Candidate Number ………………………………………..

Ascham School

Trial Examination 2015

Physics

Time allowed: 3 hours (plus 5 minutes reading time)

Section 1

PART A 15 one mark multiple choice questions.

Write your answers in pencil on the Part A answer sheet. (20 marks)

Write your Candidate number on the Part A answer sheet.

PART B Short response questions.

Write your answers in the space provided. (60 marks)

Write your Candidate number on each section.

Section 2

Option: Medical physics (20 marks)

Write your answers to this section in the writing booklet.

Write your Candidate number on each booklet you use.

A Periodic Table, A Data sheet and a Formula sheet are provided.

Section 1

Total marks (80)

<u>Part A</u>

Total marks (20)

Attempt questions 1 to 20

Use the multiple choice answer sheet.

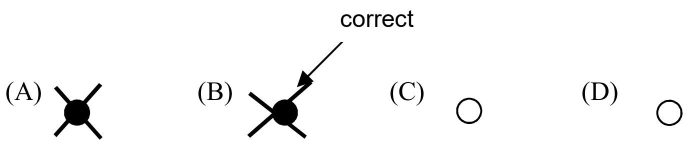
Select the alternative A, B, C or D that best answers the question. Fill in the response circle completely.

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.

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:



1 Which of the following shows the correct relationship between escape velocity and the orbital velocity for a given planet?

(A) escape velocity = 2 × orbital velocity

(B) escape velocity = $\sqrt{2}$ × orbital velocity

(C) orbital velocity = $\sqrt{2}$ × escape velocity

(D) orbital velocity = 2 × $\sqrt{escape\ velocity}$

2 Special relativity can be used to calculate length contaction and time dilation during

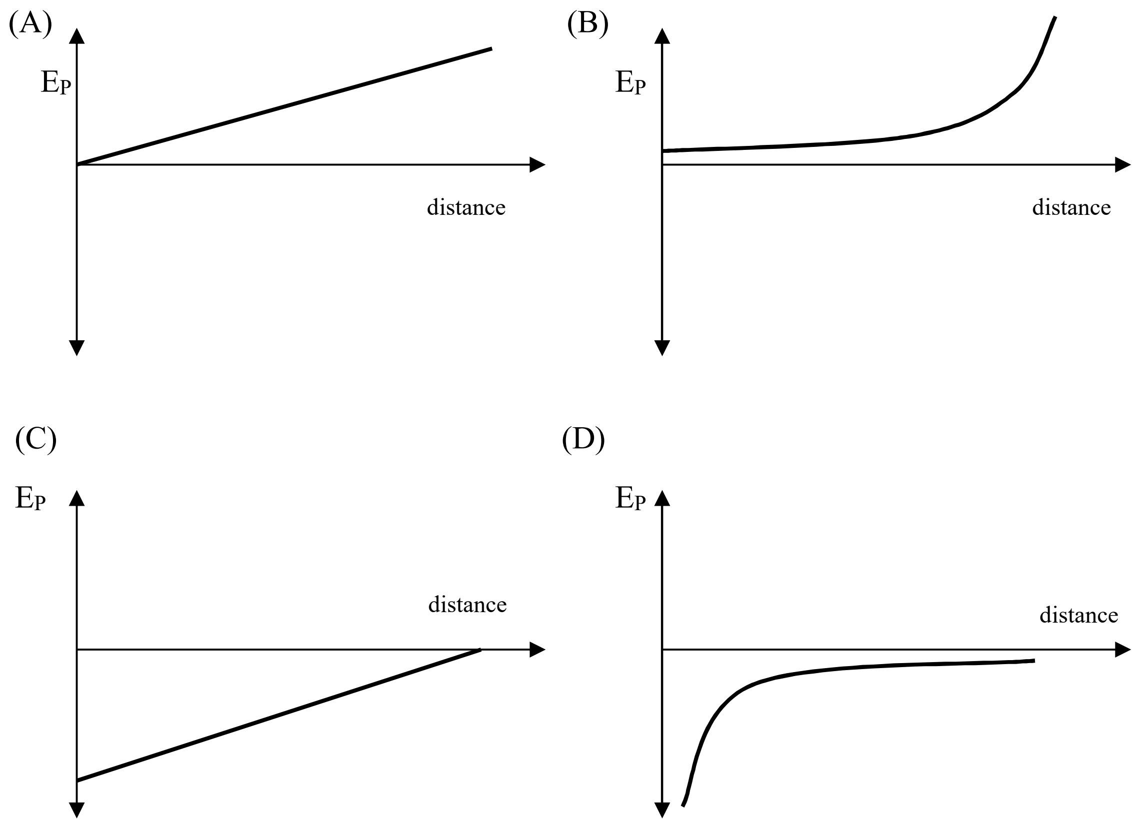
(A) a slingshot manounvre

(B) the launch of a rocket

(C) both (A) and (B)

(D) neither (A) or (B)

3 An asteroid is falling towards Earth from a large distance away. Which graph best represents the asteroid's gravitational potential energy plotted against its distance from Earth's centre?



