Physics

HSC Course

2008

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 at the back may be removed from the rest of the paper

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

Part A – 15 marks
Attempt questions 1-15 (multiple choice)
Allow about 30 minutes for this part.

Part B – 70 marks
Attempt questions 16 to 30
Allow about 2 hours for this part

Section II – Medical Physics Module
15 marks
Attempt question 31
Allow about 30 minutes for this part

Teachers: Mr Coombes, Mr Robson, Mr Pitt

Task Weighting: 40 %

This page is blank

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. The gravitational acceleration on the surface of Mars is 3.72 m s^{-2}. An astronaut wearing his space suit on the Moon, where the gravitational acceleration is 1.6 m s^{-2}, has a weight of 224 N. If the astronaut was standing stationary on the surface of Mars, which of the following would correctly represent his mass?

   (A) 520.8 N

   (B) 224 N

   (C) 140 kg

   (D) 60.2 kg

2. Compared with a low earth orbit satellite, a geostationary satellite has

   (A) a longer period and a lower orbital velocity

   (B) a longer period and a higher orbital velocity

   (C) a shorter period and a lower orbital velocity

   (D) a shorter period and a higher orbital velocity

3. The illustration shows an artist's impression of an Earth-like planet discovered orbiting a distant sun. Careful measurements suggest its mass is identical to that of Earth, but that its radius is twice as large.

If the escape velocity from the earth is v_E, then the escape velocity from this planet is

(A) $1/\sqrt{2}\ v_E$

(B) $\frac{1}{2}\ v_E$

(C) v_E

(D) $2\ v_E$

4. The photograph below shows a UFO as it hovered above the Earth's surface.

A moment later the UFO streaked directly away from the photographer's line of sight at 0.6c. Which image below best represents the appearance of the UFO as seen by the photographer when it is at the same position as in the above photo, but moving away at 0.6c?

(A)

(B)

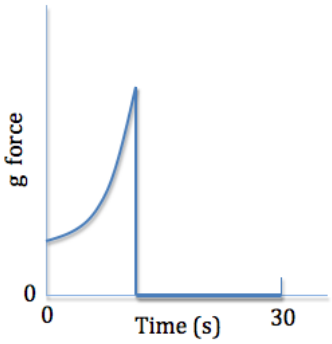
(C)

(D)

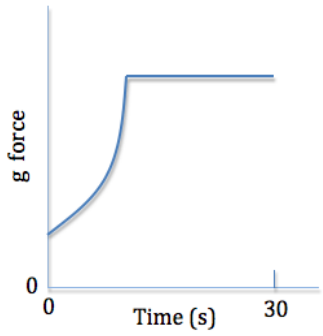
5. The picture below shows the launch of a test rocket. The rocket engine burns and produces a constant thrust for a period of 12 seconds before the engine was switched off. A parachute was opened 30 seconds after launch to control the rocket's decent back to Earth.

Identify which graph best illustrates the g forces acting on the rocket over the first 30 seconds.

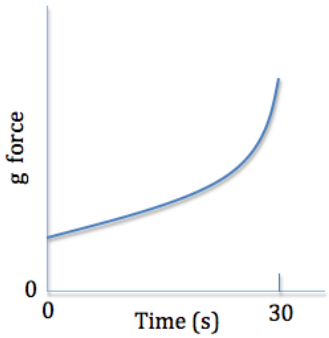
(A)



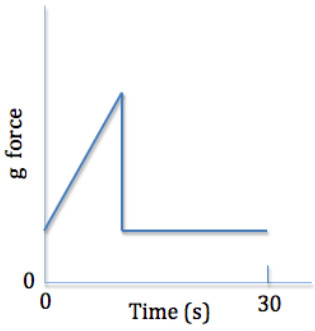
(B)



(C)



(D)



6. A computer transformer has an output voltage of 20 V. The computer plugs into a standard 240V / 10 A wall socket. The transformer has 480 primary turns. How many turns are there on the secondary coil?

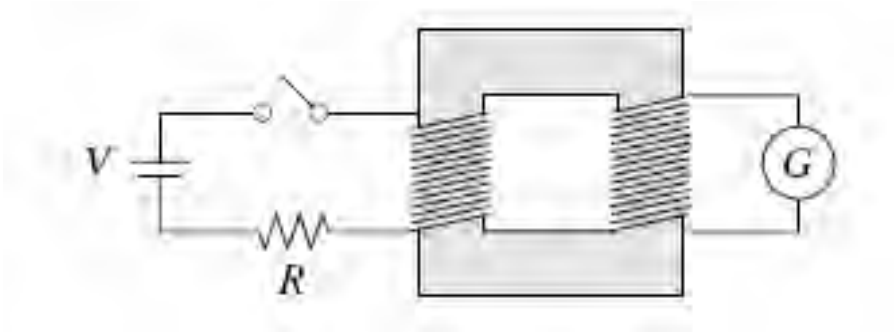
(A) 24

(B) 40

(C) 5760

(D) 9600

7. The primary coil of a transformer is connected to a resistor (R) , a switch and a DC voltage. The student switches on the circuit and notices a deflection of the galvanometer for a short period of time.



Which of the following would **not** increase the size of deflection observed by the student?

