Caringbah High School	
Physics: HSC Course	
Trial Exam 2020	

Write all your answers in this answer booklet.

Use pen for written responses and pencil for diagrams and graphs.

Total Marks: 100

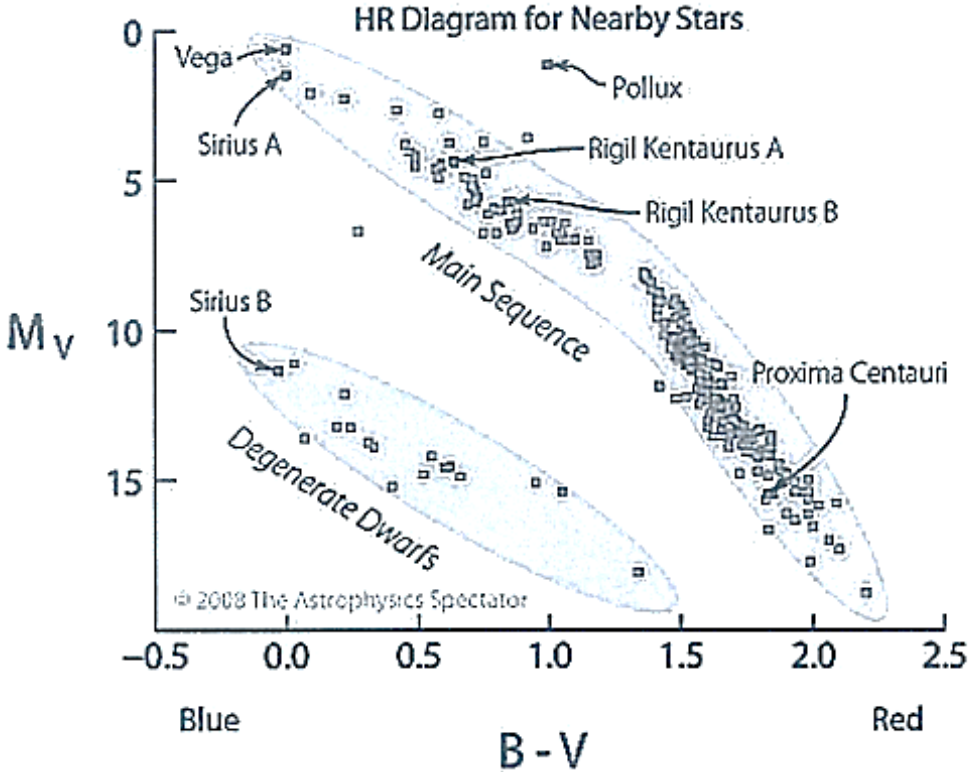*Exam Length: 3 hours + 5 minutes reading time*

PART A: Multiple Choice Questions (20 marks)

PART B: Longer Response Questions (80 marks)

Exam Prepared by: C. Cantor

OUTCOME	*MARK*
Knowledge and Understanding	*/68*
Working Scientifically Skills *Q 9, 10, 16, 21, 22,27, 29, 36, 37, 38*	*/32*

PART A: Circle the letter of the BEST answer on the grid (20 marks)

| 1.	How would an increase in the value of "g", the acceleration due to gravity, affect the flight of a projectile launched with the same initial conditions? A. decreased range; decreased maximum height B. decreased range, same maximum height C. same range, decreased maximum height D. same range, same maximum height	
2.	The diagram below is a Hertzsprung-Russell diagram for the nearby stars. The stars Vega and Proxima Centauri differ greatly in magnitude and colour and are consequently at opposite ends of the main sequence. How do astronomers explain this difference? A. The stars are fusing different elements for energy. B. The stars are located in different areas of the galaxy. C. Vega moved up the main sequence at a faster rate than Proxima Centauri. D. The original mass of Vega when formed was greater than the original mass of Proxima Centauri	
3.	According to Max Planck's black body experiments, which characteristic of an object determined the wavelength of the peak radiation emitted by a hot object. A. The type of material the object is made of. B. The temperature of the object. C. The type of material and the temperature. D. The temperature of the object and its shape.	

4. An electrical generator is shown in the diagram below. The generator is turning clockwise.
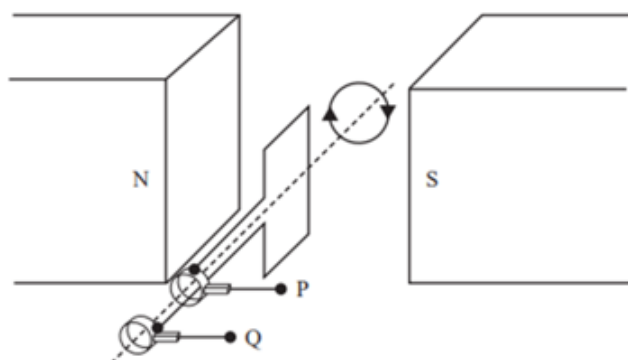
The voltage between P and Q and the magnetic flux through the loop are both graphed as a function of time, with voltage versus time shown as a solid line and magnetic flux versus time shown as a dashed line.

Which of the following graphs best shows the relationships for this electrical generator?

