Physics

HSC Course

2014

Year 12 Trial HSC Examination

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Use the multiple-choice answer sheet provided

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
- Allow about 35 minutes for this part

Part B – 55 marks
- Attempt Questions 21-30
- Allow about 1 hour and 40 minutes for this part

Section II Pages 25-30

25 marks
- **Medical Physics** Question 31
- Allow about 45 minutes for this section

2014 HSC TRIAL EXAMINATION
PHYSICS

Part A – 20 marks
Attempt Questions 1-20
Allow about 35 minutes for this part

Use the multiple-choice answer sheet provided for Questions 1-20

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 have changed 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 ○

1

The gravitational acceleration on the Earth's surface is approximately 9.8 m s^{-2}. In order for any planet to have a gravitational acceleration greater than that of Earth, which of the following properties would it be necessary for that planet to have?

(A) A mass greater than that of the Earth

(B) A radius larger than that of the Earth

(C) Both larger mass and greater radius than those of the Earth

(D) None of the above properties are necessarily true for such a planet.

2

The mass of the Moon is 7.4×10^{22} kg. Its radius is 1 737 km.
Which of the following is nearest to the escape velocity of an object launched from the Moon's surface?

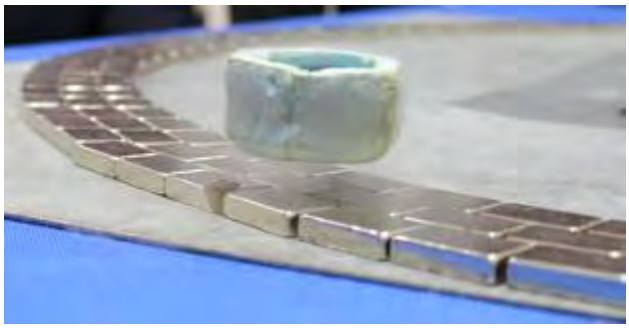
(A) $v_{esc} = 1\,700 \text{ m s}^{-1}$

(B) $v_{esc} = 2\,400 \text{ m s}^{-1}$

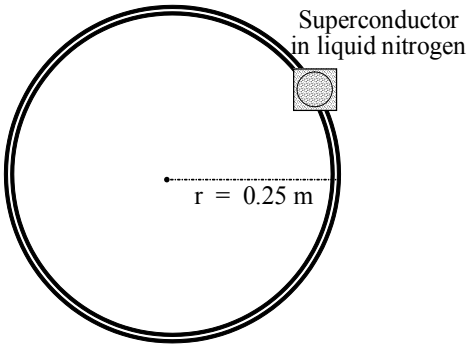
(C) $v_{esc} = 53 \text{ km s}^{-1}$

(D) $v_{esc} = 75 \text{ km s}^{-1}$.

3



Courtesy of Tom Gordon, Outreach Officer, School of Physics, Sydney University and the "Kickstart" team of demonstrators.



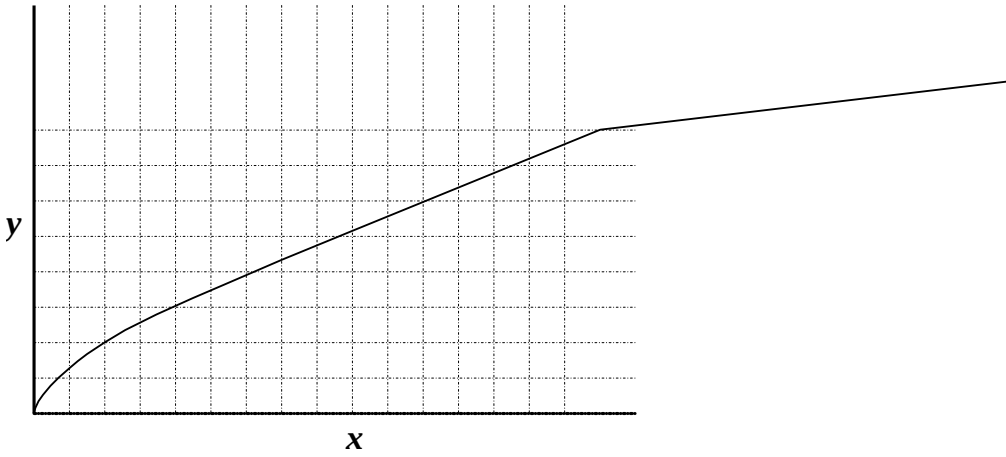
Track made of a ring of powerful magnets

The Kickstart team has set up a novel example of the phenomenon of levitation. A circular track of strong magnets allows a superconductor in a liquid air bath inside a polystyrene box not just to float, also to undergo uniform circular motion when pushed.

The superconductor is found to complete 3 revolutions in 8.0 seconds. The mass of the superconductor is 0.16 kg.
For this example, determine which of the following gives the most correct values of the orbital speed of the object, and the centripetal force acting on it.

	Orbital speed	*Centripetal force*
(A)	0.59 m s^{-1}	0.22 N
(B)	0.59 m s^{-1}	11 N
(C)	4.2 m s^{-1}	0.7 N
(D)	4.2 m s^{-1}	11 N

4



Consider the graph. The quantities represented by x and y are not provided.
For which of the following formulae could this graph be suitable, if the axes x and y are renamed as indicated?

	x	y	*Formula*
(A)	E_K	v	$E_K = \frac{1}{2} m v^2$
(B)	T	r	$\frac{r^3}{T^2} = \frac{Gm}{4\pi^2}$
(C)	L_v	v	$L_v = L_0 \sqrt{1 - v^2/c^2}$
(D)	m_v	v	$m_v = \frac{m_0}{\sqrt{\left(1 - v^2/c^2\right)}}$

5

The Earth's radius at the equator is close to 6 380 km, and its rotational period can be assumed to be exactly 24 hours.