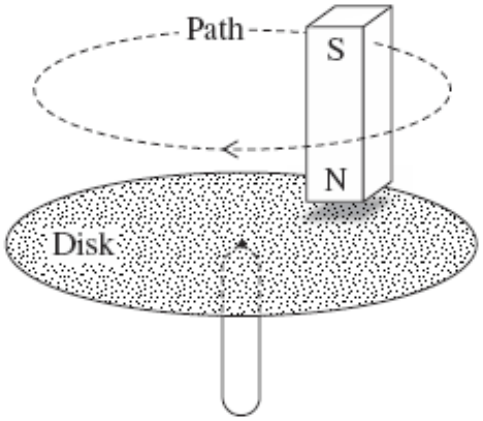
(A) Increase the number of secondary coils

(B) Increase the size of the resistor

(C) Increase the voltage supply

(D) Decrease the time taken to close the switch

8. A student conducts an investigation by moving a magnet in a circular path slightly above a thin metal disk, which is free to move.

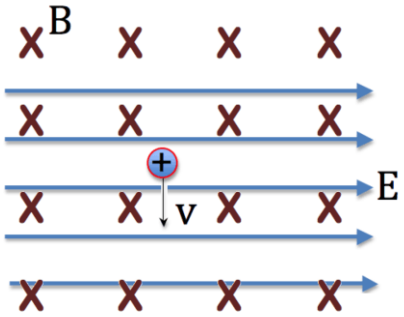


Which of the following would correctly show the aim and results of the student's investigation?

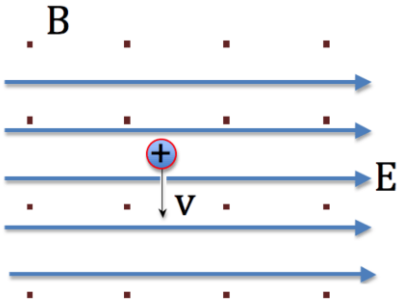
	Aim	**Results**
(A)	To demonstrate the principle of an induction motor	The disk rotates in the opposite direction to the magnet
(B)	To demonstrate the principle of an induction motor	The disk rotates in the same direction to the magnet
(C)	To demonstrate the principle of if a DC motor	The disk rotates in the opposite direction to the magnet
(D)	To demonstrate the principle of if a DC motor	The disk rotates in the same direction to the magnet

9. Which of the following diagrams best represents the experiment Thomson used to measure the charge to mass ratio of electrons?

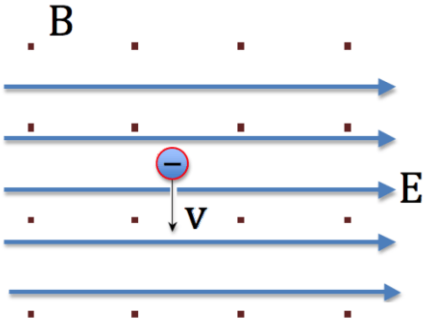
(A)



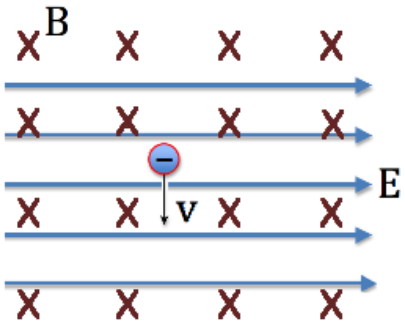
(B)



(C)



(D)



10. The minimum energy required to eject an electron from the surface of aluminium is 4.08 electron volts (eV). What would be the wavelength, in metres, of the light needed to eject an electron from the surface of aluminium?

(A) 6.54×10^{-19}

(B) 9.86×10^{14}

(C) 2.96×10^{23}

(D) 3.04×10^{-7}

11. The increased understanding of the behaviour of cathode rays led most directly to the development of which of the following technologies?

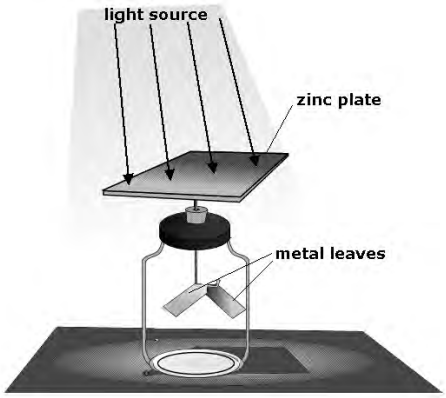
(A) improved vacuum pumps

(B) radio

(C) television

(D) mobile phones

12. An electroscope was charged negatively causing the metal leaves on the electroscope to diverge as shown in the following diagram. A monochromatic green light source was directed onto a cesium metal plate sitting on top of the electroscope and it was observed that this caused the electroscope to discharge.



The electroscope was given the same charge again and the intensity of the light was increased. Which of the following statements best describes the observation that would be made, compared to the first experiment with the lower intensity light, and provides a correct explanation for the observation?

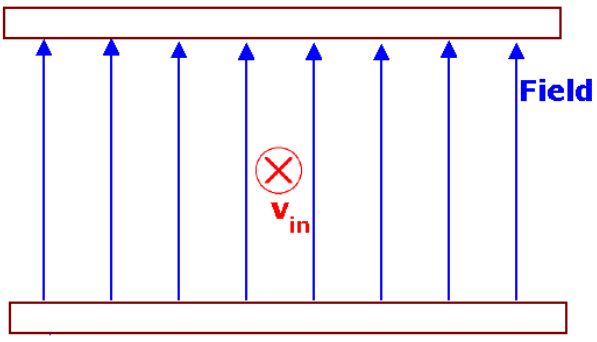
(A) The electroscope would discharge more quickly because there are more photons hitting the metal.

