Physics

General Instructions

- Assessment Task No. 2
- Weighting 10%
- Reading Time - 5 minutes
- Working Time –1 hour 30 minutes
- Board approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- A Data Sheet and Formulae Sheets are provided at the back of this paper
- Write your name of every page

Total Marks 74
Answer ALL questions
This exam has two parts, Section I and Section II

Section I
Total marks (12)
Attempt questions 1-12
Allow about 15 minutes for this part

Section II
Total marks (62)
Attempt questions 13-21
Allow about 1 hour 15 minutes for this part

This paper MUST NOT be removed from the examination room

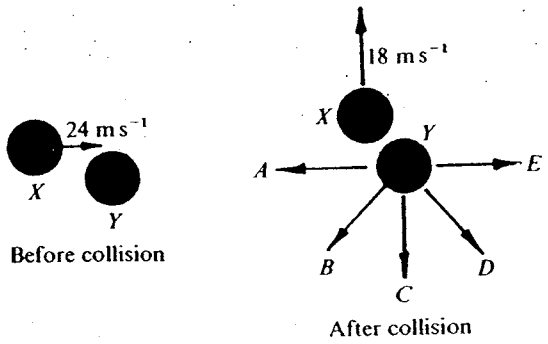
Section I

1. Which row correctly matches the scientist with his contribution to our understanding of the universe?

	Aristotle	Copernicus	Newton
(a)	Importance of gravity	Elliptical path of comets	Geocentric model
(b)	Elliptical path of comets	Geocentric model	Heliocentric model
(c)	Geocentric model	Heliocentric model	Importance of gravity
(d)	Heliocentric model	Importance of gravity	Geocentric model

Questions 2, 3 and 4 refer to the following figure.

A ball **X** of mass 0.5 kg moving at a speed of 24 ms^{-1} strikes a glancing blow on a second ball **Y** of mass 0.5 kg which is stationary. After the collision is complete (0.1 s later) **X** is moving at right angles to its original direction of motion with a speed of 18 ms^{-1}



2. The magnitude of the change in momentum of ball **X** is:
   (a) 3 $kgms^{-1}$
   (b) 15 $kgms^{-1}$
   (c) 6 $kgms^{-1}$
   (d) 42 $kgms^{-1}$

3. The direction of ball **Y** after the collision is best represented by arrow:
   (a) A
   (b) B
   (c) C
   (d) D

4. The average size of the force acting on ball **Y** during the collision is:
   (a) 150 N
   (b) 300 N
   (c) 90 N
   (d) 120 N

5. After the big bang matter gradually formed from energy. The most likely order in which matter formed after the Big Bang is:
   (a) Quarks → atoms → protons → ionized atoms
   (b) Quarks → neutrons → ionized atoms → atoms
   (c) Quarks → neutrons → electrons → atoms
   (d) Protons → atoms → electrons → Radioactive material

6. A constant force acting on a 2.0 kg mass increases its velocity from 5 ms^{-1} to 10 ms^{-1} in 0.2 s. The size of the force in newtons is:
   (a) 50
   (b) 15
   (c) 10
   (d) 5

7. As the space shuttle orbits the Earth in a circular path it has:
   (a) A constant velocity but a changing speed
   (b) No resultant force acting on it
   (c) A constant speed but a changing velocity
   (d) A constant velocity and a constant acceleration

8. A student walks 10 m east, then 20 m due north then 5 m due south. The magnitude of his displacement from his original position is closest to:
   (a) 35 m
   (b) 18 m
   (c) 14 m
   (d) 25 m

9. The brightness of a star does not depend upon:
   (a) The size of the star
   (b) The surface temperature of the star
   (c) The distance from the star
   (d) Whether it is viewed with the naked eye or a telescope

10. The expansion of the Universe was first predicted by:
   (a) Newton
   (b) Hubble
   (c) Einstein
   (d) Freidmann

11. The intensity of light from a source is ***I*** at a distance of ***d***. If the distance is increased ***4d*** the intensity is:

    (a) ***I***/16

    (b) ***I***/8

    (c) ***I***/4

    (d) ***I***/2

12. Sunspots can be described as:

    (a) Areas with relatively higher temperatures and strong magnetic fields

    (b) Areas with relative cooler temperatures and strong magnetic fields

    (c) Areas with relative higher temperatures and weak magnetic fields

    (d) Areas with relative cooler temperatures and weak magnetic fields

End of Section I

Section II

Question 13. **Marks**

(a) Define the relationship between the temperature of a body (blackbody) and the dominant wavelength of the radiation emitted from that blackbody.