If a new satellite launching station were established at Woomera in South Australia, which of the following would best describe the launch velocity advantage.

	Launch velocity advantage	Launch direction
(A)	Less than 464 m s^{-1}	East → west
(B)	More than 464 m s^{-1}	East → West
(C)	More than 464 m s^{-1}	West → east
(D)	Less than 464 m s^{-1}	West → east

6 The Michelson-Morley experiment was carried out many times in different localities and at different times of the day and year, it always produced a null result, although it was accurate, reliable and valid for its hypothesis.

Which of the following alternatives best describes what is meant by a null result?

(A) The dependent variable does not change when the independent variable changes

(B) The dependent variable changes in a non-linear way relative to the independent variable

(C) The dependent variable changes in a non-consistent way as the independent variable is changed

(D) The dependent variable changes in a way contrary to what the experiment had predicted as the independent variable is changed.

7

The Moon

Alien craft – not to scale

The diagram shows an alien galactic voyager craft approaching the Moon at 0.99c .
Earth observers note that the craft starts exactly 18 light hours distance from the Moon.
From the Aliens perspective it takes less than 18 hours to reach the Moon.
How could the aliens explain why the trip took less than 18 hours to complete the trip to the Moon?

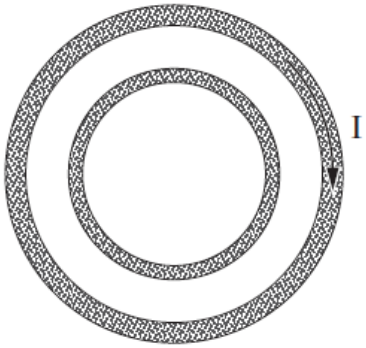
(A) The distance between the Aliens and the Moon contracts at relativistic speeds

(B) The aliens' frame of reference must be accelerating, and therefore is not inertial

(C) This is the same as the Twin Paradox where the actual travellers' view is wrong

(D) According to relativity, the mass of the craft increases greatly, and this affects the space-time constant.

8 Two copper rings lie in the same plane as shown in the diagram below. A large constant current initially flows in the outer ring. The current in the outer ring is then reduced to zero.



Which option best describes the current in the inner ring.

	Initial current	Current as outer ring current is reduced.
A	Zero	Anticlockwise
B	Zero	Clockwise
C	Clockwise	Anticlockwise
D	Anticlockwise	Clockwise

9. All of the following are essential features of a functioning DC electric motor except for which non-essential feature?

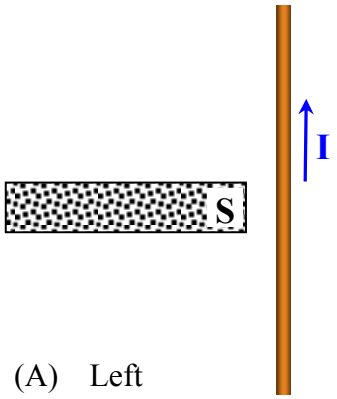
(A) Slip-rings to allow current to enter

(B) A coil free to rotate that turns the armature

(C) A fairly strong magnetic field to create the motor effect

(D) An external source of potential difference to provide the current and energy.

10



The south pole of a bar magnet is brought close to the western side of a wire carrying DC current due north, as shown.

What is the direction of the force on the wire?

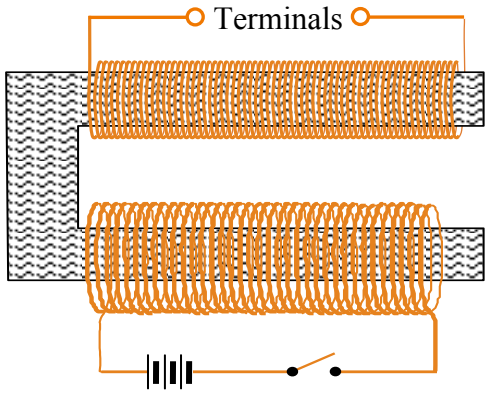
(A) Left

(B) Right

(C) Into the page

(D) Out of the page

11



The primary coil of this transformer has 100 loops and the secondary coil 400 loops.

When the switch is closed DC electric current passes through the primary coil as shown. Which statement correctly describes the voltage that would be measured across the terminals of the secondary coil.

(A) A continuous AC voltage.

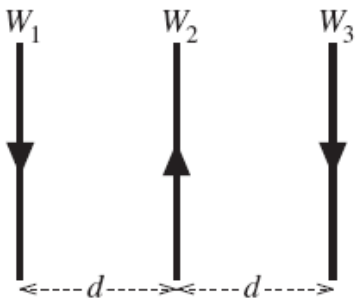
(B) An AC voltage that would be present for a very short period of time.

(C) A continuous DC voltage.

(D) A DC voltage that would be present for a very short period of time.