(B) There would be no change in the rate of discharge of the electroscope because an increase in frequency of the light is needed to increase the energy of the photons of light.

(C) The electroscope would discharge more quickly because increasing the intensity of the light increases energy of the light photons.

(D) The electroscope would discharge less quickly because increasing the intensity of the light results in there being fewer photons to interact with electrons even though each has more energy.

13. A proton is enters the field between two charged plates travelling with a velocity v, into the page as shown on the diagram.



What is the direction of the force on the proton due to the field?

(A) left

(B) right

(C) toward the top of the page

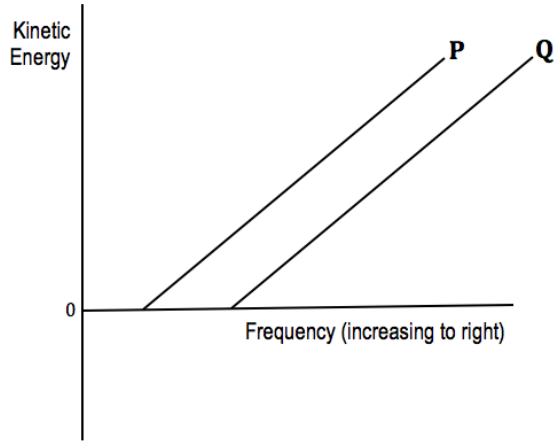
(D) toward the bottom of the page

14. The following diagram shows a piece of apparatus that you used to investigate cathode rays.

Which alternative correctly identifies the positive electrode in this apparatus and the property of cathode rays that is best demonstrated with this apparatus?

	Positive Electrode	What this apparatus demonstrates best about cathode rays
(A)	R	Cathode rays travel in straight lines
(B)	Q	Cathode rays travel in straight lines
(C)	R	Cathode rays possess momentum
(D)	Q	Cathode rays possess momentum

15. The following graph shows the relationship between the frequency of incident light and the kinetic energy of photoelectrons produced.



Which statement correctly describes a feature of this graph?

(A) P and Q show data for two different metals.

(B) P and Q show data for the same metal at different temperatures.

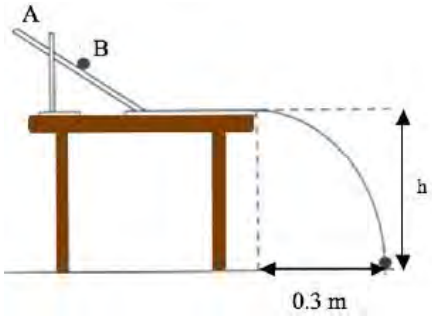
(C) P and Q show data for n-type and p-type semiconductors.

(D) P and Q show data for data for the same metal using different stopping voltages.

Section I – Part B

Question 16

The diagram below illustrates an experiment on projectile motion in which a steel ball is allowed to roll down a ramp, along a horizontal table and then off the edge. When the ball was released from point B (halfway down the ramp), it took an average time of 0.34 seconds, measured using a stop watch, to reach the ground from the time it left the table edge.



Calculate

(a) the height of the table, h. [1M]

.....

.....

.....

(b) the speed of the ball as it leaves the table if it lands an average horizontal distance of 0.3 from the edge [1M]

.....

.....

.....

.....

(c) the expected horizontal distance travelled if the ball is released from the top of the ramp (A) [2M]

.....

.....

.....

.....

.....

.....

(d) At the completion of the experiment, the students carefully measured the height of the table using a metre rule and found it to be 0.78 m. Assess the significance of this value on the validity of the data collected in this experiment. [2M]

.....

.....

.....

.....

.....

.....

.....

.....

[Question continues on next page]

Question 17

The tau lepton is a negatively charged subatomic particle, which was first detected in a series of experiments between 1974 and 1977 at the Stanford Linear Accelerator Centre. At rest, it has a lifetime of 2.9×10^{-13} seconds before decaying into other subatomic particles.

A tau lepton is moving at a speed of 0.9994c in a linear accelerator. The accelerator has a length of 3000 m as measured in the Earth frame of reference.

(a) Calculate the length of the accelerator in the tau lepton's frame of reference. [2M]

.....

.....

.....

.....

.....

(b) Predict whether the tau lepton can reach the end of the accelerator before decaying. Justify your answer. [3M]

.....

.....

.....

.....

.....

.....

.....

.....

(c) How far does the tau lepton travel in the linear accelerator in the Earth frame of reference? [2M]

.....

.....

.....

.....

.....

.....

Question 18

In April 1990, the space shuttle Discovery carried the 11 110 kilogram Hubble Space Telescope to an altitude of 600 kilometres above the Earth's surface orbiting at a speed of 7560 m s^{-1}, where it has since been transmitting images of the distant heavens to scientists.

Calculate the work done by the Discovery in placing the Hubble Space Telescope into a stable orbit [4M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

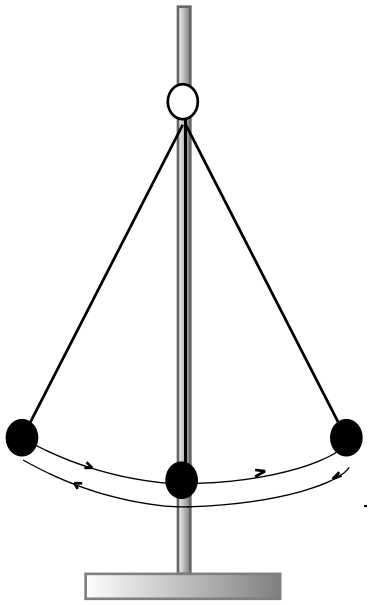
.....

