Ascham School

Trial Examination 2014

Physics

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

Section 1

PART A 20 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. (55 marks)

Write your Candidate number at the beginning of Part B

Section 2

Option: Medical physics (25 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 (75)

Part A

Total marks (20)

Attempt questions 1 to 20

Use the multiple choice answer sheet.

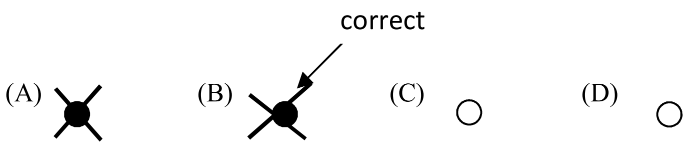
Select the alternative A, B, C or D that best answers the question. Fill in the response circle completely.

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. The information below shows the data collected by four students who were measuring the acceleration due to gravity using a pendulum

Alice's Data

Length Pendulum (m)	Period Pendulum (s)	Acceleration Due to Gravity (ms^{-2})
1.0	2.10	8.94
1.2	2.20	9.78
1.4	2.36	9.91
1.6	2.60	9.33
1.8	2.80	9.05
2.0	3.00	8.76
	AVERAGE	9.30

Sophie's Data

Length Pendulum (m)	Period Pendulum (s)	Acceleration Due to Gravity (ms^{-2})
1.0	1.90	10.92
1.2	2.25	9.35
1.4	2.34	10.08
1.6	2.50	10.10
1.8	2.90	8.44
2.0	3.10	8.21
	AVERAGE	9.52

Antonia's Data

Length Pendulum (m)	Period Pendulum (s)	Acceleration Due to Gravity (ms^{-2})
1.0	2.00	9.86
1.2	2.20	9.78
1.4	2.37	9.83
1.6	2.54	9.78
1.8	2.69	9.81
2.0	2.85	9.71
	AVERAGE	9.79

Susannah's Data

Length Pendulum (m)	Period Pendulum (s)	Acceleration Due to Gravity (ms^{-2})
1.0	1.91	9.07
1.2	2.22	8.81
1.4	2.31	8.90
1.6	2.58	9.07
1.8	2.65	8.96
2.00	2.97	8.96
	AVERAGE	8.96

Which student collected the most reliable data?

(A) Alice
(B) Sophie
(C) Antonia
(D) Susannah

2. A space probe executes a slingshot manoeuvre around Venus in order to decrease the time to take to reach its destination of Neptune.

Which statement below is correct, regarding the motion of the probe?

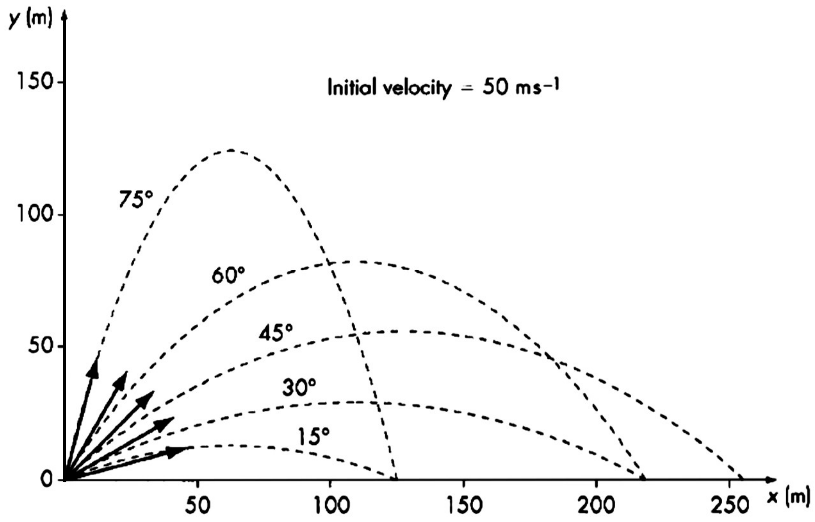
(A) Its speed relative to the Sun and Venus both increase
(B) Its speed relative to the Sun and the Venus both stay the same, but increases relative to Neptune
(C) Its speed relative to Venus stays constant but increases relative to the Sun
(D) Its speed relative to both planets decreases but increases relative to the Sun.\

3. A modern high power laser can produce short light pulses containing 0.2 Joules of light energy. Given that the operating wavelength of the laser is 370 nm, how many quanta of light would a single pulse from the laser contain?

(A) 8.3×10^{38}
(B) 3.7×10^{17}
(C) 3.7×10^{14}
(D) 8.3×10^{35}

The description below refers to questions 4 and 5

In an experiment designed to examine projectile motion, a small steel ball is fired with an initial velocity of 50 ms^{-1} at a variety of angles of projection. This is illustrated in the diagram below.