12. Three identical conductors shown below have been measured to have the following currents .

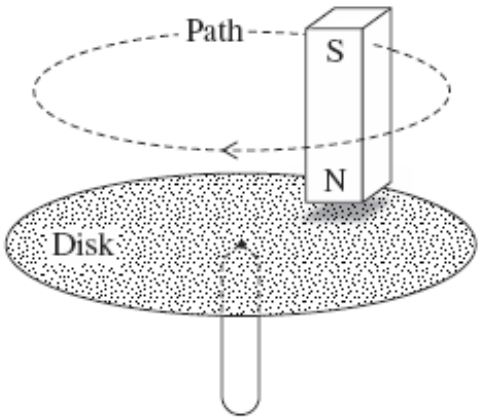
Conductor	Current (A)
W_1	9
W_2	6
W_3	3



Conductor W_2 is an equal distance from W_1 and W_3. What is the initial net force acting on W_3?

(A) Zero.
(B) Non-zero and to the right.
(C) Non-zero and to the left.
(D) Non-zero and out of the page.

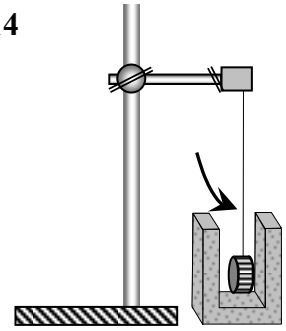
13. The following model is used to demonstrate the principal of an AC induction motor.



Which of the following correctly relates the part of the model to the part of the AC induction motor.

	Part of model	**AC induction motor part**
(A)	Rotating magnet	Squirrel cage rotor
(B)	Rotating magnet	Stator coils
(C)	Disc	Magnetic core
(D)	Disc	Rotor coils

14



A very strong permanent magnet is attached to a string, forming a simple pendulum when suspended from a clamp attached to a retort stand.

The magnet is then pulled back, and allowed to swing between the sides of a U-shaped channel made of aluminium.

The pendulum comes to a stop very quickly. What is the main reason it stops so abruptly?

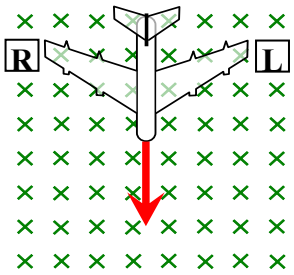
(A) The magnet is attracted by the metal of the channel, and sticks to it.

(B) Induced currents in the metal produce magnetic fields repelling the magnet.

(C) Induced currents in the metal produce magnetic fields that both attract and repel the magnet.

(D) The magnet is repelled by the metal of the channel and spins before sticking to it.

15



An aircraft is flying due south at cruising speed above a point where Earth's magnetic field is directed vertically downwards.

An emf is induced between the tips of the plane's wings.

To which of the wingtips, L or R, do electrons move, and which wingtip becomes positively charged?

(A) Electrons move towards wingtip R, so it becomes positively charged

(B) Electrons move towards wingtip L, so it becomes positively charged

(C) Electrons move towards wingtip R, so wingtip L becomes positively charged

(D) Electrons move towards wingtip L, so wingtip R becomes positively charged.

16 Many experiments involving cathode-rays were carried out in the later part of the 19th century by Julius Plucker, William Crookes and others, the aim being to discover their properties in order to determine their nature. Some of these experiments led to the following results:

(I) The tube with a fluorescent plate demonstrated that cathode-rays are deflected by a magnetic field.

(II) The Maltese Cross tube established that cathode-rays move in straight lines, and form "shadows" behind barriers.

(III) The Geissler tube confirmed that cathode-rays cause fluorescence on the glass behind the anode.

(IV) The paddle-wheel tube showed that cathode-rays possess momentum and kinetic energy.

(V) A cathode-ray tube with photographic film in darkness verified that cathode-rays expose photographic film.

Which of the following identifies the properties of cathode-rays that exclusively give support to the view that cathode rays are charged particles?

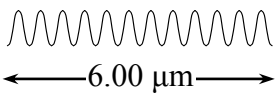
(A) (I) and (IV) only

(B) (III) and (V) only

(C) (I), (II) and (IV) only

(D) (II), (III) and (V) only.

17



This diagram represents a photon of electromagnetic radiation that strikes a metal having a work function $\Psi = 3.85 \times 10^{-19}$ J.

Which of the following identifies the frequency of the photon, the energy it possesses, and whether it releases a photoelectron?

	Frequency [Hz]	*Photon energy [J]*	*Releases photoelectron?*
(A)	5.0×10^{13}	3.3×10^{-20}	yes
(B)	5.0×10^{13}	3.3×10^{-20}	no
(C)	6.0×10^{14}	4.0×10^{-19}	no
(D)	6.0×10^{14}	4.0×10^{-19}	yes

18 What was the main reason why Germanium was used in the earliest transistors?

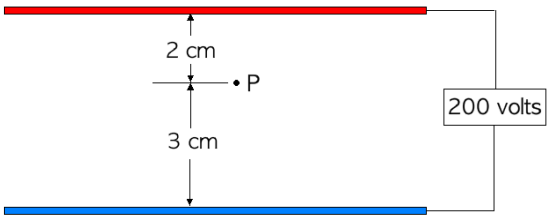
(A) Silicon is a rare element which had not been mined yet.

(B) Silicon was difficult to produce with a suitable purity.

(C) Germanium was more abundant and cheaper to produce.

(D) Germanium was a more suitable choice for doping with other elements.

19 Two oppositely charged metal plates are separated by 5 cm and the voltage between them is 200 V.



Calculate the force that would act on a 1C charge placed at the position, P, between the plates.

(A) 10N

(B) 40N

(C) 4000N

(D) 10000N

20 In class you carried out an investigation to observe striation patterns in discharge tubes at different pressures. Which option correctly identifies the variables in this investigation?