4 A group of students carried out an experiment with a pendulum to determine a value for acceleration due to gravity.

Which of the following steps would enhance the VALIDITY of their results?

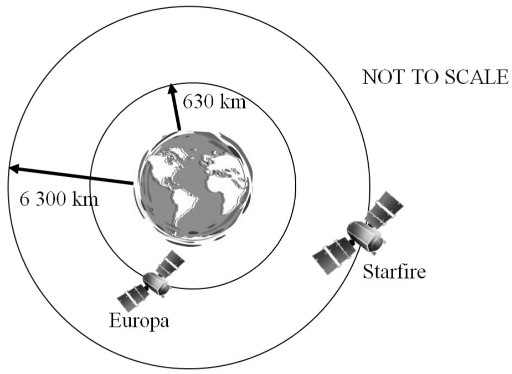
(A) repeating the experiment sevral times for each string length and averaging the result

(B) using a piece of string that weighed as little as possible

(C) neither (A) or (B)

(D) both (A) and (B)

5 Europa is a satellite orbiting with an altitude of 630 km. Starfire is another satellite orbiting with an altitude of 6 300 km.



The centripetal acceleration of Europa would be:

(A) 10 times greater than that of Starfire.

(B) 100 times greater than that of Starfire.

(C) the same as Starfire.

(D) not be able to be compared to Starfire without knowing the satellites' speeds.

6 In 1894, J. J. Thomson measured the speed of cathode rays by passing the rays through crossed electric and magnetic fields. He found that in a highly evacuated tube, the maximum velocity of the rays was 1/3 the speed of light. What could Thomson deduce from this experiment about the nature of cathode rays?

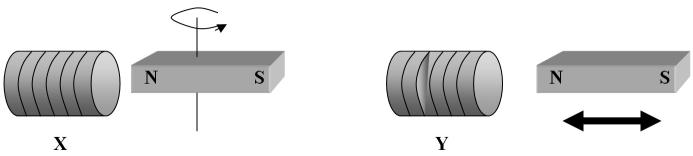
(A) Cathode rays must be some type of electromagnetic radiation.

(B) Cathode rays must be negatively charged.

(C) Cathode rays must not be some type of electromagnetic radiation.

(D) Cathode rays must not be charged.

7 A bar magnet placed at one end of a solenoid **X** was spun as shown. An identical bar magnet was also moved backwards and forwards close to the end of an identical solenoid, **Y**. The second bar magnet completed one oscillation for every one rotation of the other magnet.



When the EMF in the coils of the solenoids was displayed on a CRO, it was found that:

(A) the graphs of the EMFs had the same general shapes.

(B) the graph of solenoid **X** had twice the frequency of the graph for solenoid **Y**.

(C) the graph for solenoid **X** was much smoother than the graph for solenoid **Y**.

(D) the graphs were a sine wave shape for solenoid **X** and a square wave shape for solenoid **Y**.

8 Which of the following is **NOT** due to the motor effect?

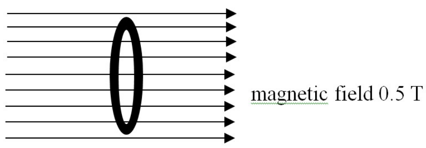
(A) Rotation of a coil in a generator

(B) Movement of a needle in a galvanometer

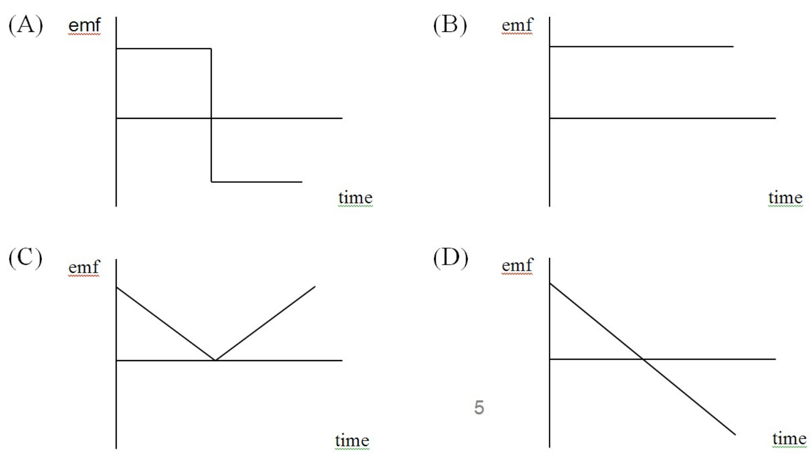
(C) Movement of the voice coil in a loud speaker