Key
— voltage
---- magnetic flux
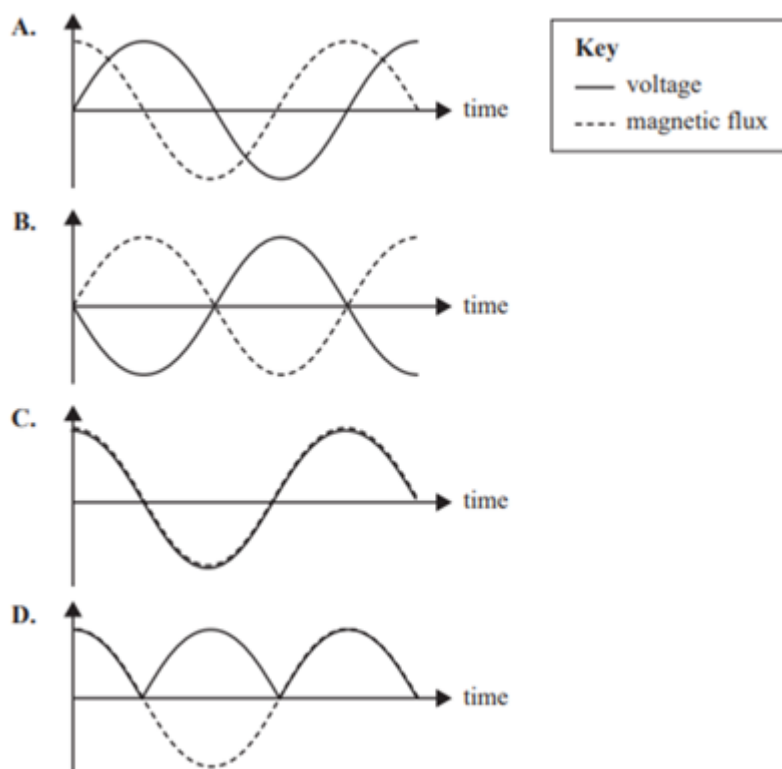
5. Which of the following could represent the kinetic energy, the gravitational potential energy and the total energy for an orbiting satellite in a stable circular orbit?

	KINETIC ENERGY	GRAVITATIONAL POTENTIAL ENERGY	TOTAL ENERGY
A.	40 000 J	–80 000 J	–40 000 J
B.	40 000 J	40 000 J	80 000 J
C.	80 000 J	40 000 J	120 000 J
D.	80 000 J	–40 000 J	40 000 J

6. An absorption spectrum from a star is shown.

Wavelength (nm)
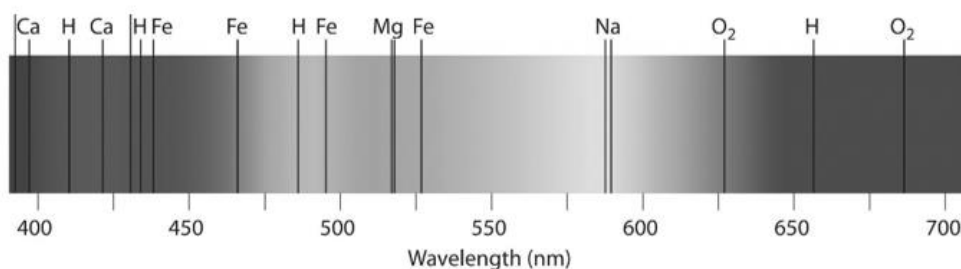
The dark lines in the spectrum indicate that:

A. the star is moving away from us.
B. atoms in the star's atmosphere are absorbing light and not re-emitting it.
C. several elements are present in the star's atmosphere.
D. only some atoms in the star's atmosphere are contributing to the spectrum.

7. An ideal transformer with 120 V_{ac} on the primary coil supplies power to the resistor R. If this resistor dissipates 35 W of power, what is the current in the primary and secondary coil?
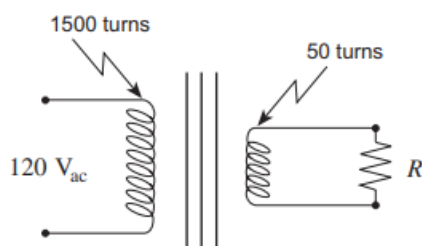
	CURRENT IN PRIMARY	CURRENT IN SECONDARY
A.	0.29 A	0.29 A
B.	0.29 A	8.8 A
C.	8.8 A	0.29 A
D.	8.8 A	8.8 A

8. Which planet would have the lowest escape velocity?

	Planet name	Planet mass (kg)	Planet radius (km)
A.	Newton	5 x 10^{24}	8000
B.	Einstein	8 x 10^{24}	7800
C.	Bohr	5 x 10^{24}	9500
D.	Hawkins	8 x 10^{24}	10200