	Dependent	Independent	Controlled
A	Gas Pressure	Striation pattern	Voltage
B	Striation pattern	Voltage	Gas Pressure
C	Voltage	Striation pattern	Gas Pressure
D	Striation pattern	Gas Pressure	Voltage

Centre Number

Student Number

Part B – 55 marks
Attempt Questions 21-30
Allow about 1 hour and 40 minutes for this part

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

Question 21
Spacecraft can either burn up or veer off course during re-entry from orbit. This is avoided by ensuring :

- The craft is the correct shape
- The craft re-enters at just the right angle
- The craft is covered in an insulating material.

Using relevant physical principles explain each of these points.
(6 marks)

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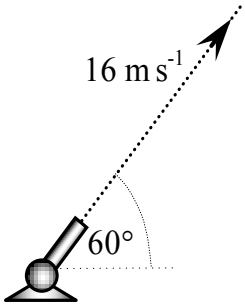
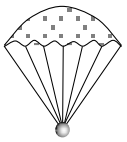
Question 22



Parachute

16 m s-1

60°



Parachute

Robert made a device that launches a projectile at 16 m s^{-1} at an angle 60° above the horizontal, as shown in the diagram. The projectile is a sphere wrapped in a parachute. At exactly 1.5 s after being launched a parachute opens instantly, causing the sphere to lose all horizontal velocity and fall vertically down with a constant velocity until it reaches the ground. Its speed as it falls is identical to its *vertical* velocity when the parachute opened.

(a) What is its vertical displacement when the parachute opens?(2 marks)

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(b) How long after the parachute opens does it take the projectile to drop back to the same level from which it was launched?(2 marks)

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(c) What is its horizontal displacement when it drops back to that same point? (1 mark)

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Question 23

Sputnik 1 Replica, from Wikipedia

:02pm on 4th October 1957 Australians looking
head could observe for the first time a small bright dot
ly moving across the sky. It was Sputnik-1, the first
icial satellite launched into orbit.
tnik was only visible for a short time. At 7:38pm
tnik was observed again in exactly the same position.

(a) Given that the mass of the Earth is 6.0×10^{24} kg, determine the radius of orbit of Earth's first artificial satellite (assuming it to be circular, although it was not). (3 marks)

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(b) One of the reasons why Sputniks orbit was not circular was that it experienced another force except for gravity. Explain why this force contributed to the non-circular orbit of the satellite.(3 marks)

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Question 24

Albert Einstein was responsible for many significant changes in scientific thinking related to motion and light. Assess this statement with reference to Einstein's work. (7 marks)

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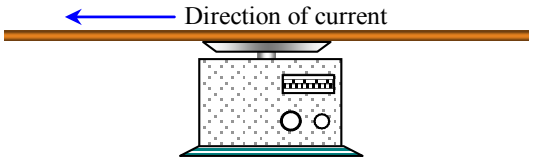
Question 25



Students have been asked to test Ampere's Law. They place a 40-cm length of stiff copper wire on the top of an accurate electronic balance and connect it to the output of a device called a potentiometer so that they can vary the DC current flowing through it. The current is directed *due north*. A horizontal uniform magnetic field is set up between two powerful rare earth magnets on either side of the wire.
The readings the students obtain as the current is varied are shown in the table below.

Current (A)	0.25	0.75	1.00	1.50	2.00
Reading (kg)	0.0039	0.0071	0.0090	0.0120	0.0153

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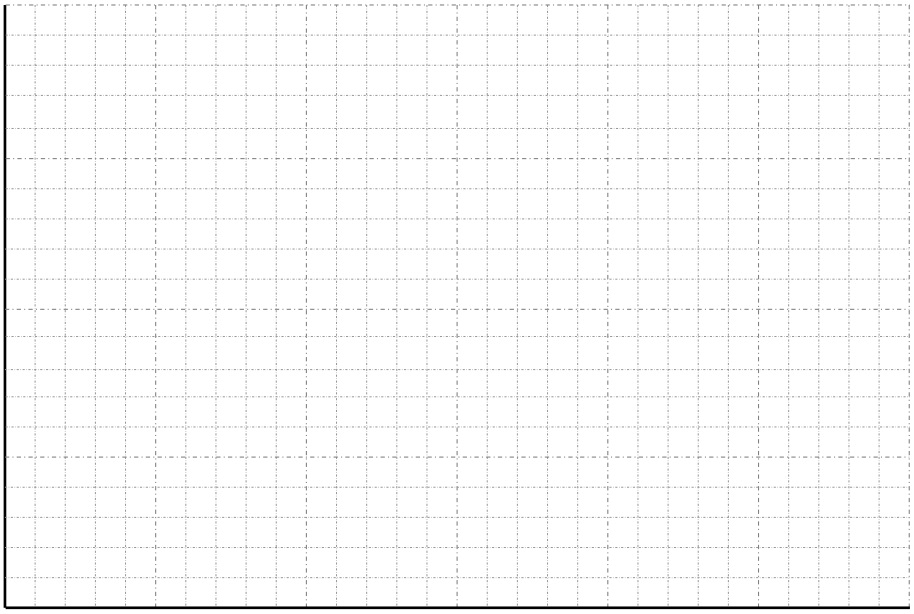
(a) Use the axes provided below to design an appropriate graph of the relationship between the current through the wire and the readings on the balance, including a line of best fit. (4 marks)



(b) Using the graph determine the mass of the 40-cm length of wire. (2 marks)

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Question 26

Consider the following data concerning the (pure) metals aluminium and copper:

Metal	*Resistivity (20 ℃)*	*Density*	*Stress ÷ strain*
Aluminium	$2.65 \times 10^{8}\ \Omega\,\text{m}$	$2.70\ \text{kg}\,\text{m}^{-3}$	70 GPa
Copper	$1.68 \times 10^{8}\ \Omega\,\text{m}$	$8.92\ \text{kg}\,\text{m}^{-3}$	130 GPa

Points to consider:

* the higher a metal's resistivity the larger the resistance of otherwise identical cable;
* the greater its density the heavier an identical length of cable will be to work with;
* the higher the stress : strain ratio the more the cable sags when strung between pylons.