.....

.....

Question 19

To meet the requirements of the course a senior physics student wished to perform an investigation to determine the value for the acceleration due to gravity using pendulum motion. Using an Internet search, he found the following procedure, which he used as the basis for his experiment.



You are going to find out if string length affects the time a pendulum takes to swing. The time period is the time for one full swing, there and back to its starting point.

Measure the length of the string.
Set the pendulum swinging.
Time 20 swings.
Change the length.
Do it again!
Repeat this for five different lengths.

The results and calculated data obtained by the student are shown below.

Length of string (cm)	Time for 20 swings (s)	Time for one swing (s)
20	17.95	0.90
30	21.99	1.10
40	25.39	1.27
50	28.39	1.42
60	31.10	1.55

(a) Describe two modifications to the procedure that would be essential if the student's results are to be considered valid. [2M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Without performing the calculations, recount how the results were used to determine the acceleration due to gravity [3M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 20

Einstein's Special Relativity theory is based on two postulates

1. The laws of physics are the same in all inertial frames of reference and
2. The speed of light always has the same value which is independent of the motion of the light source and observer.

Evaluate the importance of the second postulate in changing the direction of scientific thinking at the start of the twentieth century. [4M]

Question 21

Recount a first-hand investigation that you carried out to demonstrate the effect on a generated electric current when the relative motion between the coil and the magnet was varied. [5M]

In your description, include:

- a labelled sketch of the experimental set-up;
- how you varied the relative motion
- how other variables were controlled.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

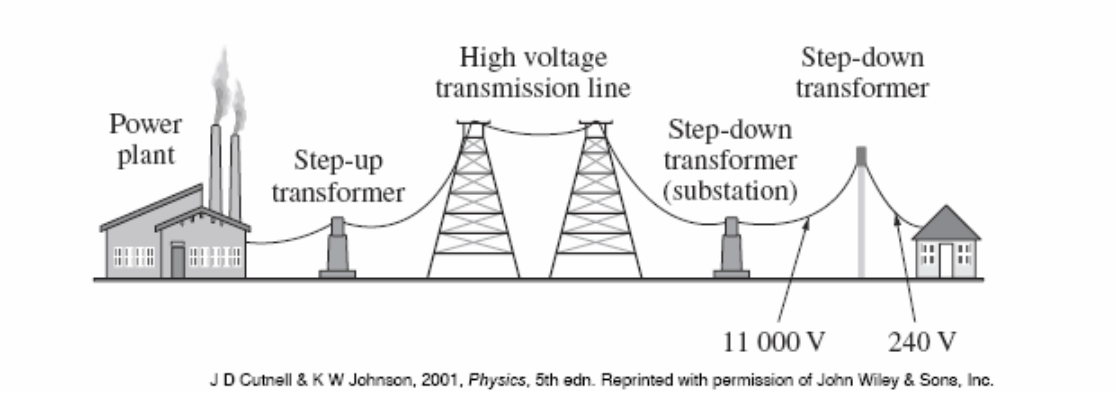
.....

.....

.....

Question 22

A schematic diagram of a system to supply electricity to a house is shown below. [4M]



J D Cutnell & K W Johnson, 2001, *Physics*, 5th edn. Reprinted with permission of John Wiley & Sons, Inc.

Explain two significant reasons why transformers are needed between the power station and a person's home.

.....

.....

.....

.....

.....

.....

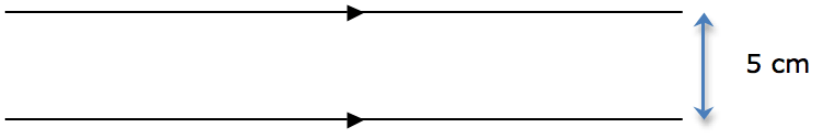
.....

.....

.....

Question 23

Calculate the force per metre acting on the bottom wire if each wire has a current of 10 A. [2M]



.....

.....

.....

.....

.....

