for bomb release	4
Correctly calculates time for plane to travel 10 km.	3
Incorrect time for bomb release but correct calculation of time for plane to travel 10 km and time for bomb to hit the ground	2
Calculates time for bomb to reach the ground, or use of v=r/t.	1

22.(a) Criteria	Mark/s
Identifies three significant devices we have studied and their major energy transformations	3
Identifies two significant devices we have studied and their major energy transformations	2
Identifies one significant device we have studied and its major energy transformation	1

22.(b) Criteria	Mark/s
Answer demonstrates an understanding of both the law of conservation of energy and Lenz's law. Answer correctly relates loss in kinetic energy with increase in electrical energy, linking the law of conservation of energy and lenz's law.	3
Answer demonstrates an understanding of both the law of conservation of energy and Lenz's law	2
Answer demonstrates an understanding of either the law of conservation of energy and Lenz's law	1

23. (a) Criteria	Mark/s
Correct diagram of Michelson-Morley experiment. Includes in answer the observation of an interference pattern and rotation of the apparatus through 90°	4
Correct answer missing either observation of an interference pattern or rotation of the apparatus through 90° or one mistake in the diagram	3
Correct answer including two errors in either the diagram or answer	2
Correct answer including three errors in either the diagram or answer	1

23b. Criteria	Mark/s
Makes a judgement of the statement and justifies by relating the null result to later development is scientific thinking such as Einstein's postulate regarding the constancy of the speed of light.	3
Makes a judgement of the statement and states the results and makes some reference to changes in scientific thinking.	2
Demonstrates a limited understanding of the importance of the results of this experiment.	1

24(a) Criteria	Mark/s
Correctly identifies the independent variable(pressure) and the dependent variable (striation pattern) AND Two significant controlled variables (eg voltage, gas in tube(air), length of tubes.	2
Correctly identifies the independent variable and the dependent variable OR Two significant controlled variables	1

24(b) Criteria	Mark/s
One significant safety precaution related to the induction coil	1

25(a) Criteria	Mark/s
Tim	1

25(b) Criteria	Mark/s
Correct answer of 3.2 months	2
Correct substitution into equation with incorrect answer	1

25. Criteria	Mark/s
Judgement of statement with significant	3
	2
	1

26. Criteria	Mark/s
Judgement of importance AND Significant reasoning related to safety and efficiency AND Demonstrates a logical progression and good use of scientific terminology	6
Judgement of importance AND Significant reasoning related to safety and efficiency	4-5
Limited discussion of issues related to safety and efficiency	2-3
One correct point related to efficiency or safety.	1

27. Criteria	Mark/s
Answer calculates the force per unit length due to wire X and Y and adds them using appropriate vector addition.	3
Answer calculates the force per unit length due to wire X and Y and adds them incorrectly. OR Correct method with one error or substitution..	2
Correct method with two errors	1

28. Criteria	Mark/s
Answer explains how the Earths orbital motion and the slingshot effect can be utilised to minimise the fuel needed by the probe.	4
Answer demonstrates some understanding of how orbital motion of the Earth and the slingshot effect are utilised.	2-3
Answer identifies that the slingshot effect or orbital motion of the Earth is utilised.	1

29. Criteria	Mark/s
Explanation of why increasing voltage decreases current and relates the change in current to the wires in the secondary being thinner.	3
Explanation of why increasing voltage decreases current.	2
Identifies that increasing voltage decreases current.	1

30. Criteria	Mark/s
Correct description of method including ▪ A suitable method of controlling speed. ▪ The use of a galvanometer or micro ammeter ▪ Measurements across a specific range of distances. ▪ Repetition of each measurement at least three times.	4
Correct description of method with one of the above omitted.	3
Correct description of method with two of the above omitted.	2
Correct description of method with three of the above omitted.	1

31 Criteria	Mark/s
Well written response which includes • Identification of the tube (maltese cross) • A specific observation that the cathode rays formed a shadow and this means that • Cathode rays travel in straight lines but • This inference can be explained using both the EM wave and particle models proposed for cathode rays.(including an outline of how the two models explain the observation(s)) • And therefore this tube could not resolve the debate	3-4

