

Cheltenham Girls High School
2010 HSC Physics Trail Exam
Marking Guidelines

Section I - Part A

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

Section I - Part B

21(a)

Marking Criteria	Marks
Provides comprehensive definition of Newton's law of gravitation, referring to the masses of both objects and the inverse of the square of the distance.	2
Provides an answer which leaves out one of the dependencies from (a) OR writes the correct formula.	1

Sample answer:

The gravitational force between two objects is proportional to the product of the masses of the objects and inversely proportional to the square of the distance between them.

21(b)

Marking Criteria	Marks
Accurately calculates the approximate mass of the sun.	2
Provide correct equation and substitution of values, but makes an error in the calculation.	1

Sample answer:

$$a = GM/r^2$$

$$M = ar^2/G$$

$$M = 6 \times 10^3 \times (1.5 \times 10^{11})^2 \div 6.67 \times 10^{-11} = 2.0 \times 10^{36} \text{ kg}$$

22(a)

Marking Criteria	Marks
Identifies and correctly states the principle of relativity.	2
Provides answer which clearly states that no experiment can be done to determine the state of constant motion of the container without reference to outside the container OR correctly identifies the principle of relativity.	1

Sample answer:

According to the Principle of relativity, no experiment can be done to determine the state of constant motion of the container without reference to some point or object outside the container.

22(b)

Marking Criterion	Marks
Accurately identifies the name given to the frame of reference referred to in part	1

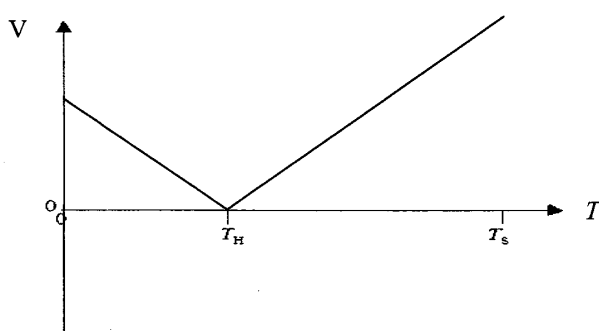
Sample answer:

Inertial frame of reference.

23(a)

Marking Criteria	Marks
Provides correct answer which shows the final speed is greater than initial speed, magnitude is zero at T_H , and one gradient = -gradient of the other.	2-3
Provides an answer with two of the above requirements.	1

Sample answers:



23(b)

Marking Criteria	Marks
Accurately calculates the time it takes for the stone to hit the water.	2
Provides correct formula or other method but makes numerical or one substitution error in calculating answer.	1

Sample answer:

$$T_{\text{total}} = T_s = T_H + T_{HS} = v \sin 30^\circ / g + \sqrt{2h/g}$$

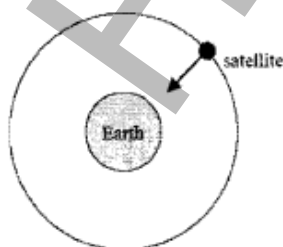
$$T_{\text{total}} = 25 \times \frac{1}{2} \div 9.8 + \sqrt{2 \times (8 + 28) \div 9.8} = 4.0 \text{ s}$$

24(a)

Marking Criteria	Marks
Provides the correct force name AND correct vector addition to the diagram.	1

Sample answer:

Centripetal force or gravitational force



24(b)

Marking Criteria	Marks
Provides the correct answer	2
Provides correct formula or other method but makes numerical or one substitution error in calculating answer	1

Sample answer:

$$a = GM_E/r^2 = 6.67 \times 10^{-11} \times 6 \times 10^{24} \div [(6280 + 20000) \times 10^3]^2 = 0.58 \text{ ms}^{-2}$$

25(a) i

Marking Criteria	Marks
Correctly calculates the time for the journey from the Earth frame of reference	1