(D) Electromagnetic brakes

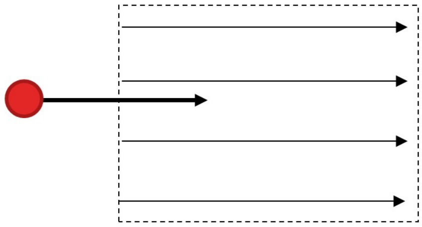
9 A metal ring has its plane perpendicular to a magnetic field of strength 0.5 T as shown.



Over a period of time the direction and magnitude of the field changed uniformly so that in its final position it is reversed, but with the same original magnitude. Which graph shows a possible emf induced in the ring during this time?

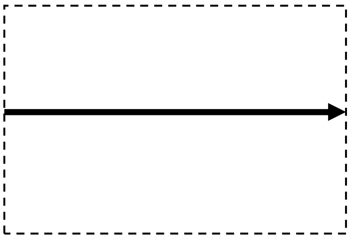


10 A positively charged particle enters a region of uniform electric field. The direction of the particle's velocity is parallel to the field as shown in the diagram.

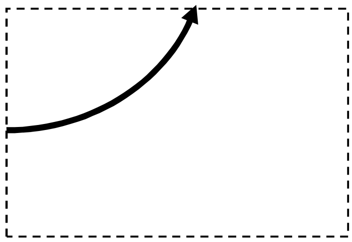


Which choice best describes what happens to this particle while it is in the field?

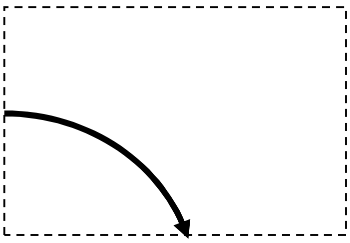
(A)



(B)



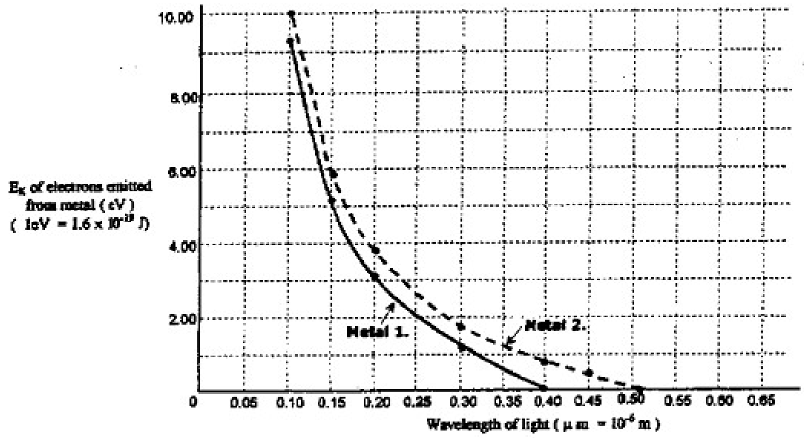
(C)



(D)

Particle curves up out of the page.

11 The following graph shows results collected on the kinetic energy of electrons that were emitted from TWO metals as the wavelength of the light source was changed



Considering the graph above, which of the following statements is correct?

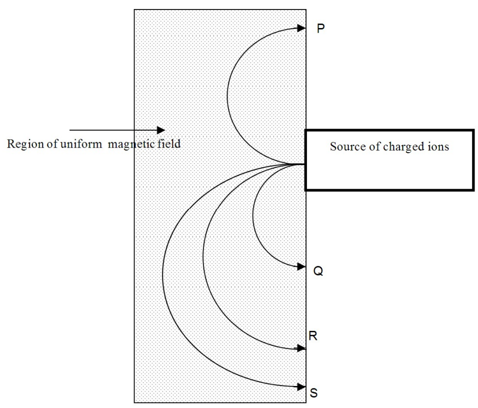
(A) The threshold frequency for Metal 1 is greater than for Metal 2

(B) The greater the kinetic energy of the electrons, the shorter their wavelength

(C) The intensity of the light used for Metal 2 was greater than that used for Metal 1

(D) The work function for Metal 2 is greater than for Metal 1

12 The diagram shows the paths taken by four charged particles, (P, Q, R and S), fired with identical speeds into a region of uniform magnetic field directed normally to the page.