Identifies the type of tube and the relevant observation but does not clearly link this to the fact that both models can explain this behaviour OR Response includes information based on observations/inferences from other CRT's (eg the paddle wheel) in addition to the points raised above.	1-2

Section II – Medical Physics

A (i) Criteria	Mark/s
Describes the Doppler effect as the observed change in frequency of a **wave** (or sound) due to the relative motion of wave source and the observer.	1

a (ii). Criteria	Mark/s
Coherent response which includes • a specific cardiac problem (eg. faulty heart valve, blocked coronary artery, hole in the wall between ventricles) • an outline of how Doppler ultrasound can image movement of blood and • clearly relates this technique to the identified cardiac problem	3
Response includes the above information but lacks important detail (eg identified medical problem not specific to the heart OR does not make a specific link between the technique and the medical problem) or Response contains one significant factual error	2
Response demonstrates a basic understanding of how Doppler ultrasound can be used to image moving tissue	1

b. Criteria	Mark/s
Correctly identifies the time interval between the two peaks on the graph (2×10^{-5} s) and Substitutes correctly into the formula v = r/t to calculate the distance travelled by the ultrasound in the organ (0.03 m) and Recognises that this is twice the size of the organ – final answer is 0.015 m or 1.5 cm	3
Correctly calculates the distance travelled by the ultrasound in the organ	2
Correctly identifies the time interval between the two peaks on the graph	1

c (i). Criteria	Mark/s
Substitutes correctly into the equation Z = pv to determine the acoustic impedance (Z = 1341250 kg m^{-2} s^{-1})	1

c (ii). Criteria	Mark/s
Correctly calculates the percentage of sound reflected at a soft tissue/air boundary (99.89 %) and Clearly relates the calculation to the structure of the lungs and States that the intensity of sound penetrating the lungs is too low to produce an image of the internal structure	3
Correctly calculates the percentage of sound reflected at a soft tissue/air boundary and Relates the calculation to the strong reflection of sound from the lungs without linking it specifically to lung structure.	2
Correctly calculates the percentage of sound reflected at a soft tissue/air boundary OR Shows a basic understanding of the importance of a large difference in acoustic impedance in imaging the lungs	1

d. Criteria	Mark/s
Coherent and logical discussion which includes • A correct identification of the two techniques (conventional X-ray and ultrasound sector scan) • A relevant use of each technique outlined (eg X-rays used to identify bone fractures, US used to diagnose health of developing embryo) • A significant point for and against each technique in relation to the identified use	3-4
Response correctly identifies the two techniques and outlines a significant point for OR a significant point against for each.	1-2

e Criteria	Mark/s
Response makes a clear judgement of the size of the impact on society and Demonstrates a thorough knowledge of CAT scans including • Identification of at least two different conditions that can be identified using CAT scans • At least two relevant features of CAT scans that relate to their ability to detect these conditions (eg high resolution, 2 D to show position of structures, expense) and Clearly links the identified uses of CAT scans to their impacts on society (eg improved knowledge of the anatomy of the human body which leads to better health provisions for society, pressure on the health budget to purchase and maintain expensive CAT scanners, early diagnosis contributes to a healthier society Demonstrates coherence and logical progression and includes correct use of scientific principles and ideas	4-5
Response makes a clear judgement of the size of the impact on society and demonstrates a sound knowledge of CAT scans and clearly links an identified use of CAT scans to a significant impact on society	3
Response demonstrates some knowledge and understanding of the use and impact of CAT scans on society or the individual.	1-2

f (i) Criteria	Mark/s
Describes two significant features of the image - for example • 2 dimensional • High resolution • Shows clear distinction between bone and soft tissue using grey scale	2
Describes one of the above	1

f (ii) . Criteria	Mark/s
A thorough description which includes • a fan-shaped beam of X-rays is passed through the body • The X-ray tube is rotated 180^0 around the body • a ring of detectors on the opposite side of the body detects variations in the intensity of transmitted X-rays • data analysed by computer (A diagram was useful to illustrate these features)	3
Response contains the above points but lacks detail and/or clarity (eg no diagram)	2
Response missing one essential point	1