Discuss why copper wire is commonly used for domestic, commercial and industrial electric circuitry, whereas aluminium is used for cross-country power cables. (6 marks)

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Question 27
A laptop computer requires an input of 19.6 volts DC, which is provided by its power adaptor. In Australia the input to these is normally the 240 V AC supply.

(a) What is the ratio of the number loops on the primary coil of the adaptor for this laptop to the number of loops on its secondary coil?(1 mark)

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(b) Explain how transformers such as this are designed to reduce the amount of heat losses that occur within them. (2 marks)

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Question 28
Using the band theory model describe how conduction occurs in an intrinsic semiconductor and an n-type semiconductor. (7 marks)

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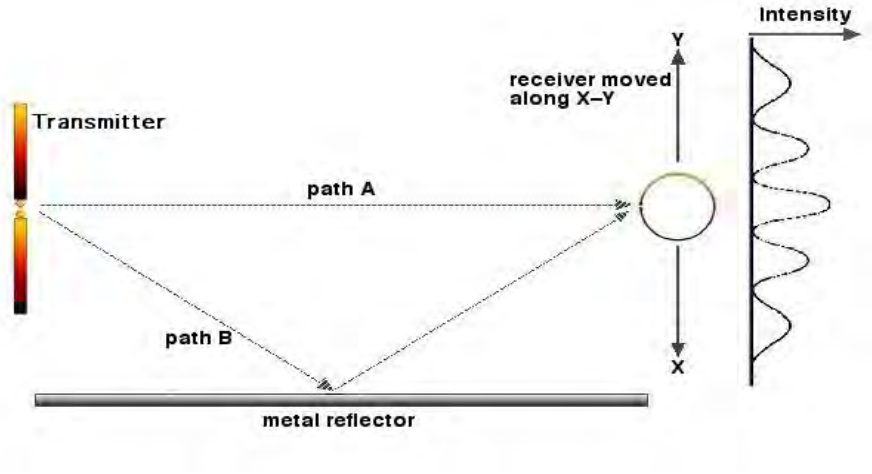
Question 29

Heinrich Hertz used the following apparatus to calculate the speed of radio waves.



(a) Outline the significance of the speed calculated by Hertz. (2 marks)

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(b) In order to calculate the speed, he first needed to work out the wavelength of the radio waves. Explain how he was able to do this.(3 marks)

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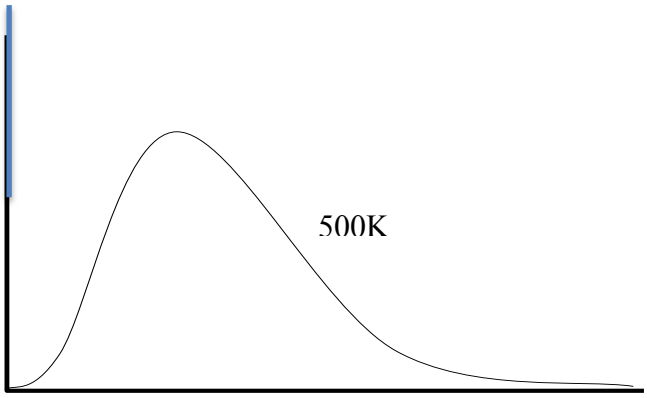
Question 30



The above graph shows a black body radiation curve for an object at 500K. The analysis of such curves caused much controversy towards the end of the 19th century, because the theoretical relationship did not match the experimental one.

(a) Identify appropriate labels for the axes of the graph: (1 mark)

x-axis ..... *y*-axis .....

(b) Describe why this graph was so controversial near the end of the 19th century. (2 marks)

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(c) On the black body graph above draw a second curve for an object at 1000K. (1 mark)

2014 HSC TRIAL EXAMINATION

Physics
Section II

25 marks
Attempt the Medical Physics elective
Allow about 45 minutes for this section

Answer the question in a SEPARATE writing booklet.

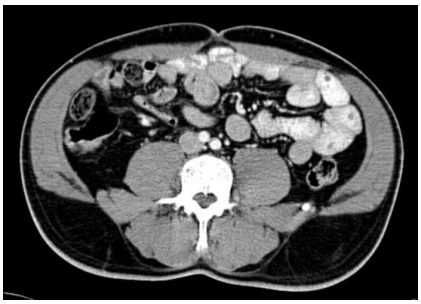
Show all relevant working in questions involving calculations.

Question 31 – Medical Physics (25 marks)

(a) The following images show two different scans of the human abdomen.

Scan A

Scan B



(i) Compare the image produced by Scan A with Scan B (2 marks)

(ii) Assess this statement:

"Scan B has a higher resolution than scan A. Therefore scan B would be superior for use in obstetrics" (3 marks)

(b) The table below provides some characteristics of various body tissues:

Body tissue	*speed of sound*	*density*
air	330 m s^{-1}	1.3 kg m^{-3}
soft tissue, e.g. skin	1540 m s^{-1}	1040 kg m^{-3}
muscle	1590 m s^{-1}	1075 kg m^{-3}
normal healthy bone	4080 m s^{-1}	1908 kg m^{-3}

Following extended periods in space-stations some astronauts were found to have suffered a reduction in their bone density because of the "microgravity" conditions within which they lived.