4. The angles of projection which give the greatest final horizontal velocity and the greatest initial vertical velocity are, respectively

(A) 15^0 and 75^0
(B) 45^0 and 75^0
(C) 75^0 and 45^0
(D) 45^0 and 45^0

5. With respect to any projectile which choices in the table below are all correct?

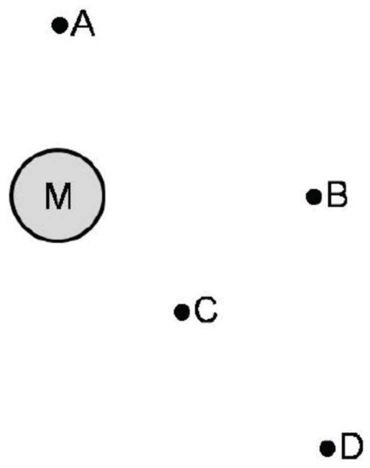
	Acceleration at top of path	Velocity at top of path	Net Force at top of path
(A)	down	zero	zero
(B)	zero	right	right
(C)	down	right	down
(D)	down	right	zero

6. The mass of Mars is about 0.1 times that of the Earth and its radius is about half that of the Earth. The magnitude of the gravitational potential energy of an object at the surface of the Earth is 32 J.

What is the approximate gravitational potential energy of the object on the surface of Mars?

(A) 6.4 J
(B) -12.8 J
(C) 12.8 J
(D) -6.4 J

7. The diagram below shows four points, labelled ‘A’ to ‘D’, in free space around a large mass M.



Between which two points would no work be done in moving a mass between those points?

(A) from A to B
(B) from C to A
(C) from D to C
(D) from B to D

8. The time *T* of oscillation of a mass *m* suspended from a vertical spring is given by the expression

$$T = 2\pi\sqrt{\frac{m}{k}}$$

where k is a constant.

Which of the following graphs would allow the value of the constant k to be determined using the gradient of a line?

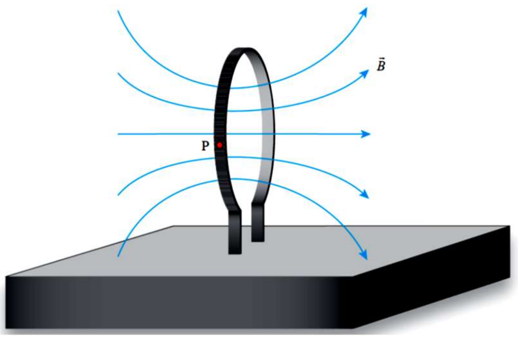
(A) T^2 against $\sqrt{m}$
(B) T against m
(C) T^2 against m
(D) $\sqrt{T}$ against m

9. A rocket of mass M is ascending vertically from a launch pad on Earth. The rocket’s engine exerts a downwards force T on the exhaust gases.

What is the magnitude of the net force acting on the rocket?

(A) T + M
(B) T – Mg
(C) Mg –T
(D) T + Mg

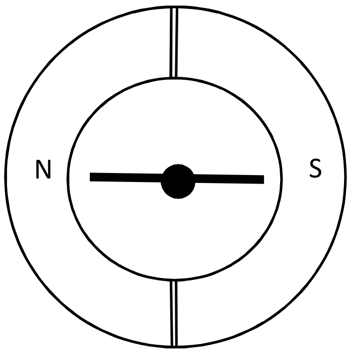
10. A loop of wire is arranged so that the plane of the loop is perpendicular to the surface of the desk. The magnetic field B created by a current in the loop is as shown



The direction of the electron flow at point P is

(A) Left
(B) Up
(C) Down
(D) Right

11. Consider a coil of wire rotating clockwise in a circular radial field as shown below.



Which statement below is correct, regarding the emf generated in the coil when it is moving through the position indicated?

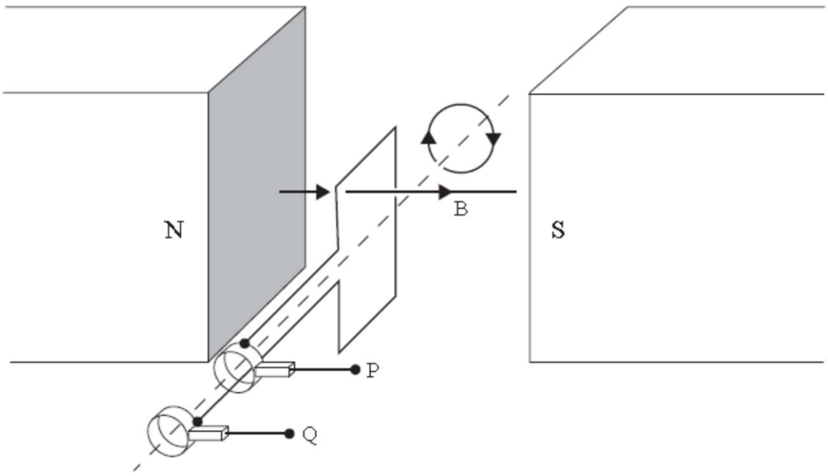
(A) Emf will be maximum because flux is being cut at a maximum rate
(B) Emf will be zero because zero flux is being cut
(C) Emf will be the same as at any other position because the rate at which flux is cut is constant
(D) Emf will be minimum because flux is being cut at a minimum rate

12. The motor / generators in modern electric cars have a dual role. They use electrical energy to power the car and use the kinetic energy of the car to generate electricity when the car decelerates.

Which of the following features enable the motor / generator to carry out both roles?