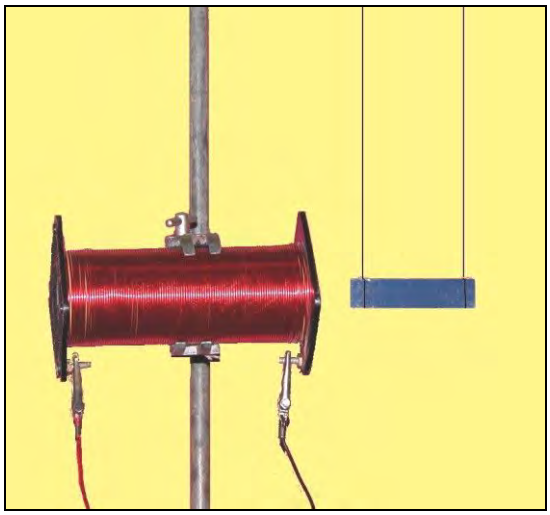
Question 24

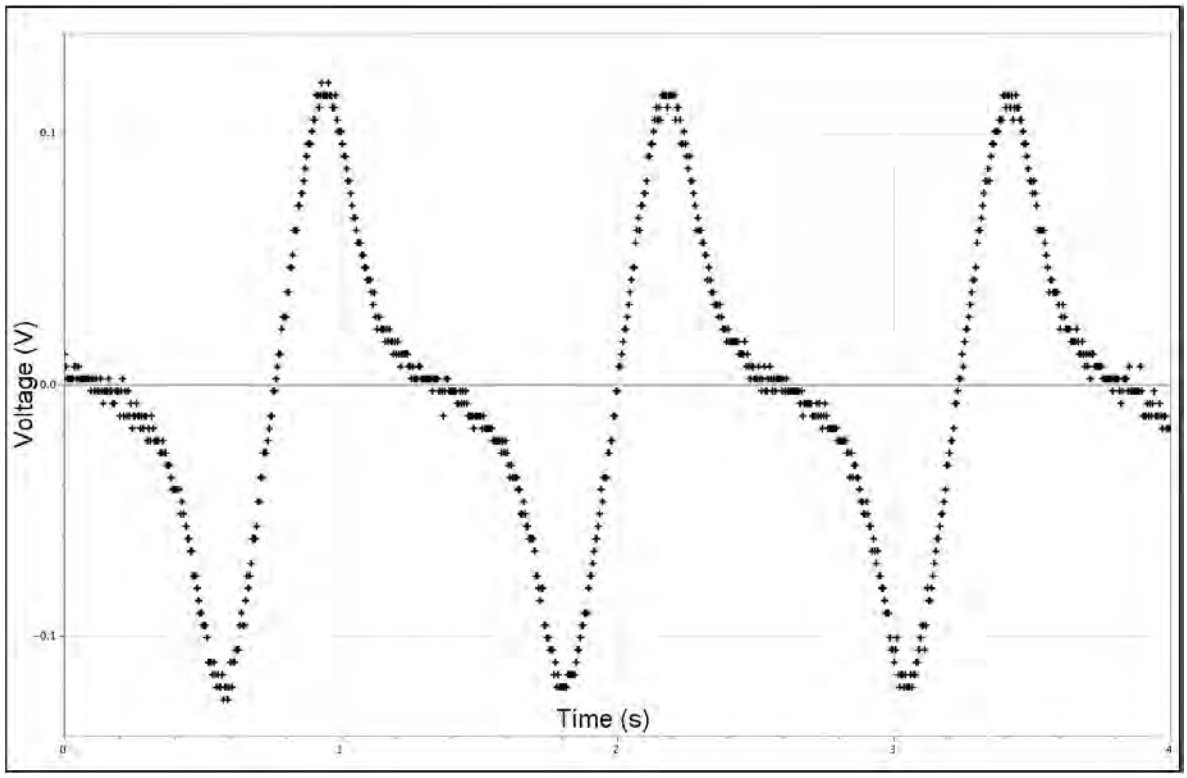
In Australia, most power plants burn a fuel, such as coal, or use the energy of falling water to generate electricity on a large scale. Assess the impact on the environment of such large scale electricity generation. [5M]

Question 25

A magnet was suspended by strings, as shown in the photograph, so that it behaved as a simple pendulum. It was placed near the end of a solenoid, across the ends of which was connected a voltage probe connected to the data logger shown. The pendulum is shown in the photograph in its equilibrium position

The magnet was set oscillating so that the end closest to the magnet entered approximately 1 cm into the end of the coil one extreme point of its motion. The voltage produced was logged and the graph below shows this data.





Account for the shape of the graph produced. Clarify your answer by using suitable labels / sketches on the graph and the photograph. [4M]

[Answer this question on the next page]

Question 25 (Continued) .....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

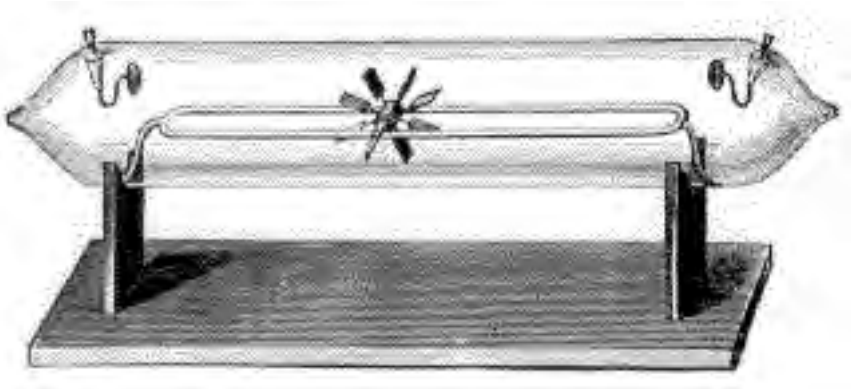
.....

.....