9.	**_Use the following information to answer Questions 9 and 10._**

As part of an experimental investigation, Physics students use a pendulum, as shown below, to indirectly measure the magnitude of Earth's gravitational field at their location.
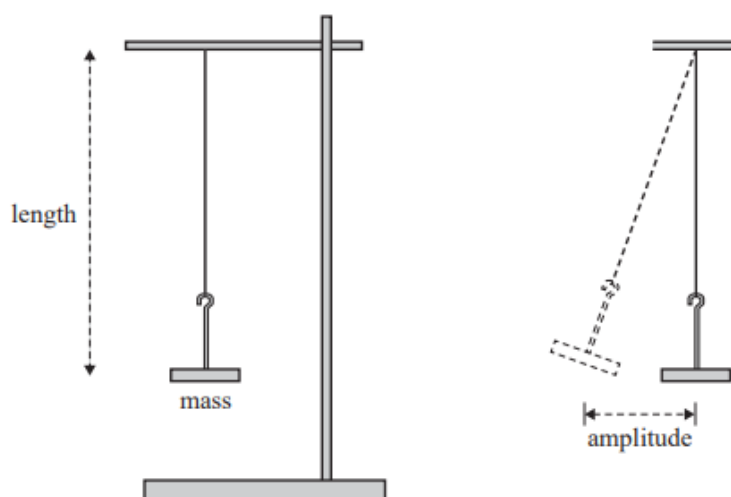
The students use a constant mass and a constant amplitude of swing, changing only the length of the pendulum and then measuring the time for five oscillations. They obtain four different time readings for four different lengths of the pendulum.

$$T = 2\pi\sqrt{\frac{l}{g}}$$

By using the relationship $T = 2\pi\sqrt{\frac{l}{g}}$ where T is the period and l is the length of the pendulum, the students obtain four values for the magnitude of the Earth's gravitational field.

Which of the following best identifies the independent, dependent and controlled variables in the students' investigation.

	Independent	**Dependent**	**Controlled**
A.	length	time	mass, amplitude
B.	time	length	mass, amplitude
C.	mass	time	length, amplitude
D.	amplitude	length	time, mass

10.	Which of the following best explains why the students measured the time for five oscillations rather than the time for one oscillation.

A. One oscillation is too quick to see.
B. Five oscillations reduce the effect of air resistance.
C. Five oscillations reduce the uncertainty of the measured period.
D. Five oscillations reduce the uncertainty of the measured length.

11.	Joanna is an observer in Spaceship A, watching Spaceship B fly past at a relative speed of 0.943c She measures the length of Spaceship B from her frame of reference to be 150 m.

Spaceship A
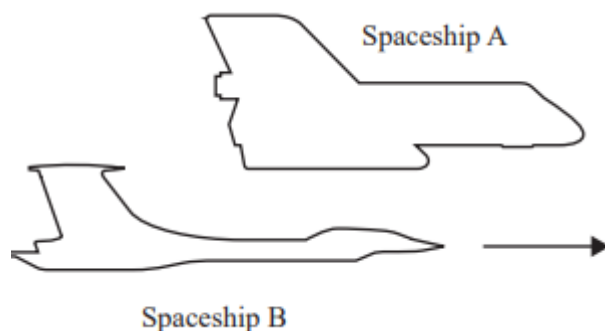
Spaceship B

Which one of the following is closest to the proper length of Spaceship B?
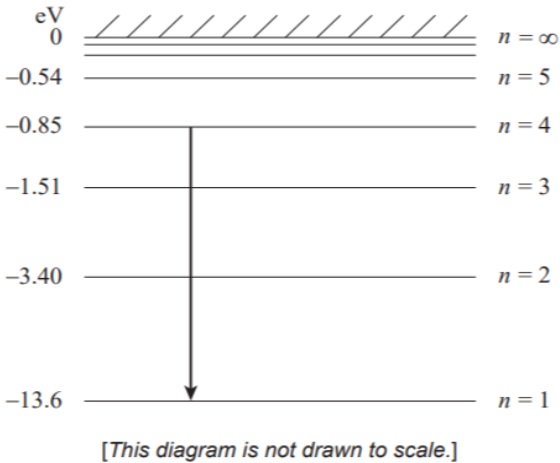
A. 50 m
B. 150m
C. 450m
D. 900 m

12.	The graph shows information about the emission of photoelectrons from a metal
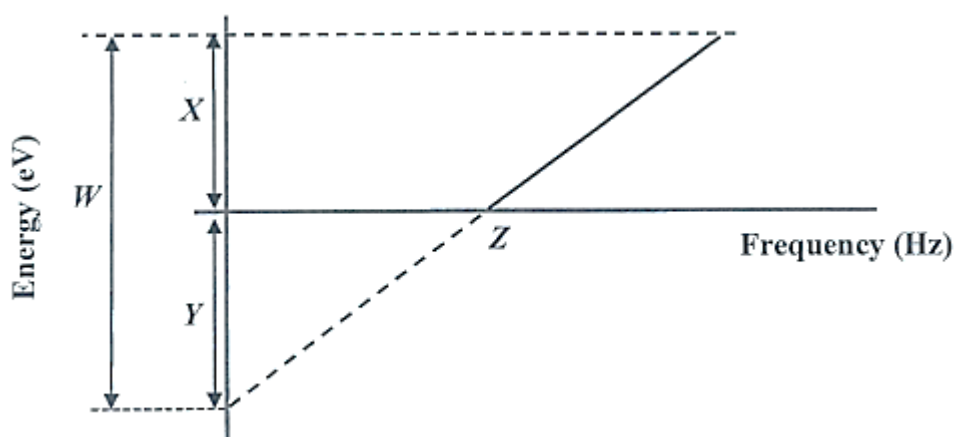
Which choice correctly identifies the sections labelled W, X, Y and Z?