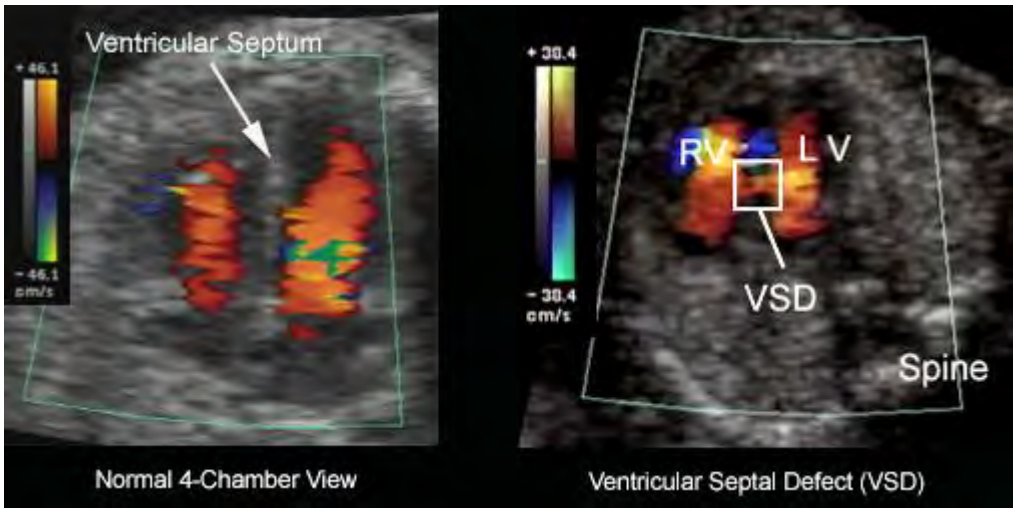
(i) Determine the acoustic impedance of bone tissue.

(2 marks)

(ii) An ultrasound scan from muscle to the femur (long leg bone) of one cosmonaut was taken, and the ratio of reflected to initial intensity was measured to be 0.387. (Muscle has an acoustic impedance of 1.7 Rayls)

Compare this value to that of a normal healthy bone. (3 marks)

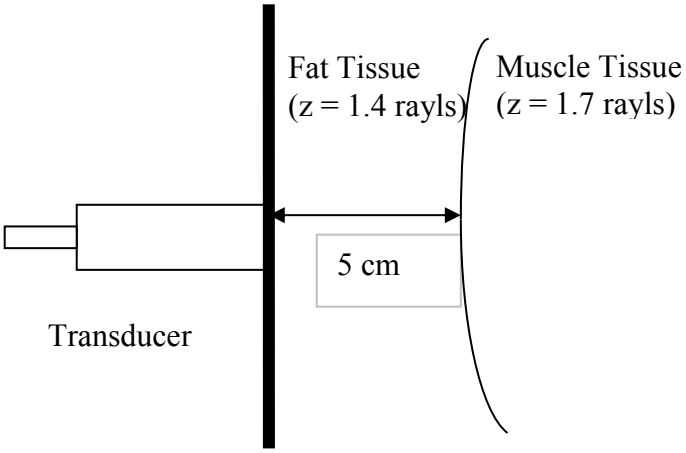
(c)



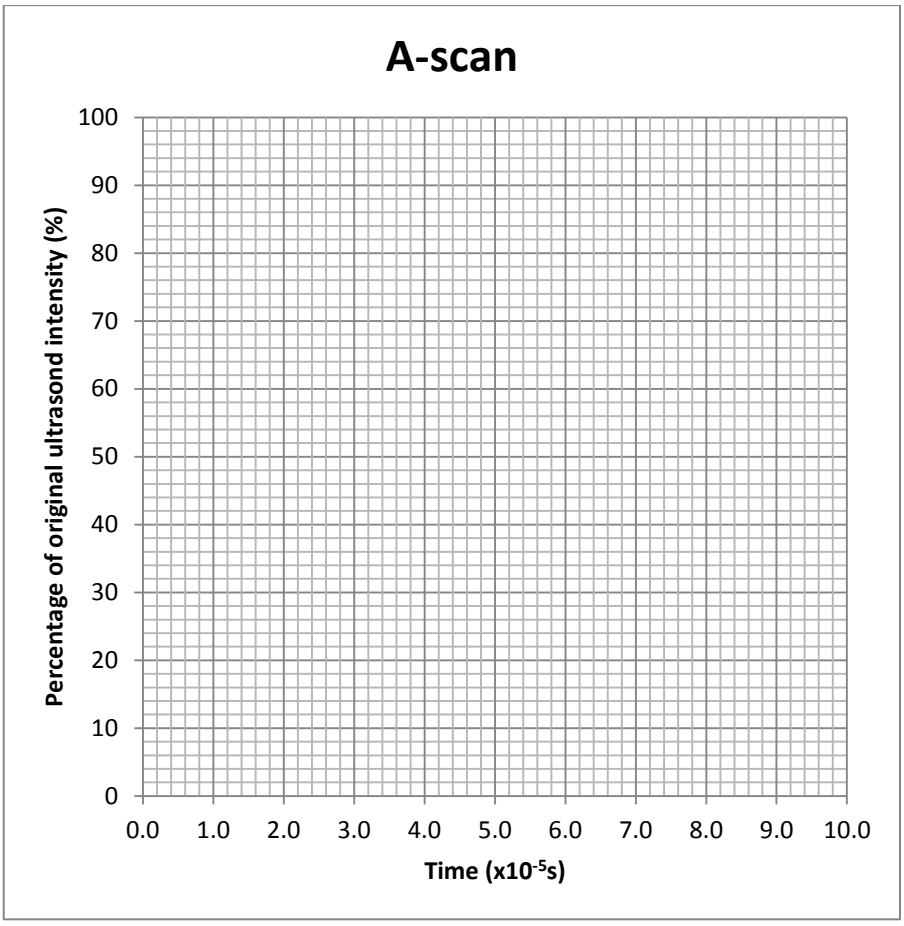
(i) Describe the production of the ultrasound images above.(2 marks)