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(b) The three stars Rigel, Betelgeuse and alpha-Centauri have colours of blue-white, orange-red and yellow respectively. Arrange these three stars in order of increasing surface temperature.

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(c) The star Regulus has a brightness of 7.17×10^{-9} Wm^{-2} as seen from Earth. Regulus is 7.8×10^{14} km from Earth. Calculate the brightness of Regulus as seen from Earth if this star was located at half its actual distance from Earth.

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(d) Star A has a luminosity of **L watts**. Star B has a luminosity of **3L watts**. Both of these stars are located an equal distance from Earth. Determine the ratio of the brightness of Star A to the brightness of Star B as seen from Earth. You may assume the path the light travels to Earth from each Star is equally free from interstellar dust and other material that may absorb or scatter the light.

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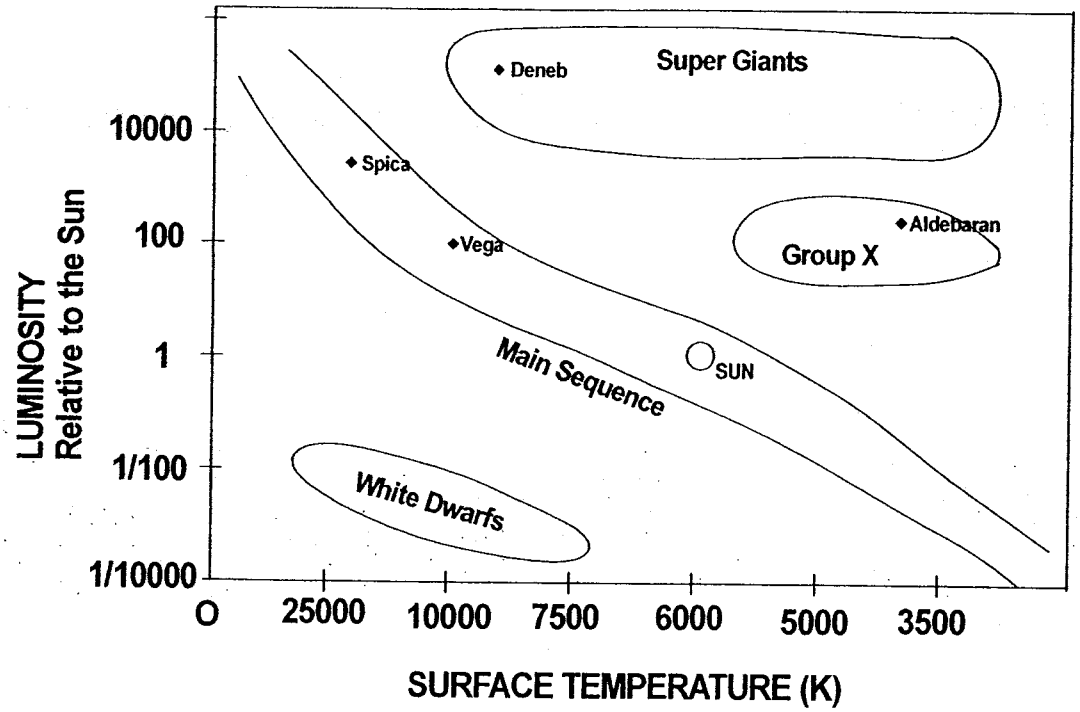
Question 14 refers to the following Hertzsprung-Russell Diagram. **Marks**



(a) Antares is a star with a surface temperature of 3400K and luminosity relative to the Sun of about 10^4. Clearly label the position of Antares **on the HR Diagram**. **1**

(b) The HR Diagram above has been drawn with a horizontal axis of "Surface Temperature". Identify one other physical characteristic of a star that can be used as the horizontal axis variable in an HR plot. **1**

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(c) Identify the correct name of the star group labelled "Group X".

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(d) Identify the energy source characteristic of stars in Group X.

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(e) A certain star is described as being "about the same size as the Earth, blue in colour, with no thermonuclear reactions occurring in its core". Identify the star group into which you would place this star.

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Question 15 **Marks**

Describe the Experimental Method used in a first-hand investigation that you have carried out to compare the penetrating power of alpha, beta and gamma radiation in a range of materials.

As part of your description:

- Draw a labelled diagram of the experimental set-up;
- Outline the method used
- Identify the independent and dependent variables involved in the investigation; **5**
- Identify 2 potential hazards inherent in this experiment and the steps that were taken to protect the experimenters from these.