	W	X	Y	Z
A.	Energy of incident photon	Work function of emitter	Kinetic energy of emitted photoelectron	Threshold frequency
B.	Kinetic energy of emitted photoelectron	Energy of incident photon	Threshold frequency	Work function of emitter
C.	Threshold energy	Kinetic energy of emitted photoelectron	Energy of incident photon	Work function of emitter
D.	Energy of incident photon	Kinetic energy of emitted photoelectron	Work function of emitter	Threshold frequency

| 13. | The magnitude of the acceleration due to gravity at Earth's surface is g.

Planet Y has twice the mass and half the radius of Earth. Both planets are modelled as uniform spheres.

Which one of the following best gives the magnitude of the acceleration due to gravity on the surface of Planet Y?

A.   0.5 g

B.   1 g

C.   4 g

D.   8 g | |
|---|---|---|
| 14. | A hydrogen atom that has been raised to the n = 4 excited state quickly returns to its ground state. The arrow on the diagram represents one transition between energy levels.

[This diagram is not drawn to scale.]

What is the wavelength of the photons that would be emitted when a hydrogen atom undergoes the transition from n=4 to n=1 as shown on the diagram?

A. 1.028×10^7 m
B. 2.04×10^{-18} m
C. 9.72×10^{-8} m
D. 3.08×10^{-7} m | |
| 15. | de Broglie proposed that any mass which has momentum also has a wavelength.
In keeping with this assumption, a student attempted to calculate the mass of a photon with a wavelength of 500 nm.

The student's result for the mass of this photon is closest to:

A. 4.4×10^{-36} kg
B. 6.7×10^{-3} kg
C. 1.32×10^{-27} kg
D. 3.0×10^{-8} kg | |

16.	An experiment is performed to measure the intensity of light transmitted through two polarising sheets. The initial orientation of the polarisers to each other is unknown.
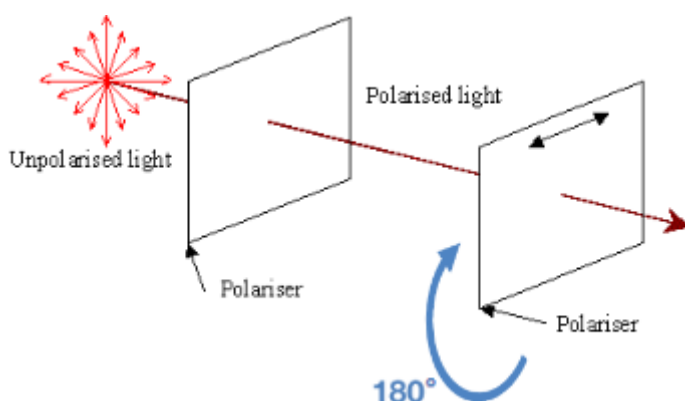
Which of the following graphs would represent how the intensity could change as the second polariser is rotated through 180°?

(A)

(B)

(C)

(D)
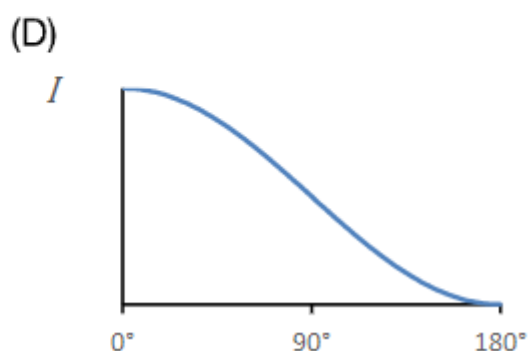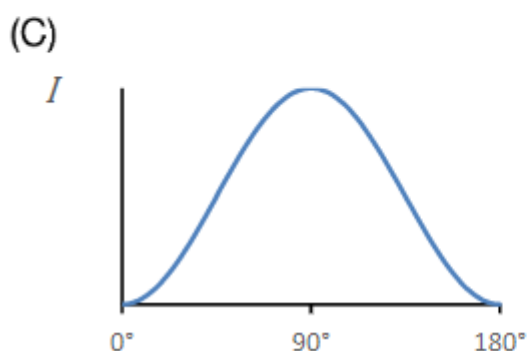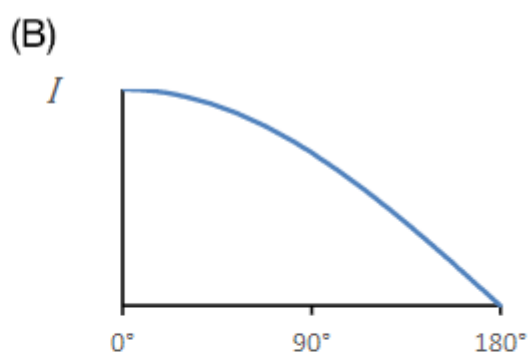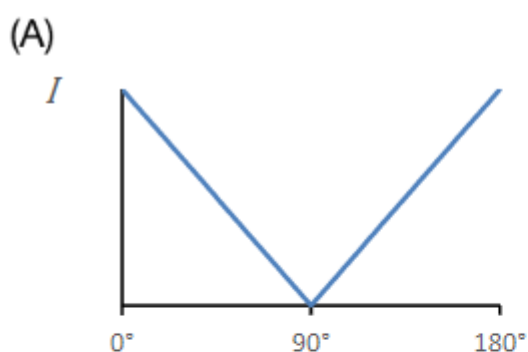
17.	A UV lamp emits a wavelength of 400 nm. Calculate the minimum number of photons required to transfer at least 31 eV of energy.