Which statement about these particles could account for these paths?

(A) P and Q carry opposite and equal charges and Q has more mass than P.

(B) Q and R have the same mass, carry opposite charges and R has a larger charge than Q.

(C) R and P have the same mass, carry opposite charges and R has a smaller charge than P.

(D) R and S carry identical charges and R has a larger mass than S.

13 Photons of wavelength λ are incident on a metallic surface in a vacuum. The number of photons incident on the surface per second is N. No electrons are emitted from the surface.

Which of the following actions is most likely to cause electrons to be emitted from the surface?

(A) Decrease the frequency of the incident light

(B) Decrease the wavelength of the incident light

(C) Increase the number of photons per second incident on the surface

(D) Change to a different metallic surface

14 Which of the following correctly describes the most commonly used semiconductor material, in which conduction involves the movement of holes when an electric field is applied across the semiconductor?

(A) Silicon doped with phosphorus

(B) Germanium doped with phosphorus

(C) Silicon doped with boron

(D) Germanium doped with boron

15 Which of the following is an advantage of semiconductor technology over cathode ray tube technology?

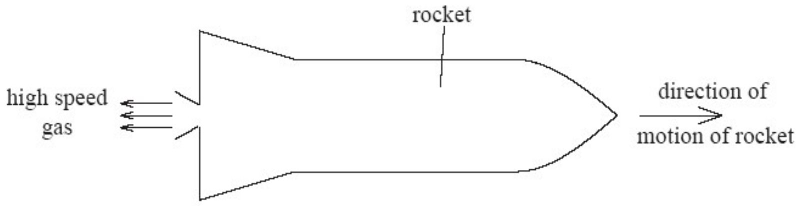
(A) Data transfers more rapidly through semiconductor devices than cathode ray tubes.

(B) Semiconductor devices are less physically stable than cathode ray tubes.

(C) Larger currents can pass through semiconductor devices than through cathode ray tubes.

(D) Semiconductor devices operate at a much lower temperature than cathode ray tubes.

16 The engine of a rocket ejects gas at high speed, as shown below.



Which statement explains why the rocket accelerates forward?

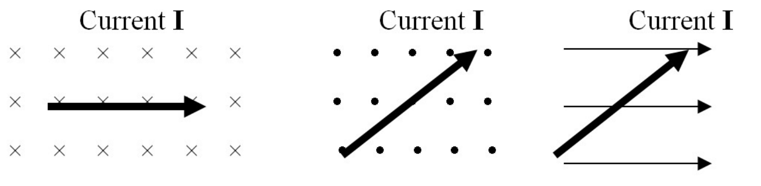
(A) The momentum of the gas is equal to the momentum of the rocket.

(B) The gas pushes on the air at the back of the rocket.

(C) The change in momentum of the gas gives rise to a force on the rocket.

(D) The ejected gas creates a region of high pressure behind the rocket.

17 Three conductors are of equal length, carrying equal currents and are situated in magnetic fields of the same strength. The conductors are in different positions as shown in the following diagrams.

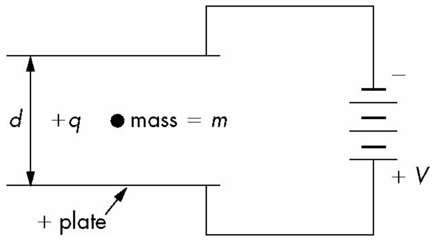


Magnetic field (**B**) into the page Force on conductor = $\mathbf{F}_1$	Magnetic field (**B**) out of the page Force on conductor = $\mathbf{F}_2$	Magnetic field (**B**) across the page Force on conductor = $\mathbf{F}_3$

Which of the following correctly compares the magnitude of the forces $\mathbf{F}_1$, $\mathbf{F}_2$ and $\mathbf{F}_3$?

(A)	$\mathbf{F}_1$ is zero	$\mathbf{F}_2$ equals $\mathbf{F}_3$
(B)	$\mathbf{F}_1$ is greater than $\mathbf{F}_2$	$\mathbf{F}_2$ equals $\mathbf{F}_3$
(C)	$\mathbf{F}_1$ equals $\mathbf{F}_2$	$\mathbf{F}_2$ is greater than $\mathbf{F}_3$
(D)	$\mathbf{F}_1$ is greater than $\mathbf{F}_3$	$\mathbf{F}_2$ is zero

18 A particle with a mass m carrying a charge of +q coulombs is placed between a pair of horizontal parallel plates separated from each other by a distance d. When a voltage of V volts is placed across the plates the particle is observed to accelerate upwards. Which of the following relationships would give the net force on the particle in the field?