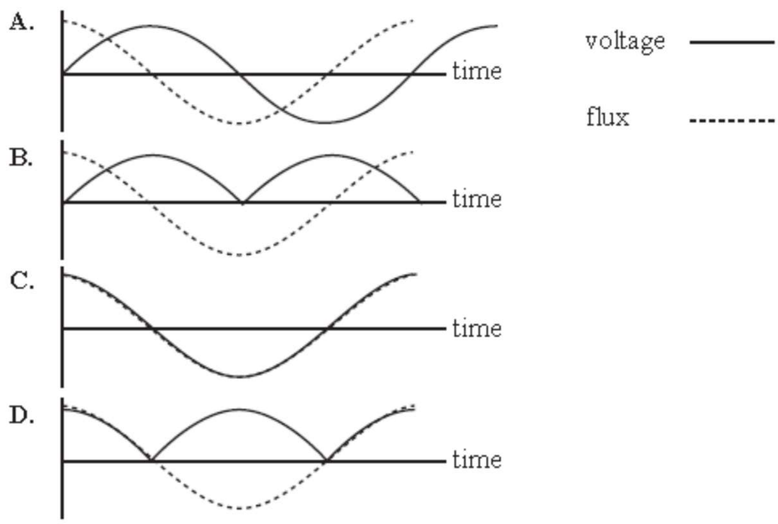
(A) Induction motors have no commutator.
(B) Potential energy can always be converted into kinetic energy
(C) The structure of a generator is identical to a DC motor
(D) When electricity is being generated the induced emf can exert a braking force on the car.

13. Some physics students were investigating a generator.



They tested the device by firstly connecting an oscilloscope between the terminals P and Q, and then rotating the coil at a constant rate, in the uniform field B, in the direction shown.

The diagram below shows graphs of the magnetic flux through the coil and of the voltage measured between the terminals.



Which one of the graphs best represents the voltage observed on the oscilloscope?

14. In an experiment a magnet was dropped vertically through an aluminium tube. The magnet fell more slowly than when it was falling outside the tube.

Which statement best accounts for this observation?

(A) Magnetic fields are induced in the aluminium tube which, according to Lenz's Law, oppose the motion of the magnet through the tube.

(B) An eddy current below the magnet is induced which, according to Lenz's Law, opposes the motion of the magnet through the tube.

(C) Eddy currents are induced above and below the magnet which, according to Lenz's Law, oppose the motion of the magnet through the tube.

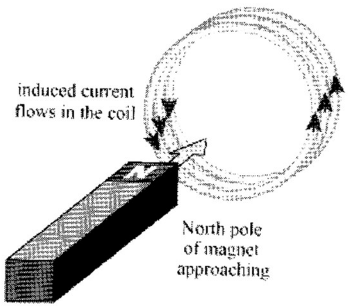
(D) Eddy currents are induced above and below the magnet which produce magnetic fields which, according to Lenz's Law, oppose the motion of the magnet through the tube.

15. When a motor is operating, the emf causing the coil to rotate reduces as the rotational speed increases. When a generator is operating, the rotor becomes increasingly more difficult to turn as trhe rotational speed increases.

Ignoring frictional effects, which selection below correctly identifies the principle of physics responsible for these observations?

	Generator	Motor
(A)	Induction of a back emf	Law of conservation of energy
(B)	Law of conservation of energy	The motor effect
(C)	Law of conservation of energy	Induction of a back emf
(D)	Induction of a back emf	Induction of a back emf

16. Students set up an investigation to explore how the relative motion between a magnet and a coil affects the size of the induced current in the coil.



Which of the following correctly describes the variables in this investigation?

	Control	Dependent	Independent
(A)	Number of turns in coil	Size of induced current	Relative motion
(B)	Relative motion	Size of induced current	Size of magnetic field
(C)	Size of magnetic field	Relative motion	Size of induced current
(D)	Size of induced current	Size of magnetic field	Relative motion

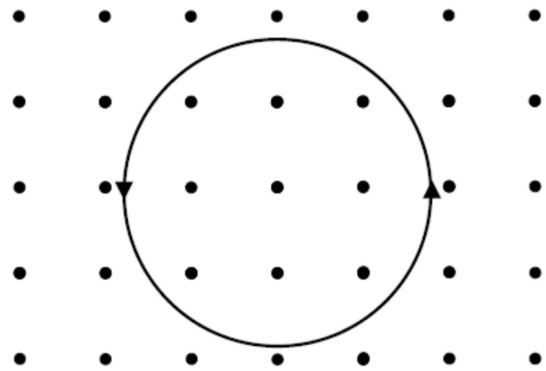
17. A rocket flies at 0.8 c parallel to a field of length 1500 m as measured by a stationary observer on the field. How long does the pilot of the rocket measure to pass from one end of the field to the other?

(A) 4.40 μs
(B) 6.35 μs
(C) 2.80 μs
(D) 3.75 μs

18. When Hertz determined the velocity of radio waves he used the interference of these waves to produce points where the intensity equalled zero. Given that he measured the distance between two of these points to be 15 m, which choice below could not be possible values for the wavelength and the frequency of the radio waves, respectively?

(A) 30 m and 10 MHz
(B) 10 m and 30 MHz
(C) 60 m and 5 MHz
(D) 15 m and 20 MHz

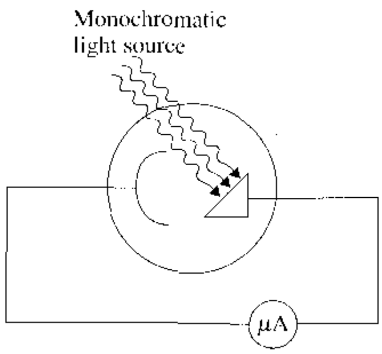
19. An charged particle travels in a circular path in a magnetic field as shown below



Using this data which choice in the table below correctly describes the type of particle and the strength of the magnetic field?