A. 1
B. 10
C. 6.238×10^{19}
D. 6.238×10^{28}

18.	The coil of an AC generator completes 50 revolutions per second. A graph of output volatge vs time for this generator is shown below.	
	Which one of the following graphs best represents the output voltage if the rate of rotation is changed to 25 revolutions per second?	
19.	Electrons pass through a fine metal grid, forming a diffraction pattern. If the speed of the electrons was doubled using the same metal grid, what would be the effect on the fringe spacing? A. The spacing would increase. B. The spacing would decrease C. The spacing would not change. D. The spacing cannot be determined from the information given.	
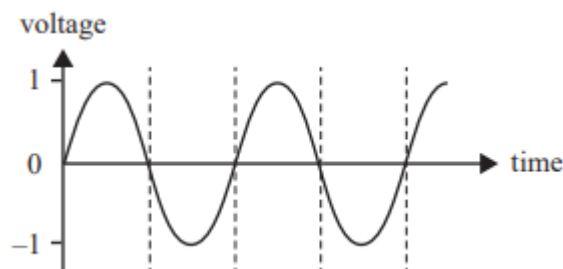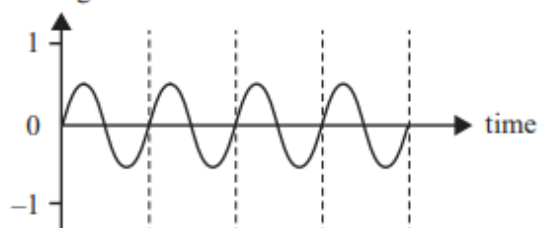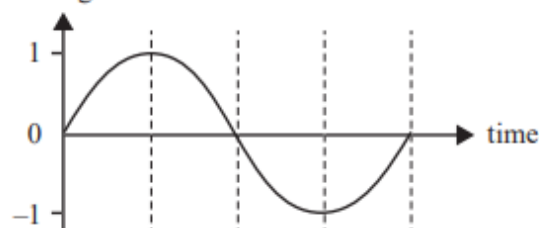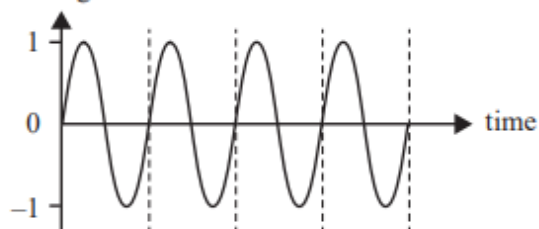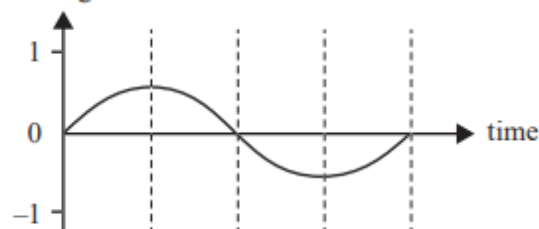
20. A conducting rod is placed on a U shaped metal conductor containing a 9 Ohm resistor. The rod is moved to the right at a constant speed of 6.2 ms^{-1} through a 0.33 T magnetic field as shown.
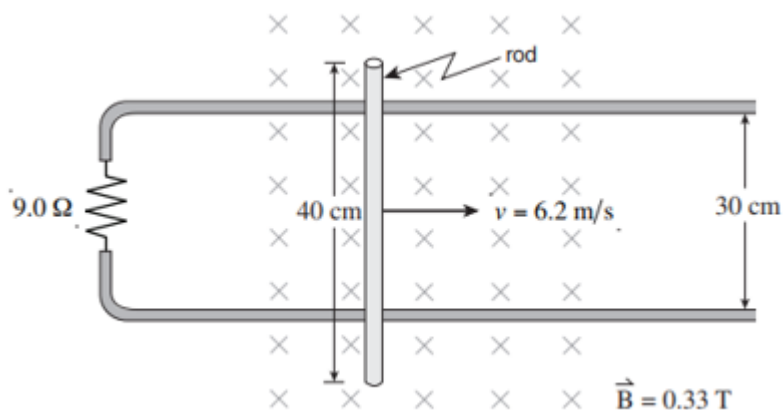
What is the magnitude of the current induced in the rod?

A. 62 mA.
B. 68 mA.
C. 91 mA.
D. 186 mA.

PART A: Answer the multiple choice questions HERE. Circle the letter of the BEST answer.

Do NOT detach this page from the rest of the exam.