(A) qV/d – mg upwards

(B) d/qV – mg upwards

(C) mg – qV/d upwards

(D) qV – mg upwards

19 Black body radiation is the electromagnetic radiation that is emitted from a body due to its temperature alone. How does the black body radiation emitted from a body change as the temperature of the body is increased?

(A) The power radiated remains constant but the frequency at which most of the radiation is emitted decreases.

(B) The power radiated remains constant but the frequency at which most of the radiation is emitted increases.

(C) The power radiated increases, but the frequency at which most of the radiation is emitted decreases.

(D) The power radiated increases and the frequency at which most of the radiation is emitted also increases.

20 What happens when a p-type semiconductor and an n-type semiconductor are joined to produce a junction?

(A) Charges diffuse across the junction leaving the n-type material with negative ions and the p-type material with positive ions

(B) Charges diffuse across the junction leaving the p-type material with negative ions and the n-type material with positive ions

(C) No charges will move until the semiconductor is forward biased

(D) The positive holes prevent the further diffusion of electrons from the n-type material.

Section I – continued

Part B Total marks (60)
Attempt Questions 21 – 35 Allow about 1 hour 45 minutes for this part

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

Question 21 (4 marks)

Two moons, X, and Z are in orbit around the same planet. The moons have identical masses and orbital velocities of v and 2v respectively.

(a) Calculate the ratio of their orbital radii. **2**

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(b) Relate one characteristics of a geostationary orbit relate to the main purposes of satellites placed in these orbits. **2**

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Question 22 (2 marks)

(a) Identify the outcome of a gravitational assist manoeuvre **1**

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(b) The average distance of Earth from the Sun is 1.5×10^{11} m. The acceleration due to the Sun's gravitational field at the Earth is 6.0×10^{-3} ms^{-2}.

Calculate the approximate mass of the Sun. **1**

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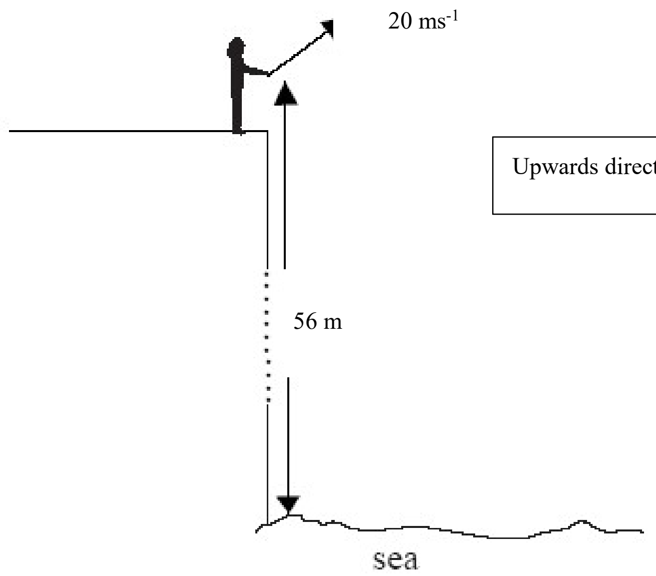
Question 23 (4 marks)

A stone is thrown from the top of a cliff at a height of 56 m above the sea. The stone is thrown at a speed of 20 ms^{-1}. (Air resistance is negligible.)

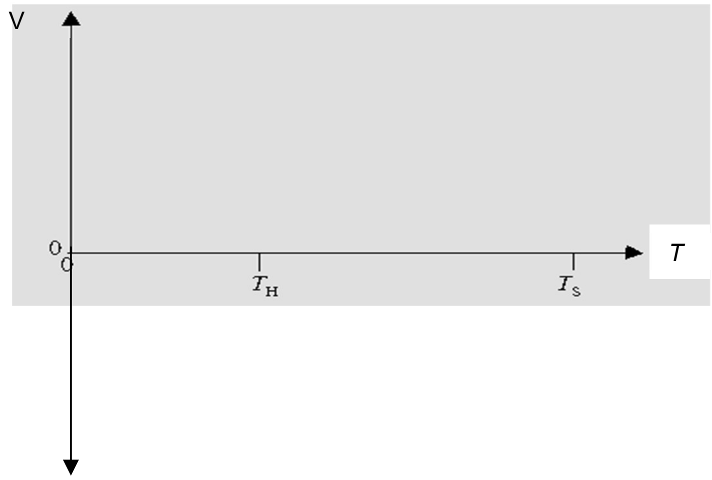
The maximum height reached by the stone from the point at which it is thrown is 8.0 m.

The stone leaves the cliff at time $T = 0$. It reaches its maximum height at $T = T_H$ and strikes the sea at $T = T_S$.