Sample answer: $t = d/v = 6 \text{ ly} \div 0.8 c = 7.5 \text{ years}$

25(a) ii

Marking Criteria	Marks
Accurately calculates the duration of the journey from the space ships frame of reference.	2
Provides correct formulae or attempts to calculate time dilation or length contraction with subsequent time calculation, but makes error in processing.	1

Sample answer:

$$\ell = \ell_0 \sqrt{1 - v^2/c^2} = 6 \times \sqrt{1 - (0.8c)^2/c^2} = 3.6 \text{ ly}$$

$$t = d/v = 3.6 \text{ ly} \div 0.8 c = 4.5 \text{ years}$$

25(b)

Marking Criteria	Marks
Provides correct answer and justification.	2
Provides correct answer but incorrect or no justification.	1

Sample answer:

From Tom's point of view both Signals travel at the same speed (and have been emitted simultaneously); so since the front of the station moves towards the signal (relative to Tom), Tom receives the reflected signal from the front mirror first.

26(a)

Marking Criteria	Marks
Accurately calculates the output voltage.	1

Sample answer:

$$V_1/V_2 = n_1/n_2$$

$$240/V_2 = 100/750$$

$$V_2 = 1800\text{v}$$

26(b)

Marking Criteria	Marks
Provides an accurate description of the impact of the development of transformers on society.	2-3
Provides some relevant information about the impact of the development of transformers on society.	1

Suggested answer:

Step-up transformers allow the transmission of electrical power while minimising energy losses and are needed in cathode ray type TVs. Step-down transformers are used to provide safe local power supply and various voltages in domestic and industrial devices. Combined with rectifying circuitry, transformers are increasingly used to charge the rechargeable batteries of many devices such as cordless drills, mobile phones and ipods.

Efficient transmission of power using transformers has allowed the development of large cities and factory locations away from power stations and the development of affordable electronic and household appliances without dependence on battery power.

27(a)

Marking Criteria	Marks
Provides an accurate outline of the basic principle of induction motors.	2
Provides some relevant information about induction motors.	1

Suggested answer:

In induction motors, a squirrel cage is surrounded by a rotating magnetic field that induces a current in the rods of the squirrel cage which then experiences a rotating force due to the magnetic field.

27(b)

Marking Criteria	Marks
Provides an accurate analysis of how the motor effect is used to produce rotation of the coil in one device and vibration in the other	3-4
Provides some relevant information about the motor effect	1-2

Suggested answer:

In galvanometers, the coil is flat, rectangular in shape and on an axis parallel to the plane of the coil. It is surrounded by a radial magnetic field of constant strength which acts perpendicular to the axis of the coil, exerting opposing forces on 2 opposite sides of the coil (the motor effect), causing a torque and rotation.

In speakers, the coil is circular and elongated. The surrounding magnetic field is radial, parallel to the plane of each turn in the coil. The motor effect results in forces perpendicular to the plane of the coil but in the same direction for each part of the circular turns of the coil. The coil then moves in the direction for the force and changes direction with changes in current direction.

28(a)

Marking Criteria	Marks
Provides an accurate justification of the use of very high voltages for the transmission of electricity.	2
Provides some relevant information about the use of high voltages for the transmission of electricity.	1

Suggested answer:

Electricity is transmitted at high voltages to reduce energy losses in transmission lines.

Power lost = I^2R where I is current flowing and R is resistance of transmission line which increases proportionally with length. This indicates that energy loss increases with distance and increases with the square of the current. Therefore it is best to transmit at low current by using the highest possible voltage. A high power transmission is still achieved as power transmitted = IV .