[continues on the next page]

Question 26

Recount the investigation that you performed using the apparatus below and outline two significant safety precautions that were applied when carrying out this investigation. [4M]



.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

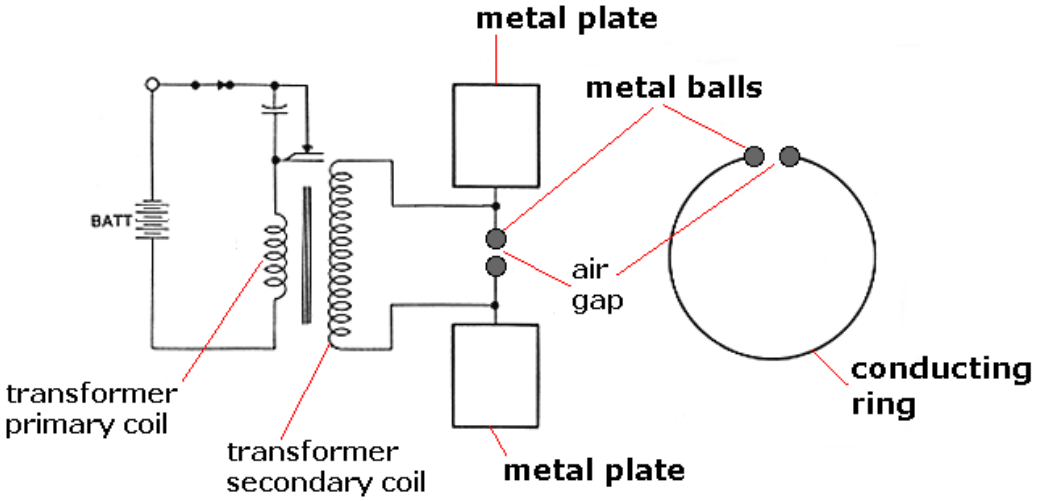
.....

.....

.....

Question 27

The following diagram represents apparatus used by Hertz to investigate electromagnetic waves.



In his notebook he recorded that he observed that the maximum length of the spark produced between the metal balls on the conducting ring decreased when a sheet of glass was placed between the two separate parts of the apparatus.

With reference to the equation, E = hf, account for Hertz's observation. [3M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 28

Evaluate the following statement. [3M]

"Planck's analysis of the emission and absorption of radiation by a black body changed the nature of scientific thinking."

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Question 29

(a) Contrast electric and gravitational fields. [2M]

.....

.....

.....

.....

.....

.....

.....

[This question continues on the next page]

(b) Describe the electric field between two parallel plates and the relationship between the variables affecting the magnitude of this field. [4M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) The electric field 20 cm from a small electric charge is 200 volts metre^{-1}. Calculate the magnitude of the force that would be produced on a charge of 3 x 10^{-7} C placed at that point in the field. [2M]

.....

.....

.....

.....

.....

.....

.....

.....

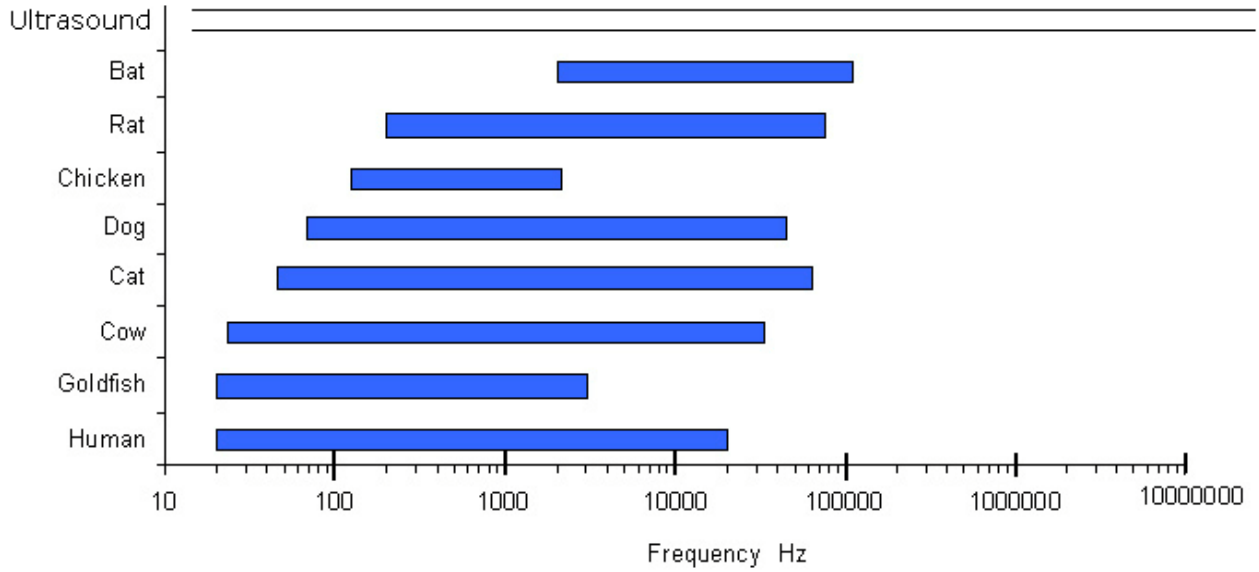
Question 30

Assess the impact of advances in physics on the development of television. [6M]

Section II
Medical Physics – 15 marks

Question 31

(a) The following diagram shows the range of human hearing. Shade in the appropriate region on this chart showing sounds classified as ultrasound. [1M]



(b) Describe how the piezoelectric effect is used to produce ultrasound. [2M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) Use data in the table to calculate the percentage of ultrasound reflected when it passes from muscle to fat compared to the incident sound intensity. [2M]

	Density (kg m^{-3})	*Acoustic impedance* (kg m^{-2} s^{-1} $\times 10^6$)
Fat	9.25×10^2	1.38
Muscle	1.073×10^3	1.70

.....

.....

.....

.....

.....

.....

.....

.....

.....

(d) Contrast soft and hard X-rays. [1M]

.....

.....