Upwards direction for all vector quantities is positive.

(a) On the axis below, sketch a graph to show the variation in the magnitude of the vertical component of the velocity of the stone, from $T = 0$ to $T = T_S$. **2**



No numerical values required

(b) Calculate the time (*T-total*) it will take for the stone to hit the water. **2**

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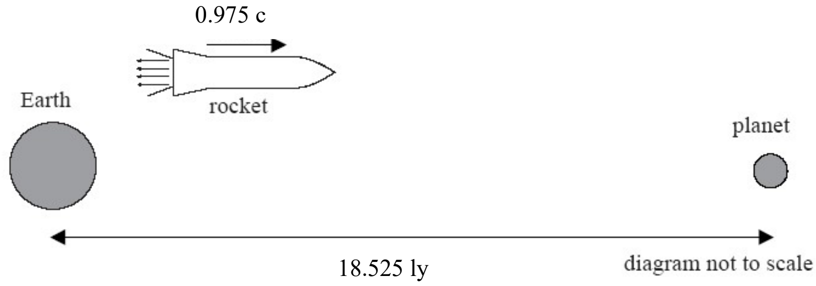
Question 24 (5 marks)

A rocket moving at 0.975 c relative to Earth passes the Earth on its way to a distant planet. The distance between Earth and the planet is 18.525 light years (ly) as measured by observer X on Earth.



(a) Calculate the duration of the journey from Earth to the planet according to observer X **1**

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(b) Calculate the duration of the journey according to the crew on the space ship. **1**

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(c) Identify two specific examples of non-inertial frames of reference. **1**

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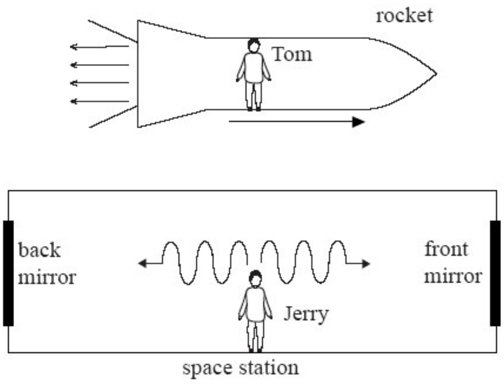
(d) Tom is an observer in the rocket that moves past a space station. Jerry is an observer in the middle of the space station. Jerry sends two light signals towards mirrors at the front and the back of the space station. The signals are emitted simultaneously according to both Tom and Jerry. The signals are reflected off the mirrors and reflected back to Jerry.



From Tom's frame of reference, determine whether the front or the back of the space station receives the signal first, or whether the signals arrive simultaneously (at the same time). Justify your answer. **2**

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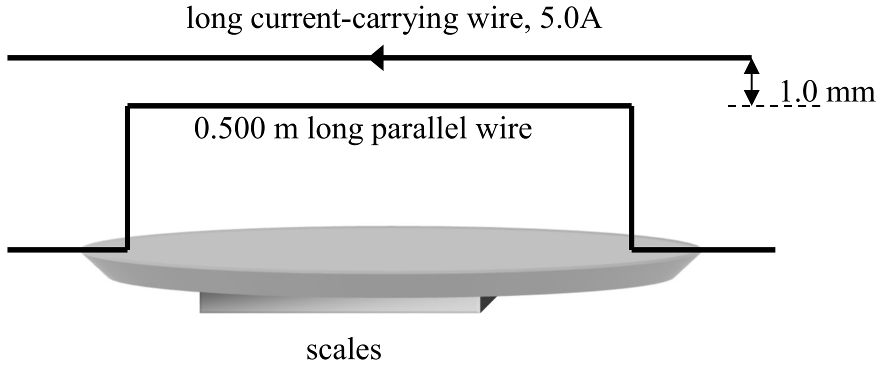
Question 25 (3 marks)

The following apparatus was constructed.



The conductors are parallel for 0.500 m, and are separated by 1.0 mm. A current of 5.0 A is flowing through the top conductor. When a current flows through the conductor, which is resting on the scales, the scales measurement *decreases* by 4.50×10^{-4} kg.

Calculate the magnitude and direction of the current flowing through the conductor resting on the scales. **3**

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Question 26 (4 marks)

The transformation of electrical energy into other forms of useful energy occurs in homes and in industry.