28(b)

Marking Criteria	Marks
Provides an outline of the reason for the limit on the magnitude of the voltage used for transmission.	1

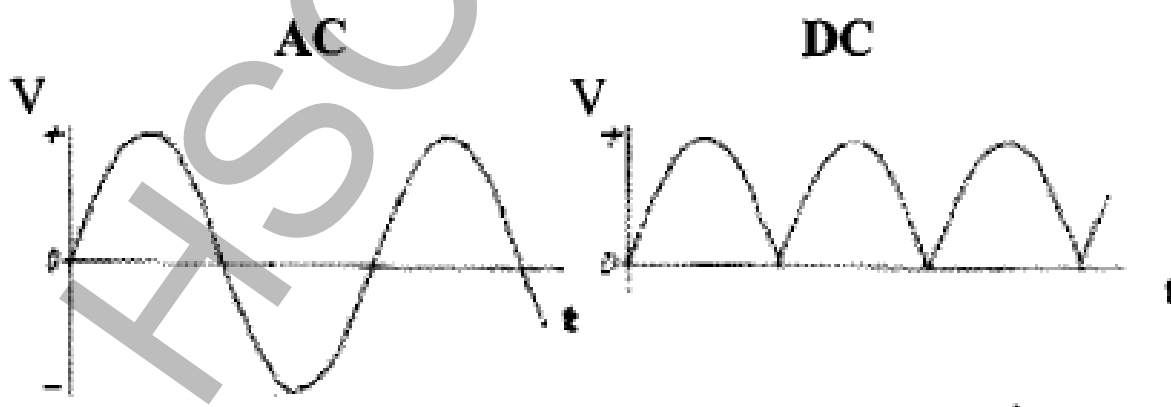
Suggested answer:

The voltage is limited as extreme voltages (above 500 kV) ionise the air and insulators are unable to prevent conduction to the ground at supports.

28(c)

Marking Criteria	Marks
Provides an accurate sketch showing the output of simple AC and DC generators.	2
Provides an accurate sketch showing the output of simple AC or DC generators	1

Suggested answer:



29(a)

Marking Criteria	Marks
Provides an accurate explanation of the cause of the current flow.	2
Provides some relevant information about the cause of current flow.	1

Suggested answer:

When the switch is closed, the current creates a magnetic field; the iron core is magnetised and coil 1 experiences a changing magnetic field which induces a current in coil 1. When the current in coil 2 reaches a steady value, the magnetic field is no longer changing and no current is induced in coil 1.

29(b)

Marking Criteria	Marks
Provides an accurate description of TWO changes to the apparatus to increase the magnitude of the momentary current flow.	2
Provides an accurate sketch description of ONE change to the apparatus to increase the magnitude of the momentary current flow.	1

Suggested answer:

Increase the voltage supplied in circuit 2, or increase the ratio of turns in coil 2 compared to coil 1.

29(c)

Marking Criteria	Marks
Proposes ONE change to the apparatus that would produce a continuous current in circuit 1 while the switch is held closed.	1

Suggested answer:

Use AC in circuit 2.

30(a)

Marking Criteria	Marks
Provides an accurate description of how p-type semiconductors are produced.	2

Suggested answer:

P-type semiconductors are produced by adding small amounts of group 3 atoms, that is, those with 3 electrons in their outermost shell (e.g. boron, gallium) to silicon.

30(b)

Marking Criteria	Marks
Provides an explanation of the change in the electrical properties of p-type semiconductors compared to the electrical properties of pure semiconductors.	2
Provides some relevant information about the electrical properties of p-type and pure semiconductors.	1

Suggested answer:

Doping a semi-conductor to make it p-type increases its conductivity. There are holes created where bonding electrons are missing. The holes are able to move through the lattice under an applied electrical field which is conduction of charge. The undoped semiconductor does not have holes and so movement of charge does not occur.

30(c)

Marking Criteria	Marks
Provides the reasons for the difference in electrical resistance of conductors and insulators.	2
Provides some relevant information about the electrical resistance of conductors and insulators.	1

Suggested answer:

In insulators, the valence band is full and there is a large gap between the valence and conduction bands preventing electrons from moving easily. In conductors, the conduction and valence bands blend into one band with many unfilled levels for electrons to move into making them mobile.