(ii) Evaluate the use of the above image for diagnosing a hole in the heart wall.(2 marks)

(d) An ultrasound was taken of a person's calf muscle. Sound travels at 1580m.s^{-1} through muscle tissue.



(i) Construct a graph in your booklet as shown on the next page. Draw the A-scan that you would expect as the ultrasound passes from fat into muscle if the ultrasound pulse was sent at t = 0 s. (4 marks)



(f) Assess the impacts of the use of X-rays in medical imaging on society.
(7 marks)

End of Question 32

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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

$$v = f\lambda$$

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

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

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

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

$$P = VI$$

$$\text{Energy} = VIt$$

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

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

$$\Sigma F = ma$$

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

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

$$W = Fs$$

$$p = mv$$

$$\text{Impulse} = Ft$$

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

$$F = mg$$

$$v_x^{\,2} = u_x^{\,2}$$

$$v = u + at$$

$$v_y^{\,2} = u_y^{\,2} + 2a_y\Delta y$$

$$\Delta x = u_x t$$

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

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

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

$$E = mc^2$$

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

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

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

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	79
Symbol	Au
Standard Atomic Weight	197.0
Name	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 65.38 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 87.61 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.96 Molybdenum	43 Tc 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 183.9 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 Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89–103 Actinoids	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium						

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm 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 173.1 Ytterbium	71 Lu 175.0 Lutetium

Actinoids

89 Ac Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium

Elements with atomic numbers 113 and above have been reported but not fully authenticated.

Standard atomic weights are abridged to four significant figures.

Elements with no reported values in the table have no stable nuclides.

The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of data. Some data may have been modified.

Marking Guidelines Trial Exam 2014 Year 12 Physics

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

Part B.

21. Marking criteria	*Marks*
Clear explanation of features related to points: Features designed to control rate of KE converted to friction (leading to heat) or re-radiation of heat produced from K energy conversion (slowing the space craft down) **Shape**: blunt face to re-entry, large SA over which heat from friction can be distributed, creation of compressed air shockwave in front of the craft acting as an insulating buffer. **Correct re entry angle** – concept of a window 5.2 to 7.2 degrees to horizontal. Too great an angle leads to friction too great as craft decelerates too fast leading to high friction overheating of craft, too low angle means craft downward impulse too small to allow penetration of the increasingly dense atmosphere causing veer off into space, a reflection. **Insulation**: Conduction of heat generated by friction into the craft prevented, re-radiation of heat from hot insulation. Note: No mention was made that this craft was manned, therefore answers should not assume so, nor discuss specific effects on people.	4
Three features explained but one or more lacking clarity.	3
Two features explained clearly.	2
One feature explained clearly.	1

22 (a) . Marking criteria	*Marks*
Correct calculation of the vertical displacement when the parachute opens.	2
Correct formula to calculate answer with an incorrect substitution	1

22 (b) . Marking criteria	*Marks*
Correct substation and method to determine the time	2
Correct method established but incorrect substitution	1

22 (c) . Marking criteria	*Marks*
Correct calculation of horizontal displacement (CTE allowed)	1

23 (a). Marking criteria	*Marks*
Correct calculation of the radius of orbit.	3
Correctly determining r^3, but not r or Incorrectly substituting T = 96 into the correct equation, producing an answer	2
Correct calculation of T= 96 X 60 seconds	1

23 (b)

Marking criteria	*Marks*
Clear explanation of why slowing velocity due to identified friction with the atmosphere reduced velocity preventing a circular orbit/creating a spiral orbit towards the Earth with best answers referring to centripetal force equation	3
Explanation identifying some aspects of the friction force contributing to noncircular orbit but lacking clarity	2
One significant aspect of the motion identified and related to why the orbit was non circular.	1

24

Marking criteria	*Marks*
High level answer showing logical progression of three significant **changes** in scientific thinking about motion and light supporting a judgement about statement. Answers included: The shift from quantities (time, mass and length) as constant under Newtonian physics to relative quantities. The change in thinking of velocity of light being measured relative to the aether to velocity of light being constant to all observers in all FOR. The change from light being thought of as a continuously emitted wave where energy can take on any quantity, to light being emitted in discrete packets (as quanta)	6-7
Answer showing logical progression of two significant **changes** in scientific thinking about motion and light OR Main ideas shown for three significant **changes** in scientific thinking about motion and light but lacking connection to clearly show transition in scientific thinking. Answer supports a judgement about statement.	4-5
Basic description of Einstein's work regarding motion and light showing some understanding of ways it has affected scientific thinking.	2-3
Basic description of Einstein's work regarding motion or light showing basic understanding of how it has affected scientific thinking.	1