	Type of Particle	Strength of magnetic Field (T)
(A)	electron	2,000
(B)	proton	1,000
(C)	electron	1.14×10^{-3}
(D)	proton	1.14×10^{-3}

20. A beam of monochromatic light is shone onto a device to study the photoelectric effect. In the first part of this experiment, while the light source is on, the microammeter records a steady current.



While keeping all other factors constant, the light source was altered by

- Increasing the intensity of the original monochromatic light source:
- Increasing the wavelength of the monochromatic light source;
- Increasing the frequency of the monochromatic light source.

How many of the factors changed would have resulted in the microammeter showing a greater current than in the original part of the experiment?

(A) All of them
(B) Only one
(C) Two of them
(D) None of them

Part B – 55 marks

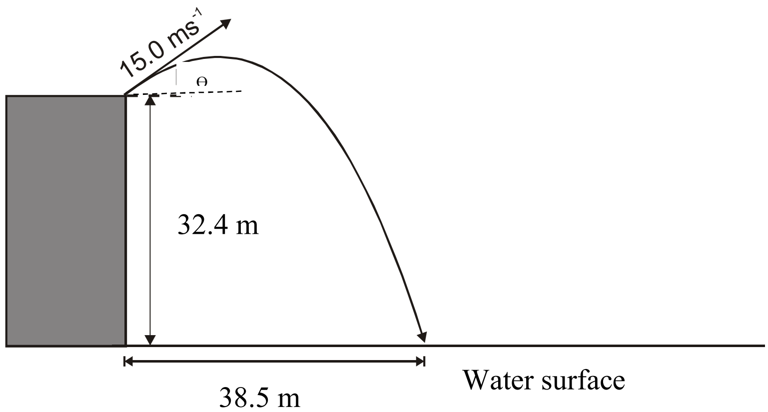
Attempt questions 21 – 30. Allow about 1 hour 40 minutes to answer this part

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Question 21 (2 marks)

Consider the following diagram.



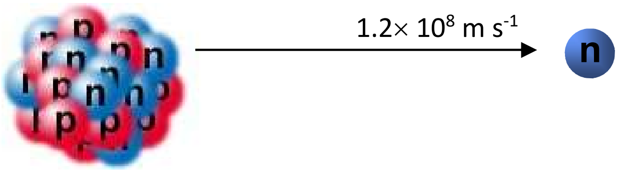
A stone is projected from a cliff at 15.0 ms^{-1} at an angle θ above the horizontal as shown in the diagram. The cliff was 32.4 m high and the stone was seen to land 38.5 m from the base of the cliff. The time of flight was 4.0 seconds.

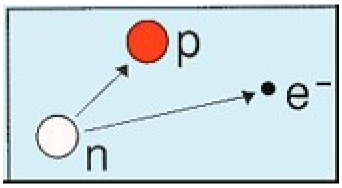
(a) At what angle, θ above the horizontal was the stone projected? (1)

(b) Calculate the magnitude of the velocity of the stone at its maximum height. (1)

Question 22 (4 marks)

Neutrons are ejected from some unstable atomic nuclei at a speed 1.2×10^{8} m s^{-1}.





At rest, isolated neutrons decay to a proton plus an electron, with a half-life of 6.20 seconds. The rest mass of a neutron is 1.675×10^{-27} kg.

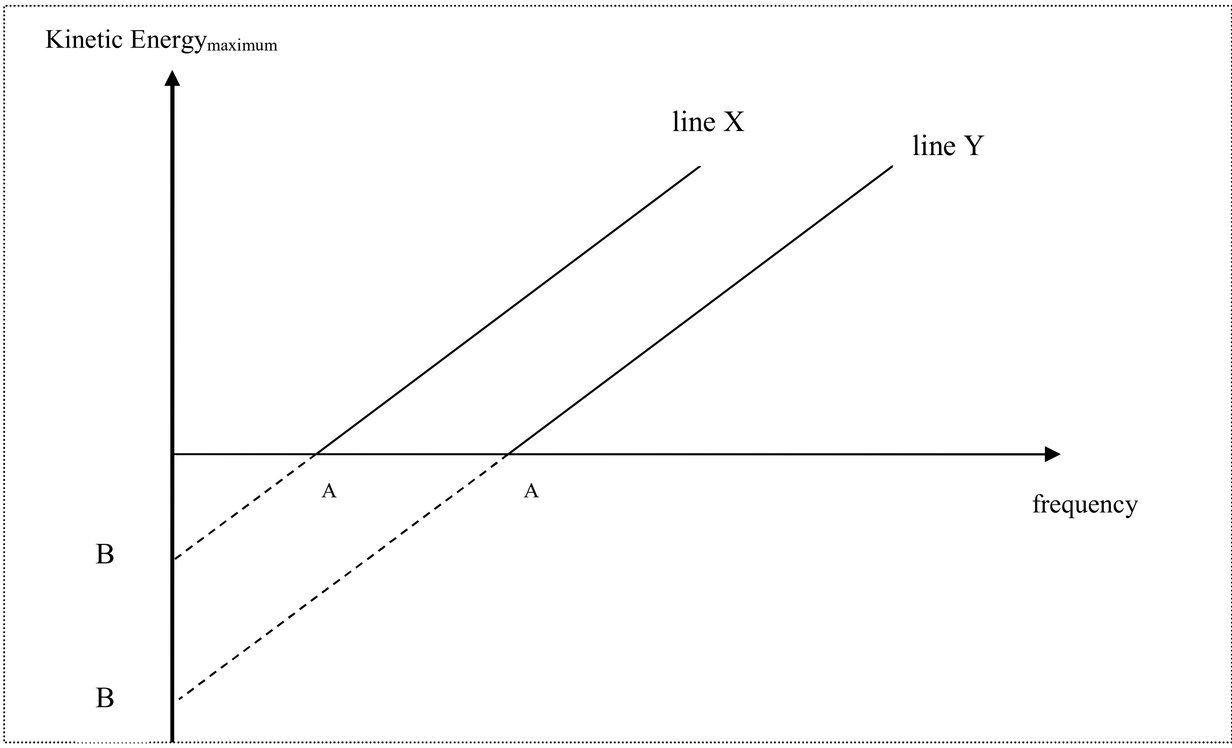
(a) Calculate the relativistic mass of a neutron with a velocity of 1.0×10^{8} m s^{-1}. (1)