31

Marking Criteria	Marks
Provides an explanation of how Thomson was able to settle the debate about the nature of cathode rays using his apparatus.	3-4
Provides some relevant information about the nature of cathode rays.	1-2

Suggested answer:

The debate concerned whether cathode rays were negatively charged particles or electromagnetic radiation with a very short wavelength. Thomson reasoned that if the rays were charged particles, they could be deflected by both electric and magnetic fields. His experiment used both fields with the forces balanced allowing him to find a constant value of e/m for all cathode materials and firmly establishing that the rays were particles.

Marking Criteria	Marks
Provides an analysis of the experimental and theoretical contributions made by various scientists that resulted in the model of light referred to by Bragg.	5-6
Provides description of the experimental and theoretical contributions made by various scientists that resulted in the model of light referred to by Bragg.	3-4
Provides some relevant information about the model of light referred to by Bragg.	1-2

Suggested answer:

Explanations of the photoelectric effect were impossible with wave theory and theoretical explanations of black body radiation failed. Max Planck's concept of quanta produced a successful black body radiation theory, and Einstein used his concept to explain the photoelectric effect. Since a quantum of energy is equivalent to a particle, e-m radiation is now considered to be both particle and wave as referred to by Bragg.

Section II

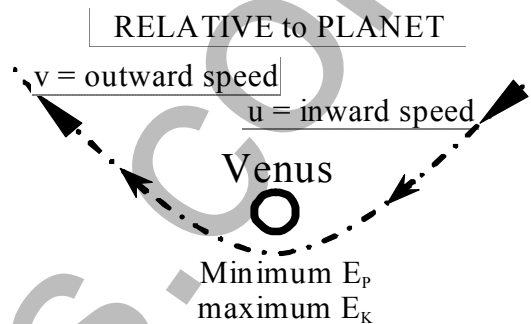
Question 33 (5 marks)

34 (a) (2 marks)

Criteria	Marks
<ul style="list-style-type: none"> Correctly identifying that speed increases during approach <i>and</i> Correctly identifying that speed decreases as it recedes 	2
<ul style="list-style-type: none"> Stating any one of the above 	1

Sample answer

As the craft approaches Venus it loses more and more gravitational potential energy, which is converted into kinetic energy according to the law of Conservation of Energy – hence it goes faster until it reaches the point of closest approach. From that point the reverse occurs – the craft gains gravitational potential energy as it recedes, so it loses the same quantity of kinetic energy, thus slowing down.



33 (b) (3 marks)

Criteria	Marks
<ul style="list-style-type: none"> Correctly outlines one physical principle supporting the reporter's claim Correctly outlines one physical principle in contrary to the reporter's claim Gives an appropriate assessment of the validity of the claim 	3
<ul style="list-style-type: none"> Omits only one of the above <i>or</i> Merely states points supporting and opposing the claim, plus an assessment 	2
<ul style="list-style-type: none"> Provides one of the above 	1

Sample answer

From the frame of reference of the planet the reporter's claim is correct. As shown above, the craft's path is hyperbolic, and since it starts 'at infinity' and returns there, the total energy it possesses remains unchanged. Further, the velocity of the craft changes even if its kinetic energy does not, because its direction is not the same as before. However, the planet is moving around the Sun, and hence the craft has actually gained both momentum and kinetic energy from Venus in the fly-by as viewed from any frame of reference apart from the planet. Hence, the claim by the reporter is invalid from our frame of reference, which is why craft do use the technique of gravitation-assist to change their total energy and speed.

Question 34 (4 marks)

Criteria	Marks
Outlines three or more facts on the contribution of the pioneer and relates these to space travel	4
Outlines two or more facts on the contribution of the pioneer and relates one to space travel	3
Outlines two or more facts on the contribution of the pioneer	2
A true statement about rocket history	1

Sample answer

Goddard built and launched many early experimental rockets and learned to wrap the tube carrying the liquid oxygen around the rocket motor; this not only kept the engine cool, it also meant that the oxygen arrived into the motor as a gas, ready to combust the fuel.

Goddard used liquid propellant to power his rockets. This allowed the development of modern liquid fuel rockets use in space travel.