.....

.....

[This question continues on the next page]

(e) Describe how the electromagnetic radiation used to produce radiographs (X-ray images) is produced. [4M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[Question continues on next page]

(f) Explain how a radiograph (X-ray image) is produced. [4M]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[Question continues on next page]

(g) Outline one advantage, observable in the images shown, of the type of image shown on the right compared to the one on the left. [1M]

.....

.....

.....

.....

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

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

$$F = BIl\sin\theta$$

$$\tau = Fd$$

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

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

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

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

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

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

$$F = qvB\sin\theta$$

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

$$E = hf$$

$$c = f\lambda$$

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

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

$$Z = \rho v$$

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

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

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

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number — Symbol of element — Atomic Weight — Name of element

Example: 79 Au 197.0 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.

This page is blank

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) ⬭

Marking Criteria

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

16a. Criteria	Mark/s
Correctly calculates the height as 0.57m	1

16b. Criteria	Mark/s
Correctly calculates the velocity as 0.88 m s^{-1}	1

16c. Criteria	Mark/s
Correctly calculates the velocity of the ball as it leaves the table as 1.24 m s^{-1} and hence the expected range as 0.42 m	2
Correctly calculates the velocity the ball as it leaves the table.	1

16d. Criteria	Mark/s
Response contains a clear statement that this accurate measurement is very significant as it is quite different to the height calculated using the time measurements, hence bringing into question their validity.	2
Response indicates that the measurement brings the results into question but does not assess the significance OR A general statement about the role of such measurements in assessing validity of data	1

17a. Criteria	Mark/s
Substitutes into the appropriate formula to correctly calculate the length (103.91 m)	2
Identifies the appropriate formula but does not correctly calculate the length	1

17b. Criteria	Mark/s
Correctly predicts that the tau lepton will NOT travel the length of the particle accelerator AND uses appropriate calculations of actual length travelled before decaying (8.69 x 10^{-5} m in the lepton's reference frame) OR the time required to travel the full path (3.47 x 10^{-7}s) which is greater than the rest lifespan to justify the prediction	3
Correctly predicts that the tau lepton will NOT travel the length of the particle accelerator AND uses appropriate calculations but does NOT clearly explain the link between the calculations and the predictions OR makes one or more errors OR Performs correct calculations but makes the wrong prediction based on these	2
Correctly predicts that the tau lepton will NOT travel the length of the particle accelerator Or Correctly calculates a relevant distance or time.	1

17c. Criteria	Mark/s
Correctly calculates the life time of the tau lepton in the earth's reference frame (8.37 x 10^{-12} s) and uses this value to determine the distance using $\Delta r = vt$ OR Substitutes appropriately into the formula for length contraction to calculate the distance as 2.51 x 10^{-3} m	2
Correctly calculates the life time of the tau lepton in the earth's reference frame OR Substitutes appropriately into the formula for length contraction but does not correctly calculate the distance	1

18. Criteria	Mark/s
Correctly calculates the required KE as 3.17 x 10^{11} J AND the change in gravitational potential energy (5.95 x 10^{10} J) to calculate the required work done by the Discovery ($E_k + E_p$) as 3.77 x 10^{11} J	4
Answer recognises that the work done is the sum of E_k and E_p and correctly calculates one of the two quantities.	3
Correctly calculates the change in E_p and identifies this as the work done.	2
Correctly calculates the E_p on the earth's surface OR at an altitude of 600km OR correctly calculates the E_k of the satellite OR calculates the change in E_p incorrectly	1

19a. Criteria	Mark/s
Describes TWO significant modifications which could include * length measured to the centre of mass * angle of swing must be less than 15^0 * repetition at each length	2
Describes ONE significant modification	1

19b. Criteria	Mark/s
A thorough recount which includes: * plot a graph of T^2 v length * calculate the gradient of the line of best fit * link the gradient to the formula for period of a pendulum to calculate g OR States that a value of g can be calculated for each length by substituting the measured period into the formula and obtaining an average.	3
Recount includes two of the above points OR Recount contains the relevant information But has significant factual errors in the description of the steps.	2
States that a measured value of the period must be substituted into the formula for period of a pendulum to calculate g OR States that the gradient of a graph must be used OR Correctly identifies the graph that must be drawn	1

20. Criteria	Mark/s
Response is thorough and well structured with a clear evaluation that it was very important AND Describes the implications of the postulate (time, length and mass become relative quantities) AND therefore the assumptions made in Newton's theories that these were absolute quantities must be re-evaluated.	4
Response is thorough and well structured with a clear evaluation that it was very important AND Describes the implications of the postulate (time, length and mass become relative quantities) AND therefore the assumptions made in Newton's theories that these were absolute quantities must be re-evaluated BUT contains one or more significant factual error.	3
Response describes the implications of the postulate (time, length and mass become relative quantities) AND therefore the assumptions made in Newton's theories that these were absolute quantities must be re-evaluated OR correctly evaluates the importance of the postulate and its implications but does not clearly link this to its effect on scientific thinking OR Response contains the relevant information but is poorly structured or sequenced	2
Describes the implications of the postulate (time, length and mass become relative quantities)	1

21. Criteria	Mark/s
A labelled sketch including coil, magnet and galvanometer AND a reasonable method of varying the relative motion including repetition of each measurement. AND two variables controlled including distance.	5
A labelled sketch including coil, magnet, and galvanometer AND/OR reasonable method of varying the relative motion repetition AND/OR two variables controlled including distance.	3-4
A partial diagram AND reasonable method of varying the relative motion OR two variables controlled including distance.	1-2