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

PART B: Longer Answers (80 marks)

21.	Mr Warner has been keeping Ms Martel busy chasing around his laser pointer. He knows that it produces a red spot that Ms Martel can't resist but he wants to know the exact wavelength of the light.	3
	Describe a procedure that he could use to determine the wavelength of the laser if he has a diffraction grating with 5000 lines per centimetre and a tape measure. Be sure to include all necessary measurements but there is no need to discuss the calculations.	
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22.	Discuss the requirements of the planning necessary to ensure that a first-hand investigation will collect data which is both valid and reliable.	4
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23.	Explain why Einstein's description of the equivalence of energy and mass was critical for the acceptance of the Big Bang Theory.	2
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24.	The photograph below shows the two lenses of a pair of glasses in front of the same light source. The arm of the glasses is pivoted on the left-hand side so that the angle of the arm relative to the light source can be changed. The photograph shows the two lenses at four different positions.	4
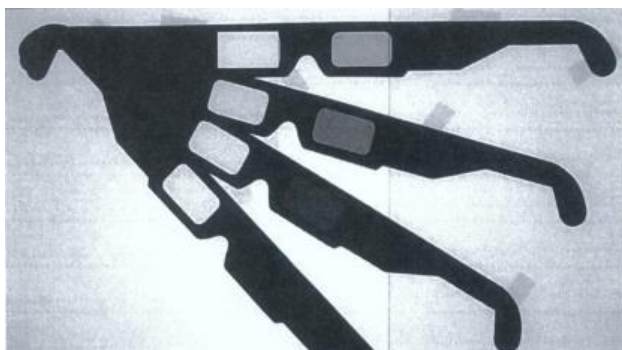
In terms of the principles of physics involved, account for the lack of change in the light passing through the left-hand lens compared to the changing amount of light passing through the right-hand lens as the angle of inclination is increased.

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25.	The diagram below shows a car travelling around a banked circular track. Without friction the car must travel at a speed of 10 ms^{-1} to maintain a constant radius. When friction is taken into account it can travel anywhere between 7 and 13 ms^{-1} and maintain a constant radius.	2
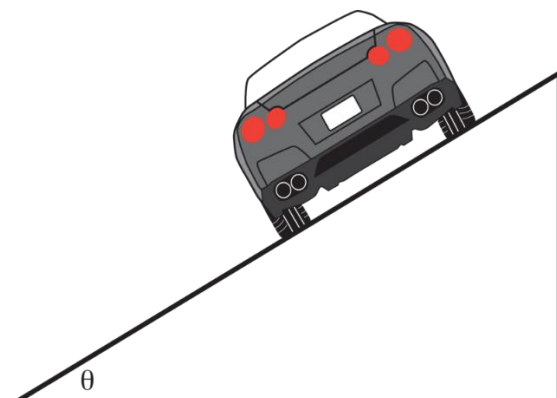
Draw arrows on diagram above to indicate the forces including friction, acting on the car when it is travelling at 8 ms^{-1}.

26.	Outline Maxwell's contribution to our understanding of the nature of light.	3
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27.	The diagram shows how the momentum of an object changes as it approaches light speed.	
	a. Explain the difference between this graph and what would have been predicted by classical mechanics.	2
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	b. Calculate the relativistic momentum of a proton travelling at 0.8 c.	2
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28. An electric field accelerates a proton from rest between two parallel plates. The proton exits into a region of uniform magnetic field strength of B = 0.1 T perpendicular to its path, as shown in the diagram below.
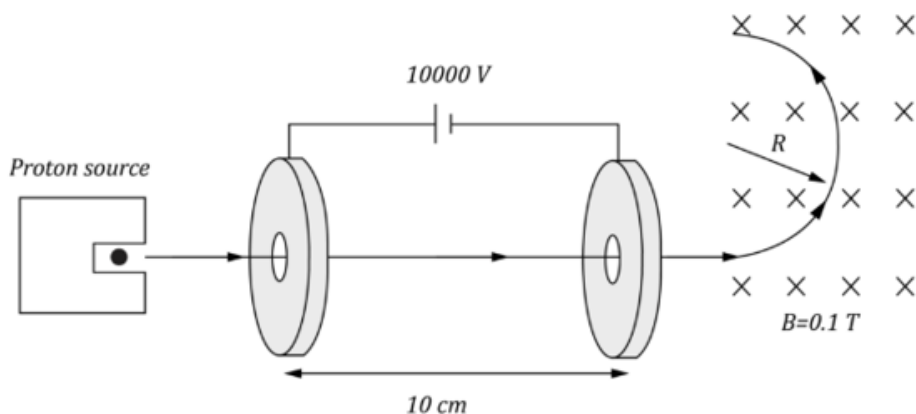
a. Calculate the radius (R) of the protons path in the magnetic field.   **4**

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b. Explain how the path would differ if an electron entered the magnetic field at the same velocity.   **3**

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29. A stroboscopic photo was taken of a student competing in the long jump. The distance between the student in the first image and the last image is 2.2 m. The camera used to take the pictures took one frame every 0.1 s.

a. Calculate the maximum height of the student above the ground.

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b. What was the magnitude of his velocity when he left the ground?