Goddard developed stabilising gyroscopes for early experimental rockets; this allowed the development of modern gyroscope stabilised rockets used in space travel.

Question 35 (4 marks)**35 (a) (4 marks)**

Criteria	Marks
<ul style="list-style-type: none"> Fully discuss Einstein and Planck's differing views (at least 2 view points from each of them) about whether science research is removed from social and political forces. 	4
<ul style="list-style-type: none"> Partially discuss Einstein and Planck's differing views (less than 2 view points from each of them) about whether science research is removed from social and political forces. 	3
<ul style="list-style-type: none"> State one or two view points of Einstein and/or Planck about whether science research is removed from social and political forces. 	2
<ul style="list-style-type: none"> State one view point of Einstein and/or Planck about whether science research is removed from social and political forces. 	1

Sample answer

Planck was a nationalist. He believed in his country and worked for his country. He was loyal to whatever the government was. When war broke out, Planck was one of the first of ninety three German intellectuals to sign a document supporting the role of Germany in the war. He devoted his work and research to whatever the war effort required of him.

Einstein was different. He had no particular politics and supported no government. He refused to sign the document supporting Germany's war effort, instead signing a different document which called for a peaceful world. He was a peacekeeper, and did not accept that his work should contribute to the killing of others.

Question 36 (6 marks)**36 (a) (1 mark)**

Criteria	Mark
<ul style="list-style-type: none"> Identifying the motor effect 	1

Sample answer

This main physics principle involved here is the motor effect.

36 (b) (2 marks)

Criteria	Marks
<ul style="list-style-type: none"> The correct formulae are given, <i>and values are correctly substituted</i> 	2
<ul style="list-style-type: none"> One correct formula is given, and substituted into to get an answer 	1

Sample answer

$$V = I \times R \quad \therefore 30 = I \times 5.5 \quad \therefore I = 5.45 \text{ amperes}$$

$$F = B I \ell \sin \theta \quad \therefore F = 0.25 \times 5.45 \times 0.75 \times \sin 90^\circ = 1.02 \text{ newtons}$$

36 (c) (3 marks)

Criteria	Marks
<ul style="list-style-type: none"> The direction of the current through the rod is stated or implied The direction of movement is stated with a correct reason Continued acceleration is stated with correct reasoning 	3
<ul style="list-style-type: none"> Two of the above outcomes are achieved 	2
<ul style="list-style-type: none"> Any one of the above answers is correctly stated 	1

Sample answer

The battery in the diagram has its positive terminal connected to the upper rail in the diagram, so current flows through the rod towards the lower rail. According to the right-hand 'slap' rule (etc), the rod experiences a force to the left ←

Also, since the force continues to be applied as long as the battery is connected to the system, the rod should continue to accelerate in that direction.

Question 37 (6 marks)**37 (a) (1 mark)**

Criteria	Mark
<ul style="list-style-type: none">Identifies black-body radiation	1

Sample answer

The graph is from experiments on black-body radiation.

37 (b) (1 mark)

Criteria	Mark
<ul style="list-style-type: none">Correctly identifies both axes	1

Sample answer

One axis is wave-length, the other is intensity (or brightness, radiance, or energy released).

37 (c) (4 marks)

Criteria	Marks
<ul style="list-style-type: none">Description involving change from continuous energy amounts, energy in packets or quanta, and two significant developments	4
<ul style="list-style-type: none">Description involving change from continuous energy amounts, energy in packets or quanta, and one significant development	3
<ul style="list-style-type: none">Description involving change from continuous energy amounts, energy in packets or quanta, OR energy in packets and one significant developments	2
<ul style="list-style-type: none">One true statement about quantum theory	1

Sample answer

Planck proposed that energy is not absorbed and emitted continuously across all energies, but only in discrete amounts or packets of energy. These packets we called quanta. The significance of this is that it explained the black-body radiation curves correctly, bringing a more accurate understanding of thermodynamics. It also led to Einstein's work in identifying light quanta, and explaining the photoelectric effect.

(End of the Paper)