(a) Discuss the need for transformers in some domestic electrical appliances which are connected to the mains power supply. **2**

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(b) Identify *two* specific examples where electricity is converted into some other useful energy form either in homes or in industry. **2**

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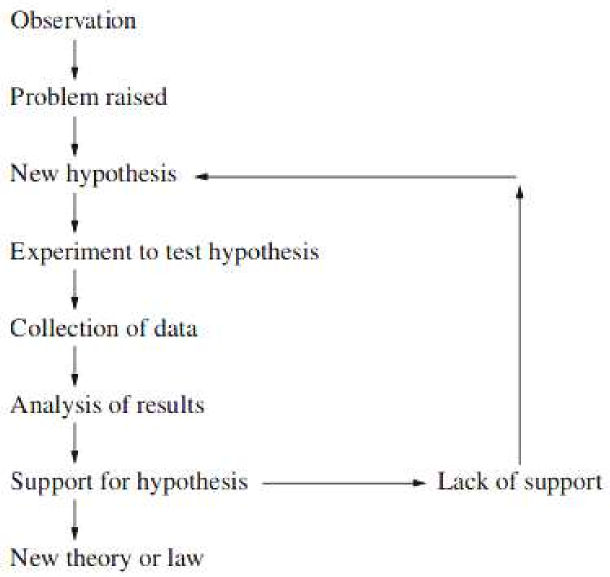
Question 27 (5 marks)

This flowchart represents one model of scientific method used to show the relationship between theory and the evidence supporting it. Analyse Einstein's Theory of Special Relativity and the evidence supporting it as an application of this model of scientific method. **5**



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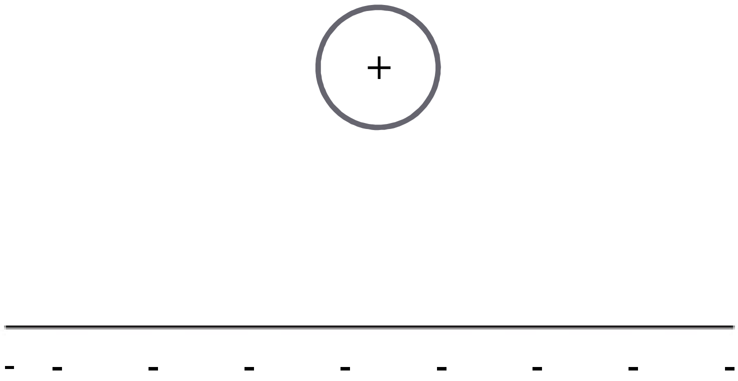
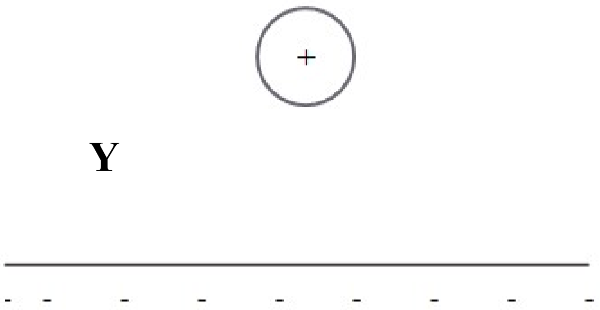
Question 28 (4 marks)

(a) A positively charged cylinder is fixed in position near a negatively charged plate as shown in the cross-section. Sketch the electric field lines between the cylinder and the plate on the cross-section diagram. **1**



(b) A particle of mass 10^{-28} kg and charge $+4 \times 10^{-12}$ C is released at point Y as shown on the diagram. The particle initially accelerates at 5.0×10^{22} m s^{-2}.



Calculate the electric field intensity at Y, given that the weight of the charge is negligible. **1**

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(d) An electric field of similar intensity to that above is used in an experiment by JJ Thompson. In combination with a magnetic field, he can determine the velocity of cathode rays.

(i) Sketch a labelled diagram of the fields as used in Thompson's experiment **1**

(ii) A value of 2.5×10^{6} ms^{-1} was determined for the speed of the cathode rays. What was the intensity of the magnetic field used? **1**

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Question 29 (4 marks)

A student claims that a DC motor is an 'electric generator in reverse'. Analyse this claim with reference to the structure and function of a simple DC motor and an electric generator. Include diagrams in your answer.

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Question 30 (2 marks)

A power drill works because of the motor effect. In using a drill, the motor can overheat if the trigger of the drill is not fully pressed and the drill rotates slowly.

Explain why the drill may overheat in this situation. **2**

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Question 31 (2 marks)

A transformer has 7200 loops in its primary coil and changes an input voltage of 1.2×10^4 V to 400 V. The output current is 60 A.

(a) Calculate the number of loops in the secondary coil. **1**

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(b) Assuming 100% efficiency of the transformer, calculate the input power to the primary coil. **1**

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Question 32 (4 marks)

Describe a first-hand investigation to demonstrate the effect on a generated electric current when the distance between a coil and magnet is varied.