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30. *The diagram shows the three main steps in the proton-proton chain which produces about 90% of the energy from the sun. The table on the right lists the masses of the particles involved in these reactions in atomic mass units, (u)*
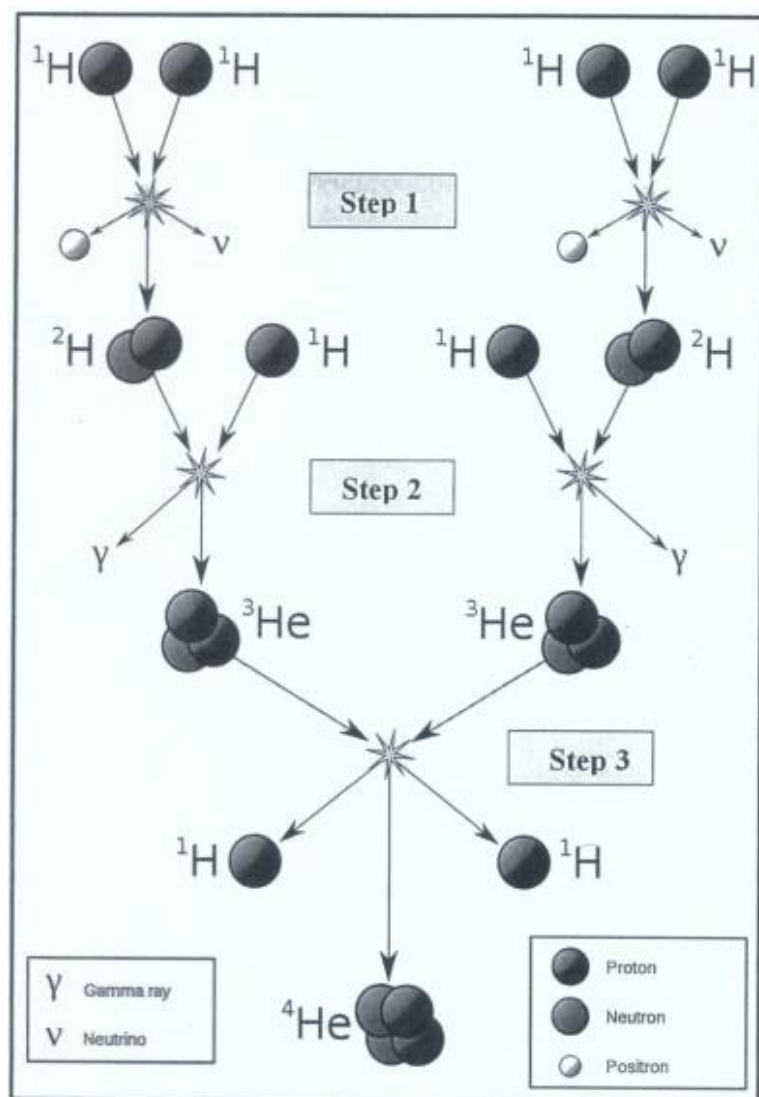
Particle	Mass (u)
$^0_{+1}e$	0.0005488
^1_1H	1.007825
^2_1H	2.014102
^3_2He	3.016029
^4_2He	4.002603
ν_e	negligible
γ	negligible

Step 1

Step 2

Step 3

γ Gamma ray

V Neutrino

Proton

Neutron

Positron

a. Write a balanced nuclear equation for the reaction in step 3 of this cycle. **2**

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b. Use the information to determine the energy produced in step 3 of this cycle. **2**

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31.	Two planets X and Y travel anticlockwise in circular orbits around a star as shown in the diagram. The radii of the orbits X and Y are in the ratio 2:5.	3

Two planets X and Y travel anticlockwise in circular orbits around a star as shown in the diagram. The radii of the orbits X and Y are in the ratio 2:5.

The planets are shown below at a time interval of 5 years. Initially they were aligned, making a straight line with the star. Five years later, planet X has rotated through 120°, as shown.
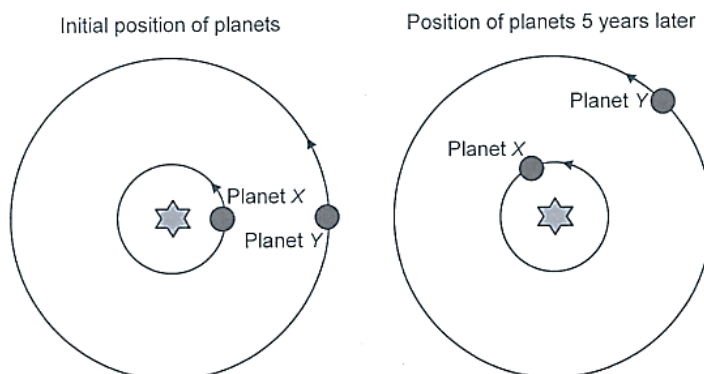
Determine how long it takes planet Y to orbit the star.

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32.	The diagram below demonstrates a possible mechanism for a braking system for trains.	4
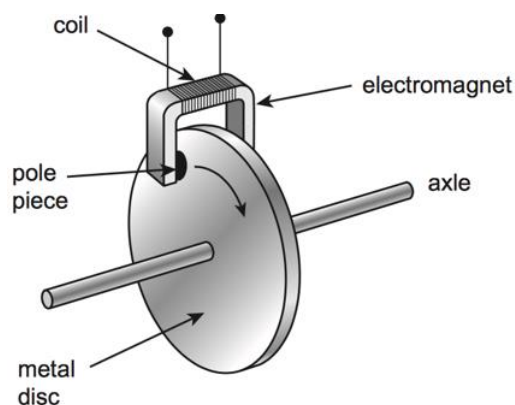
Explain how this mechanism would work if the metal disc is made of aluminum.