(b) Show by calculation whether the average lifetime of the neutrons ejected from the unstable nucleus is greater or less than 6.20 seconds as measured by a stationary observer and comment on the result. (2)

(c) Determine the ratio of the distances travelled by the neutron, before it decays, as measured by the stationary observer and the neutron itself. (1)

Question 23 (4 marks)

Einstein proposed an explanation for the photoelectric effect by applying Planck's Quantum Theory. His explanation resulted in an expression which when plotted yielded the graph below.



(a) Identify what the quantity labelled A represents. (1)

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(b) Describe, with the aid of a labelled diagram, how the variable indicated on the y-axis is measured. (3)

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Question 24 (7 marks)

The "transformer principle" is an example of electromagnetic induction.

(a) Explain how electromagnetic induction is used to change the voltage of electric current between the primary and secondary coils of a transformer. (2)

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(b) Outline ONE design strategy that is used in real-world transformers in the national electricity grid to achieve high energy efficiencies and explain why this strategy is effective. (2)

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(c) Describe a significant socioeconomic effect in Australia brought about by the use of transformers in the national electricity grid. (2)

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(d) A transformer with 2000 turns on the primary coil is used to convert 240 V AC to 12 V AC. Determine the number of windings on the secondary coil. (1)

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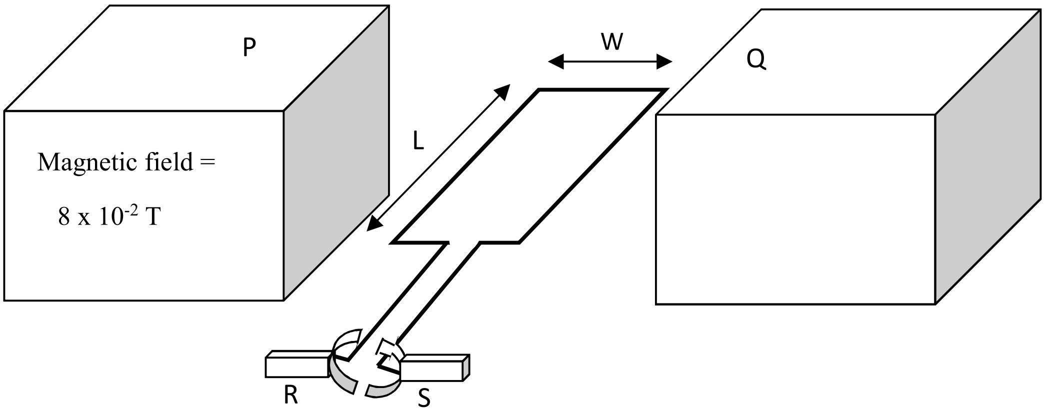
Question 25 (6 marks)

The diagram shows the arrangement of a DC motor. Magnets P and Q supply a magnetic field.



(a) If the coil, of 400 turns, is to rotate in an anti-clockwise direction, what are the polarities of the magnets P, Q and the brushes, R, S? (1)

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(b) The coil has a length L of 40 mm and a width W of 25 mm. After rotating 30^0 from the position of maximum flux what is the torque this motor produces if it draws a current of 500 mA? (1)

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(c) Draw a labelled diagram of an AC generator and compare its function to that of a DC motor. (4)

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Question 26 (6 marks)

Information about the Saturn V Rocket used in the Apollo Moon Missions is shown in the table below.

Saturn V Rocket Data

Total mass at lift off	2 217 185 kg
Duration of first-stage burn	2.5 minutes
Mass of propellant used in first-stage burn	2 000 000 kg
Height reached after first-stage burn	61 km
Speed at completion of first-stage burn	2.38 kms^{-1}
Thrust produced by first-stage burn	3 800 000 newtons

With reference to the data in the table, account for the change in acceleration and momentum of the rocket and the g-forces experienced by the Apollo astronauts up to the start of the second-stage engine burn, qualitatively and quantitatively (6)

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Question 27 (6 marks)

A rocket launches a satellite into orbit 350 km above Earth's surface. The radius of the Earth is 6378 km

(a) The weight of the satellite at launch on the Earth's surface is 19.6 kN.