22. Criteria	Mark/s
Two reasons identified and linked to the higher/lower voltage	4
Two reasons identified with one reason linked to the higher/lower voltage	3
Two reasons identified or one reason linked	2
One reason identified.	1

23. Criteria	Mark/s
Correct calculation of force per metre with direction	2
Correct substitution into formula	1

24. Criteria	Mark/s
A judgement of the impact and a well structured discussion of the environmental impacts related to both coal and hydroelectric generators.	5
A judgement of the impact and a thorough discussion of the environmental impacts related to coal OR hydroelectric generators.	3-4
A judgement of the impact AND/OR one impact identified.	1-2

25. Criteria	Mark/s
A well explained answer that relates the changing motion of the magnet to specific areas of the graph AND has labels or sketches on the graph/diagram.	4
Answer accounts for the changing direction AND magnitude of the voltage without reference to the diagram and graph	2-3
Answer accounts for changing direction or magnitude of voltage.	1

26. Criteria	Mark/s
Outline of experiment including use of induction coil, observation of direction of movement of paddle wheel (towards the anode) AND two significant safety precautions outlined.	4
Outline of experiment including use of induction coil, observation of direction of movement of paddle wheel OR one/ two safety precautions outlined.	2-3
Brief outline of investigation OR one safety precaution outlined.	1

27. Criteria	Mark/s
Answer uses the photoelectric effect and the equation E=hf to account for the decreased spark length.	3
Answer uses the photoelectric effect but not the equation E=hf to account for the decreased spark length.	2
Answer identifies the photoelectric effect as being responsible for the observation	1

28. Criteria	Mark/s
States that before Planck, the wave model of light dominated scientific thinking AND states that Planck proposed that light was absorbed/emitted as quanta AND that the particle model of light that developed from this (Einstein)and was able to explain phenomena such as the photoelectric effect which demands a particle model for its analysis.	3
Outlines that Planck's analysis moved away from the wave model for radiation towards the particle models OR Outlines that Planck introduced the quantum model and refers to either the existing wave model at the time or the particle model for light that followed.	2
Identifies the quantum nature of Planck's analysis OR the wave theory of light accepted at that time OR the particle model of light that followed.	1

29a. Criteria	Mark/s
Outlines that electric fields may result from either or both of two variants of a property of matter – charge, which may be positive or negative WHEREAS gravitational fields are the result of mass, of which there is only one type OR Outlines that electric fields can act to produce forces on charges which may be attractive or repulsive WHEREAS gravitational fields produce forces on masses which can only be attractive.	2
One of the above OR states that charge produces electric fields and mass produces gravitational fields	1

29b. Criteria	Mark/s
(1) States explicitly that the electric field is * uniform in direction and magnitude [this may be communicated in a diagram which shows these characteristics (2) * indicates that the field direction is from positive to negativt AND (3) States the equation E = V/d AND (4) Identifies the variables in the equation (OR makes an equivalent statement, to the equation, in words)	4
States that the electric field is * uniform in direction and * uniform in magnitude AND States the equation E = V/d	3
Two of the four components above.	2
One of the four components above.	1

29c. Criteria	Mark/s
Applies the equation F = qE to obtain the answer 6×10^{-5} N	2
Substitutes correctly into the equation, but does not get the correct numerical value or omits unit.	1

30. Criteria	Mark/s
Has a clear description of 5 advances in physics and outlines how each is related to the development of TV AND makes an assessment based on these advances. High level communication skills must be evident to get 6 marks.	5-6
Must make an assessment supported by four relevant advances in physics. If more relevant advances are clearly presented, this is the maximum mark if no assessment is made.	4
Relates one to three advances in physics to the development of TV.	1-3

31a. Criteria	Mark/s
Shades the region above (but not including) the upper frequency limit of human hearing (20 kHz)	1

31b. Criteria	Mark/s
Relates the vibration of a piezoelectric crystal to the application of an AC voltage to opposite sides of the crystal with reference to the fact that these vibrations produce sound (or longitudinal) waves in the medium in contact with the crystal.	2
	1

31c. Criteria	Mark/s
Calculates the correct percentage reflected 1.1 %	2
Identifies the correct equation	1

31d. Criteria	Mark/s
States that hard X-rays have a shorter wavelength or a higher frequency that soft X-rays (or equivalent stmt.)	1

31e. Criteria	Mark/s
Describes the acceleration of electrons in an X-ray tube using an electric field (produced by a high voltage) AND Describes the conversion of kinetic energy to X-rays AND outlines TWO processes - the production of both CHARACTERISTIC X-rays and Bremsstrahlung radiation.	4
Describes two of the above	2-3
Makes one correct statement related to the production of X-rays	1

31f. Criteria	Mark/s
Clearly describes the * passage of the X-rays through the patient * the differential absorption by different tissues *the detection using a film/electronic sensor (3 marks awarded for less well expressed answer)	3-4
Two of the above	2
One of the above	1

31g. Criteria	Mark/s
Identifies the type of imaging technology (left/X-ray, right/ultrasound) and provides one SIGNIFICANT OBSERVABLE difference e.g. the ultrasound image allows soft tissue to be seen whereas X-rays do not or ultrasound is a 2D slice whereas the X-ray is 3D compressed into 2D	1