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33.	*Assess the impact of Einstein's work on our understanding of the nature of light.*	**5**
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34. The diagrams below show simple DC motor with a single rectangular coil. Side JK is 5.0 cm long and KL is 3.0 cm long. The magnetic field strength is 0.08 T and the current in the coil is 0.2 A.
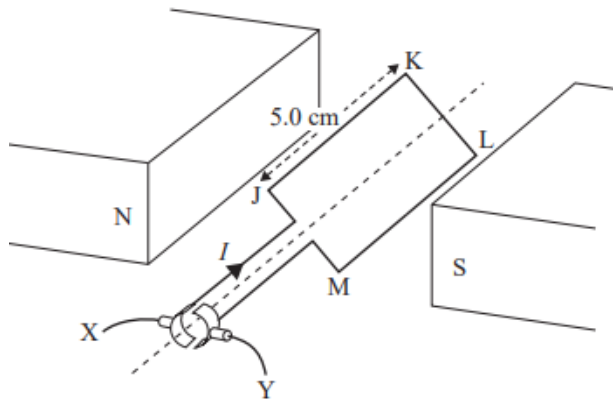
Fig.1
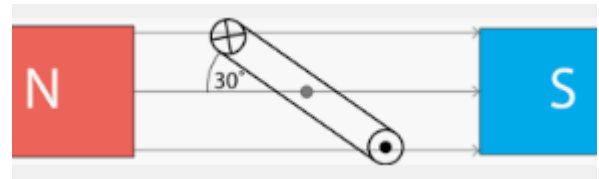
Fig.2

a. In which direction will the coil rotate? ....

b. Describe what happens to the force on side J-K as the coil rotates.

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c. Calculate the torque provided by the force on side JK at the position shown in fig. 2.

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35. The movie "The Current War" released in 2017 outlines the rivalry between Edison and Westinghouse who engage in a battle of technology and ideas that will determine whose electrical system will power the new century. Edison had established his supply of electricity with DC generators but ultimately Westinghouse won the day with the superior method of using AC generators.

Explain why AC generators are much more efficient when it comes to widespread distribution of electrical energy.

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36. *A balance was used to investigate the relationship between the current and the force between parallel wires. The apparatus was set up as shown in the diagram. The bottom rod has a mass of 0.50 kg and the top rod is fixed in place. When a current of 70 A was supplied to each rod the reading on the scales rose to 0.58 kg.*

Copper rod
Copper rod
Electronic balance
2.6 m
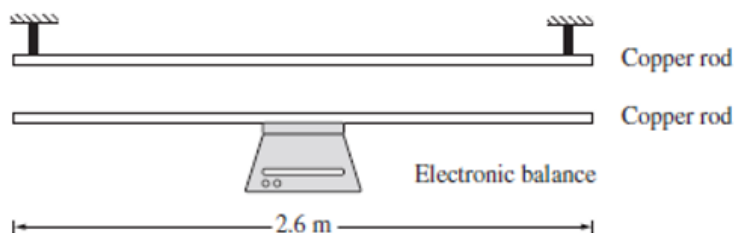
a. If the current in the top rod flowed from left to right in which direction would the current in the bottom rod be flowing?

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b. Calculate the distance between the 2 rods.

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37. *A small sphere with a charge of 2.3 μC is suspended from a thread hanging between to charged plates as shown.*

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3.1 cm
18°
2.3 μC
62 V
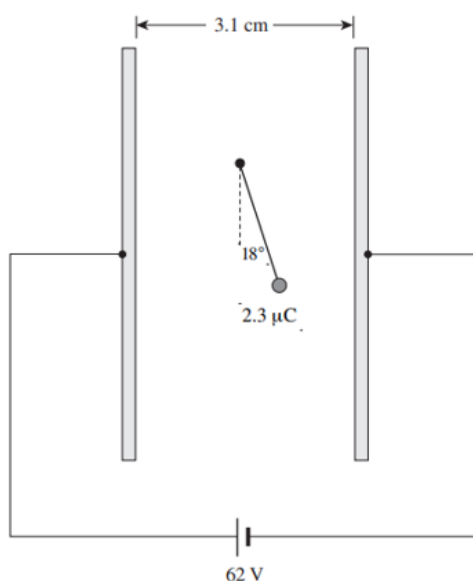
What is the mass of the sphere?

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38. As the Death Star approached Alderaan, the gravitational force between them increased. (For those of you who have been living under a rock, the Death star is an extremely massive, spherical space station that blew up the planet Alderaan in the first Star Wars movie).
The size of the force between the objects at various distances is shown in the table below.

Gravitational Force x 10^{15} (N)	Distance (d) between the centres of mass of Alderaan and the Death Star x 10^8 (m)	$1/d^2$ X 10^{17}(m^{-2})
20.0	1.00	10
5.00	2.00	2.5
2.22	3.00	1.11
1.25	4.00	0.625
0.80	5.00	0.04

a. Plot a graph of F vs $1/d^2$. Placing Force on the vertical axis

4
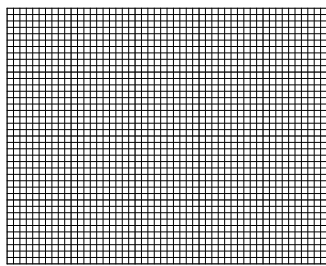
b. Given that the Death Star has a mass of 5.0 x10^{17} kg. Use the gradient of the graph to determine the mass of the Alderaan.

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39.	*Referring to the work of Bohr and Rutherford in atomic physics, discuss how scientists use experimental observation and physical principles to improve scientific models.*	6

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