What is the weight of the satellite while it is in orbit? (2)

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(b) The apparent weight of the satellite in its orbit is not equal to the weight of the satellite you determined in part (a). What is the apparent weight of the satellite and explain this value? (2)

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(c) Compare the orbital period of a second rocket which is placed in an orbit of triple the altitude of the first rocket. (2)

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Question 28 (8 marks)

(a) Einstein's explanation of the photoelectric effect justified Planck's assertion that energy is quantised. Evaluate this statement. (6)

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(b) A photon of light of wavelength 450nm hits a clean metal surface inside a vacuum tube and causes a photoelectron of energy 2.0 eV to be released from near the surface of the metal

Calculate the energy of the released photoelectron in joules. (2)

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Question 29 (5 marks)

The Law of Universal Gravitation predicts that there is a force of gravitational attraction between any two objects with mass m_1 and m_2. This can be formulated by the expression

$$F = \frac{Gm_1m_2}{d^2}$$

Where the symbols have their usual meanings.

In an experimental test of this idea, using two small metal spheres, the following data was collected:

Trial	**m_1** (kg)	**m_2** (kg)	**Separation d** (cm)	**Force F** (arbitary units)
1	1.0	2.0	6.0	20.1
2	1.0	4.0	6.0	39
3	1.0	6.0	6.0	60
4	1.0	8.0	6.0	82
5	1.0	10.0	6.0	105
6	1.0	12.0	6.0	122
7	1.0	12.0	8.0	67
8	1.0	12.0	10	42
9	1.0	12.0	12	31
10	1.0	12.0	14	21
11	1.0	12.0	16	16

(a) If a student investigated the dependence of force on mass, which trials would she select? (1)

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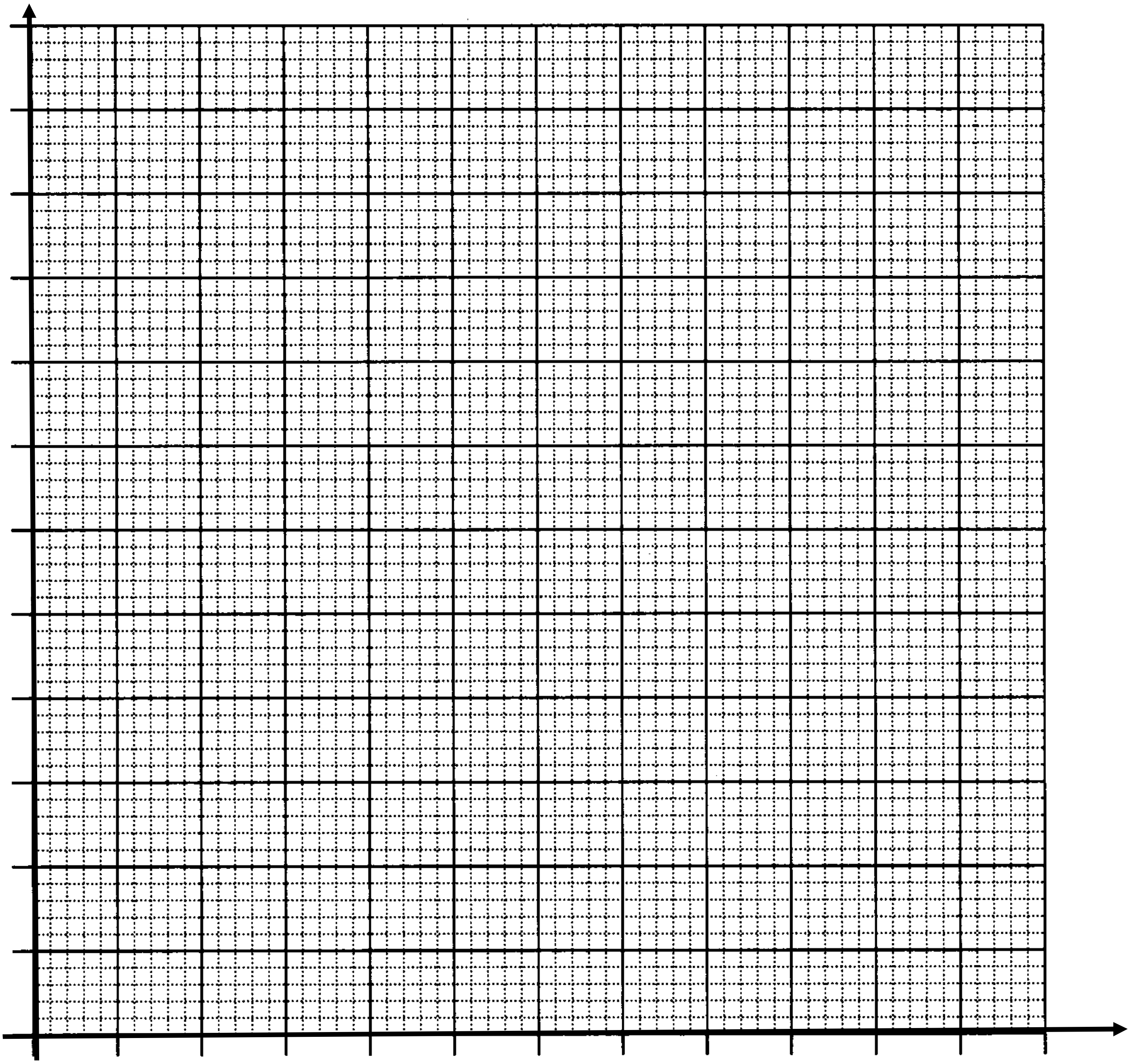
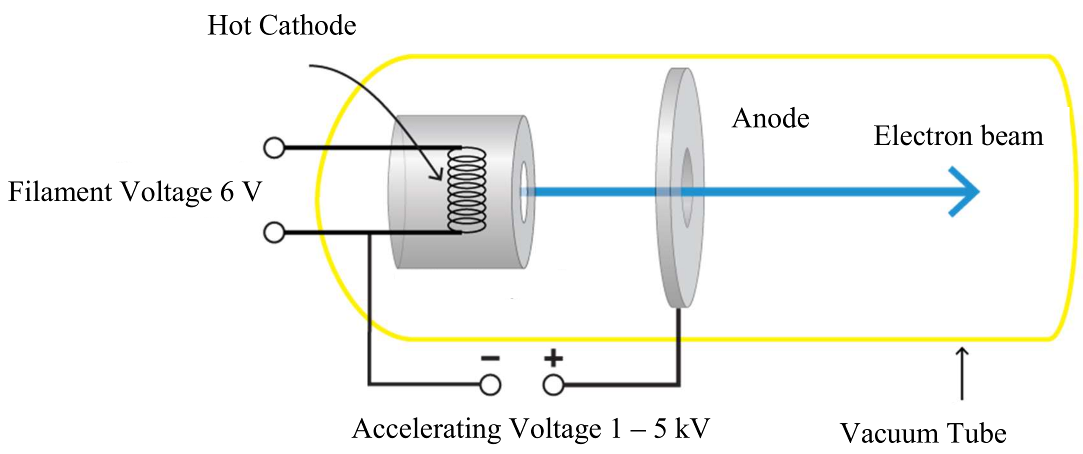
(b) Construct an appropriate graph on the following page to investigate whether this data supports the theory regarding the dependence of force on separation. (4)