In your description, include:

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

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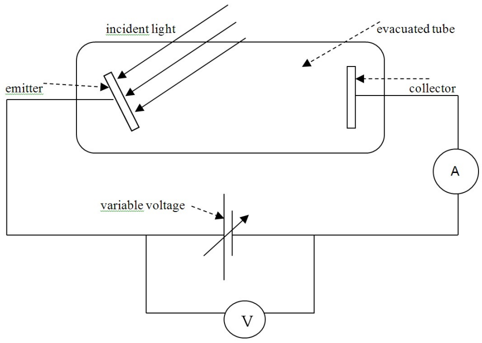
Question 33 (7 marks)

The diagram shows apparatus used to investigate the photoelectric effect.



In experiments using this apparatus to determine the work function of different materials, photoelectrons are stopped from reaching the collector.

(a) A photon of frequency 4.75 x 10^{14} Hz, emits electrons from the emitter which are just stopped from reaching the collector when the applied voltage is 1.85 V.

Calculate the work function of the emitter material. **2**

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(b) The explanation of the photoelectric effect by Einstein vindicated the approach taken by Planck to explain the energy released from hot bodies. Justify this statement. **5**

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Question 34 (6 marks)

Account for the observation that the electrical properties of p-type semiconductors are different from the electrical properties of pure silicon.

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Question 35 (4 marks)

Describe how Hertz produced radio waves and how he calculated their speed. Use diagrams to aid your explanation.

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Section 2

Question 35 – Medical Physics (25 marks)

(a) (i) Describe acoustic impedance and why it changes for different tissues in the body. **2**

(ii) The following table shows the density and the speed of sound in different parts of the body.

Calculate the ratio of the reflected to initial intensity for a boundary between blood and brain. State whether this would represent a high or low amount of reflection compared to typical ultrasound imaging. **2**

Body part	Density (kg/m^3) x 1000	Sound speed (m/s)
muscle	1.06	1570
fat	0.93	1480
blood	1.00	1560
liver	1.07	1549
brain	1.04	1521
kidney	1.04	1561

(b) X-rays are used in conventional x-ray units and in CT.

(i) Describe the type of wave used by these machines. **1**

(ii) Compare the image produced from an ultrasound of the stomach to the image produced from an x-ray of the stomach. **3**

(c) Explain how a CT image is produced and why this is a more expensive and potentially more dangerous procedure than conventional x-ray. **5**

(d) The PET technique is being increasingly used in medical imaging.

(i) Describe why the technique requires antimatter to work. **2**

(ii) Explain why researchers aim to further use this technique in the future. **2**

(e) Observe the following image.

(i) Identify whether this is image was obtained from an ultrasound, a bone scan or a CT scan. **1**

(ii) Explain whether there are any signs of disease on this hand. **2**

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, $\left(k \equiv \dfrac{\mu_0}{2\pi}\right)$	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

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

$$F = BIl\sin\theta$$

$$\tau = Fd$$

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

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

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

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

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

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

$$F = qvB\sin\theta$$

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

$$E = hf$$

$$c = f\lambda$$

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

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

$$Z = \rho v$$

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

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

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

PERIODIC TABLE OF THE ELEMENTS

KEY

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

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.39 Zinc	31 Ga 69.72 Gallium	32 Ge 72.61 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 [98.91] 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 Lanthanides	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 [210.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223.0] Francium	88 Ra [226.0] Radium	89–103 Actinides	104 Rf [261.1] Rutherfordium	105 Db [262.1] Dubnium	106 Sg [263.1] Seaborgium	107 Bh [264.1] Bohrium	108 Hs [265.1] Hassium	109 Mt [268] Meitnerium	110 Uun — Ununnilium	111 Uuu — Unununium	112 Uub — Ununbium	113	114 Uuq — Ununquadium	115	116 Uuh — Ununhexium	117	118 Uuo — Ununoctium

Lanthanides

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [146.9] 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

Actinides

89 Ac [227.0] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237.0] Neptunium	94 Pu [239.1] Plutonium	95 Am [241.1] Americium	96 Cm [244.1] Curium	97 Bk [249.1] Berkelium	98 Cf [252.1] Californium	99 Es [252.1] Einsteinium	100 Fm [257.1] Fermium	101 Md [258.1] Mendelevium	102 No [259.1] Nobelium	103 Lr [262.1] Lawrencium

Where the atomic weight is not known, the relative atomic mass of the most common radioactive isotope is shown in brackets.
The atomic weights of Np and Tc are given for the isotopes ^{237}Np and ^{99}Tc.