25a

Marking criteria	*Marks*
Correct graph drawn with correct axis labels, scales, points plotted accurately and an accurate line of best fit.	4
Three correct aspects of graph	3
Two correct aspects of graph	2
One correct aspects of graph	1

25b

Marking criteria	*Marks*
Correct extrapolation of graph to find correct mass of wire (as 0.0025 kg) with correct units.	2
Correct extrapolation of graph to find correct mass of wire (as 0.0025)	1

26

Marking criteria	*Marks*
Clear and well structured discussion relating each physical property in the table to a specific relevant advantage or disadvantage which allows for the use of the metal for its stated purpose. Eg. Low density of aluminium means that cables are lighter so exert less weight on supporting structures.	5-6
Discussion relating four physical properties in the table to a specific relevant advantage or disadvantage which allows for the use of the metal for its stated purpose.	3-4
Discussion relating two physical properties in the table use to discuss a specific advantage or disadvantage at a basic level which allows for the use of the metal for its stated purpose.	2-1

27a

Marking criteria	*Marks*
Correct ratio calculated as 600:49 (or some reasonable variation)	1

27b

Marking criteria	*Marks*
Clear explanation of how the iron core of the transformer is laminated to reduce the size of eddy currents formed and resultant resistive heat loss.	2
Clearly describes the iron core of the transformer as laminated.	1

28

Marking criteria	*Marks*
Clear well structured answer which comprehensively describes conduction in both using relevant band diagrams. Answer must include a description of the following for each semiconductor: • formation of charge carriers - conducting electrons (CB) and positive holes (VB) and relative amounts of each (Note: better answers recognised this process in both types of semiconductor) • formation of dopant (donor) level and its effect on formation of charge carriers (Note: donor level does NOT affect valence electrons) • relative amounts of energy required for conduction in each type of semiconductor related to the band theory (Note: the forbidden energy gap does NOT get smaller) • **movement of electrons (to the + terminal) and positive holes (to the – terminal) when a potential difference is applied (Note: This point describes conduction!)**	6-7
Clear answer which more generally describes conduction in both using relevant band diagrams. Most of the above points must be included.	4-5
Basic description of the mechanism required for semiconductors to conduct electricity eg. Heat energy causes excitation of electrons in valence band to conduction band. With one to two other significant statements.	2-3
Basic description of the mechanism required for semiconductors to conduct electricity or one other significant statement.	1

29a

Marking criteria	*Marks*
	2
	1

29b

Marking criteria	*Marks*
	2-3
	1

30a

Marking criteria	*Marks*
x-axis – wavelength, y-axis – intensity	1

30b

Marking criteria	*Marks*
Clear description of how blackbody graphs did not fit with the classical wave model of light including description of specific predictions made by wave model which were contrary to experimental data OR discussion of the conflicting viewpoint of Planck using mathematical equations assuming EM quantisation.	2
Clear statement of how blackbody graphs did not fit with the classical wave model of light.	1

30c

Marking criteria	*Marks*
Correct curve drawn where curve is above the 500K curve at ALL points on the graph (must NOT cross other curve). Peak in graph clearly closer to y-axis than 500K curve.	1

31a

Marking criteria	*Marks*
Two similarities or differences between the images pictured(not the techniques used) eg. Both images are greyscale or image A has more noise than image B	2
One similarity or difference between the images	1

31b

Marking criteria	*Marks*
Negative judgement related to clear reasoning as to why CAT scans are not suitable for obstetrics.	3
Negative judgement with limited or unclear reasoning as to why CAT scans are not suitable.	1-2

31bi

Marking criteria	*Marks*
Correct calculation with units	2
Correct calculation without units	1

31bii

Marking criteria	*Marks*

Correct calculation of the reflected ratio AND a comparison with the ratio with the cosmonaut	3
Correct calculation of the reflected ratio without a comparison OR Calculation of acoustic impedance of bone with comparison (not what was asked in question)	2
Correct method of calculation with an error.	1

31ci

Marking criteria	***Marks***
An understanding of the Doppler effect shown and related to how the image is produced.	2
Either an understanding of the Doppler effect shown or some aspects of how the scan is produced.	1

31cii

Marking criteria	***Marks***
Positive judgement AND clearly relates aspect of the image (orange areas between heart chambers of diseased patient) to the diagnosis	2
Demonstrates some understanding of how the image pictured is used.	1

NOTE : Many students did not refer to the image shown and only to Doppler ultrasound. This clearly does not answer the question and was awarded zero.

31d

Marking criteria	***Marks***
Correct calculation of the reflected intensity, time for the pulse to return and placement of a peak on the a-scan graph.	4
Correct calculation of reflected intensity AND either show how the graph should look or calculates the correct time for the sound wave to return.	3
Some aspects of the process calculated or demonstrated correctly.	1-2

31f

Marking criteria	***Marks***
A judgement of the impacts AND clearly links the use of x-ray imaging and CT scans on two or more significant impacts on society AND uses a coherent progression and appropriate scientific terminology.	6-7
A judgement of the impacts AND answer clearly links the use of x-ray imaging on two or more significant impacts on society OR Assesses the impacts of both x-ray imaging and CT scans with weak links to impacts on society	4-5
Demonstrates a knowledge of how x-rays or CT scans are used and shows how they impact on individuals.	2-3
Outlines some relevant information regarding either x-rays or CT scans.	1

Note : Higher mark values could only be accessed by assessing impacts of both x-rays and CT(which both use x-rays).