Comment on why your graph supports the theory.



Question 30 (7 marks)

The diagram below shows part of the apparatus used by J.J.Thomson to identify and measure the properties of cathode rays, the electron gun.



(a) Describe how the structure of the electron gun helps to provide a collimated, accelerated beam of electrons (3)

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(b) Account with the use of labelled diagrams and relevant equations for the use of crossed electric and magnetic fields in Thomson's experiments. (4)

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Section 2 - Medical Physics

Answer all parts of this question in a writing booklet.

(a) (i) Discuss how radiation is used to produce a bone scan (3)

(ii) Describe how a bone scan is able to provide information that an x-ray cannot provide (2)

(b) The following table presents acoustic data for various body tissues.

Tissue	**Density ($kg\ m^{-3} \times 10^3$)**	**Velocity of ultrasound waves ($m\ s^{-1} \times 10^3$)**
Blood	1.12	1.57
Fat	0.95	1.45
Typical muscle	1.12	1.59
Average bone	1.63	4.1
Dense tumour	1.26	1.63
Brain	1.03	1.54

(i) Calculate the ratio of reflected to incident ultrasound energy intensity at a boundary between a dense tumour and muscle tissue. (1)

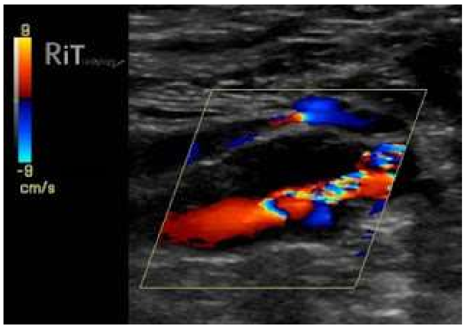
(ii) In an ultrasound sector scan of a foetus, bone shows up as bright, white areas in the image.

Use the data in the table to account for this.

(c) The following image is a Doppler ultrasound scan of a partly blocked artery.

The patches mark areas where blood is flowing towards (red colour) and away (blue colour) from the piezoelectric transducer.

Describe the scientific principles behind how this Doppler scan image is obtained. (3)



(d) Describe the advantages of using light rays to form medical images over using x-rays. (3)

(e) Critically analyse the use of a CAT scan for imaging a broken leg. (3)

(f) One of the best diagnostic tools available for medical imaging is Magnetic Resonance Imaging, MRI.

(i) In relation to MRI define the terms (2)

(1) Larmor frequency

(2) resonance

(ii) The computer used is able to distinguish between radio signals that come from different parts of the brain when an MRI image of the head is taken.

Explain how this resolution and location is achieved. (6)

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}
Radius of Earth	6.378×10^{6} m

FORMULAE SHEET

$$v = f\lambda$$

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

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

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

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

$$P = VI$$

$$\text{Energy} = VIt$$

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

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

$$\Sigma F = ma$$

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

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

$$W = Fs$$

$$p = mv$$

$$\text{Impulse} = Ft$$

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

$$F = mg$$

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

$$v = u + at$$

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

$$\Delta x = u_x t$$

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

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

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

$$E = mc^2$$

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

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

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

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	
	Gold	Name of element

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.