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Question 16 **Marks**

A vehicle of mass 1000kg increases its velocity from 5 ms^{-1} to 10 ms^{-1} in 15 seconds.

(a) Determine the increase in kinetic energy.

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(b) Define the law of conservation of energy.

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(c) A vehicle of mass 800 kg is travelling at 8 ms^{-1} is brought to rest in a distance of 40m. Determine the **magnitude** and **direction** of the average force exerted by the brakes to achieve this event.

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(d) Identify what happens to the kinetic energy of the vehicle as it comes to rest.

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(e) Station wagons are popular because of the amount of goods that they can carry in the rear section of the vehicle. Discuss a potentially dangerous situation that this could pose and name a precaution that could be taken to minimize the dangers.

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Question 17 **Marks**

Vehicle A of mass 1000 kg is travelling East at 10 ms^{-1} collides with another vehicle B of mass 1200 kg but travelling West at 10 ms^{-1}. On impact they become locked together. Assume friction is negligible.
Determine:

(a) The total momentum of the system before the collision.

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(b) The velocity of the combined vehicles after the collision.

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(c) The change in momentum of vehicle A.

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(d) Given that the collision took place in 2 seconds, determine the average force acting on vehicle A.

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Question 18

After the Big Bang matter was spread out relatively evenly throughout the universe. Outline how galaxies formed.

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Question 19 **Marks**

A 1200 kg car travelling east at 20.0 ms^{-1} moves around a curve at constant speed until it is travelling south at the same speed. The radius of the curve is 30.0 m and the car takes ~~5.0 s~~ 2.15 to move through the curve.

Include a vector diagram.

(a) Calculate the **magnitude** of the change in velocity.

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(b) Determine the **magnitude** of the acceleration as the car moves through the curve.

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(b) Calculate the **magnitude** and **direction** of the force on the car as it moves through the curve.

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Question 20

A 1000.0 kg car is at rest when it is acted upon by a force of 10 000.0 N from the engine. Assuming no slippage, a rolling friction of 2 000.0 N and air friction of 7 000.0 N.
Find:

(a) The net force acting on the car?

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(b) The acceleration of the car?

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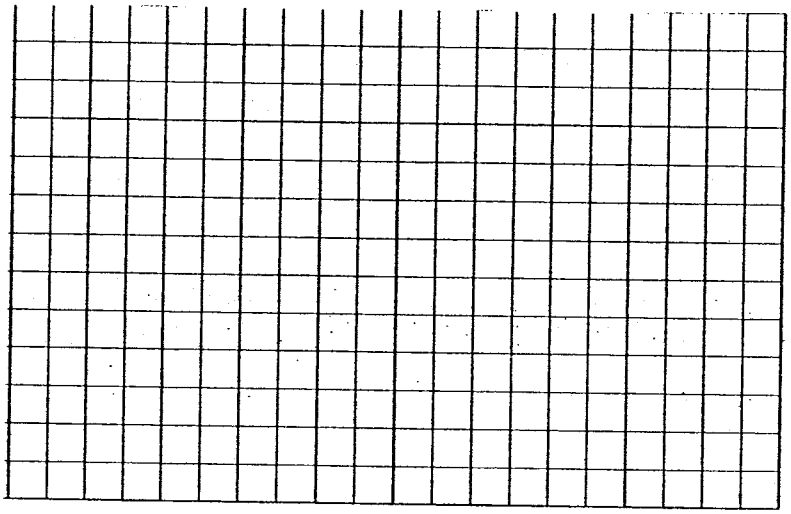
Question 21 **Marks**

The table shows the instantaneous velocity of a car starting from rest.

Velocity (ms^{-1})	0	4	8	12	12	12	12	6	0	0
Time (s)	0	1	2	3	4	5	6	7	8	9

(a) Plot a **velocity – time** graph for the car.



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(b) What is the instantaneous velocity after 6.5 s? (Show your working on the graph)

2

(c) Determine the displacement of the car after 9 s.

2

(d) Determine the average velocity of the car for the time interval from t = 0 to t = 9 s.

2

(e) Determine the acceleration for the time interval t = 6 to t = 8 s.

2

Marks

Question 22

(a) Outline the contribution of Edwin Hubble to the development of the current model of the universe.

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(b) What is the Big Bang?

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Question 23

(a) Describe ONE model of the universe developed from the time of Aristotle to Newton.

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(b) Assess this model to identify limitations placed on the development of the model by the technology available at the time.

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