2014 Trial Part A

1 C – smallest range

2 C – closest to accepted value

3 B $\frac{nh}{\lambda} = 0.2$

4 B

5 C It accelerates ↓ at all pts. At top has horizontal velocity only →.

6 D Tricky

7 B C & A are equidistant from Earth centre
∴ $Ep_C = Ep_A$ ∴ no work done

8 C

9 B

10 C It's electrons!

11 C ...except at field gaps

12 C

13 A An A at last

14 D

15 C

16 A

17 D

18 B

19 C

20. B

Trial 2014

(21) (a) 50°

(b) $15 \cos 50° = 9.6 ms^{-1}$

(22) (a) Use $m = \frac{m_0}{\sqrt{\ }}$ $m = 1.78 \times 10^{-27} kg$

(b) Question was interpreted in several ways – all OK if justified in some way!

– if measured by a stationary observer (this would mean an observer at rest relative to the ejected neutrons ... so imagine the neutron as a spaceship & the observer as a crew member on the spaceship ....)

$t = 6.2 s$ is the time measured by an observer in the lab

– relate this to the time taken for an Earth-bound observer to measure the length of time for a spaceship journey to a distant planet – they at will measure a longer time period than the astronaut ...)

So $t = 62$ refer to time "t" in the expression

$$t = \frac{t_0}{\sqrt{\ }}$$

ie $t > t_0$

as an answer $t = 6.2$

measured by stationary observer in neutron → $t_0 = 5.8 s$

(c) Again interpreted differently!!

either 1:1

or 29:31

Q23 (a) — Threshold frequency → more isn't enough!!

— describe it!

— lowest frequency photon of light, carrying energy hf, which will cause emission of an electron from that specific metal surface.

(b) — Reverse voltage (ie "—" supply nearest to surface "collecting" electrons $V_{stopping}$.

— Inc Ⓥ stopping until $I = 0$

— The energy from this field voltage V is equal to qV

... this energy, ~~change~~ EPE is equal to change in $KE_{electron}$

ie $$\boxed{qV_{stopping} = \frac{1}{2}mv^2}$$

~~24~~ (c) See similar q from this year

(d) Way too much over thinking here!!

Q just asked for a conversion of energy to J!!

$$2.0\,eV \equiv 2\,(1.602 \times 10^{-19}\ J/eV)$$

$$= \underline{3.204 \times 10^{-19}\ J}.$$

24) Use terms Changing emf in Primary

↓

Produces change $\vec{B}$ and flux in Primary

↓

linked magnetically to Secondary Coil

↓

emf induced in Secondary coil.

(b) Soft iron core
Laminated Core
Coils literally wrapped "on top" of one other.

(c) Lots of answers possible!.

(d) 100 turns

25) (a) If P = N then R is true

(b) 1.39×10^{-3} Nm

(c) Theory stuff

26 Lots of ways to answer — show me your answer ☺

27. (a) 17.7 kN.

(b) Zero → Weight is the only force acting and there is no reaction force acting on it... we always sense or experience weight of object as the reaction force from the contact surface.

(c) You need to be careful!!!! Altitude ×3 not radius of orbit ×3!!

$r_1 \approx 6400 + 350 = 6750$

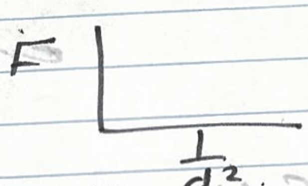
$r_2 = 6400 + 1050 = 7450$

$\therefore \frac{T_1^2}{T_2^2} = \left(\frac{6750}{7450}\right)^3$

$= \ldots$

28 (a) 1-6.

(b) graph needs to be

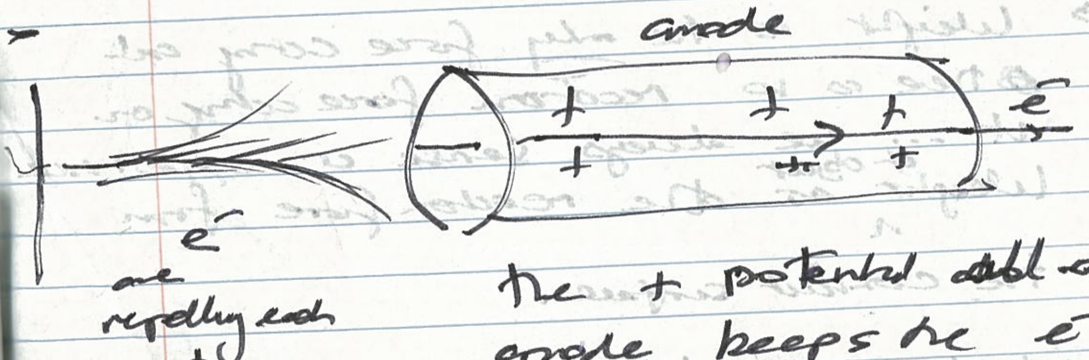


note!!

29. Gun → - anode a short distance from the cathode (which produces the electrons)

- high p.d b/w them which accelerates the e^-.

- Anode has a slit and/or a narrow cylindrical shape which is at a +ve potential



the + potential all around the anode keeps the e^- in a collimated, narrow, beam ....
(they can't to "spray" out.