These are for revision, containing questions on the learning outcomes required for Higher Physics. If you perform badly in one or more sections, please review your work and tell your teacher. It probably means that extra reinforcement is required. The earlier this is picked up the easier it is to deal with. Don’t deceive yourselves and us by cheating, it will cause problems later.

All the best! *Ms H & Mrs. H*

# Units and Prefixes Review

1. Give the SI units for the following physical quantities, state which are base units

a) length, b) mass, c) acceleration, d) velocity, e) charge. **(6)**

2. If a force of 1 N is applied to a 3 kg mass calculate the acceleration this can produce? **(1)**

3. A leaf of mass 0.1 g feels a frictional force of 948 μN as it falls from a tree. Determine its acceleration as it falls? (take g as 9.8Nkg-1 ). Include a free body diagram of the leaf. **(3)**

4. Express the following in scientific notation.

a) 50mA b) 0.3nF c) 200s d) 45μF **(4)**

# Uncertainty Review

1 a) Find the percentage error in the following display. **(2)**

**0 10 20 30 ⭡ 40 50 60**

2. Give an example of the following uncertainties,

i) Random uncertainties, ii) Systematic effects. **(2)**

3.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time/s | 1.58 | 1.55 | 1.59 | 1.56 | 1.56 | 1.58 |

Calculate the percentage uncertainty in these results. **(3)**

4. State with what you must be aware whenever you make a measurement? **(1)**

5. State how to reduce the uncertainty in your experiments. **(1)**

6. What is the best measurement that we can hope for? **(1)**

7. Draw a diagram illustrating the effects of a systematic error in a set of results. **(1)**

8. Estimate the scale-reading uncertainty in the following

a) a voltmeter reading of 0.12V b) an ammeter reading of 1.0mA **(4)**

9. a) Find the absolute uncertainty in the following readings. **(4)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Speed /ms –1 | 0.97 | 0.92 | 1.07 | 1 |

b) State the error made when recording the above results? **(2)**

10. The following results were obtained from an experiment.

*distance = 1.00 ± 0.01m, time = 0.16 ± 0.02s*

Calculate the speed from these results and express it in the form final value ± uncertainty. **(3)**

# Scalar & Vectors review

1. A fly crawls across a desk. Make a sketch of its path and mark on it the *distance* travelled, and the *displacement* of the fly. (3)

2. A dog runs from its kennel to the garden gate and back. Explain how to calculate its *average speed* and its *average velocity*. (2)

3. a) What is the definition of a *vector quantity?*  (1)

b) Give one example each of vector and scalar quantities. (2)

c) A physicist measures the size of quantity **A** and the angle it makes with some reference line. He then measures the size of quantity **B** and the size of the angle through which a wheel **C** has been rotated. Classify each of these three measurements into either vector or scalar quantities (3)

4. A bus is travelling due North at 12 ms-1, a girl runs West across the bus at 3ms-1, suddenly she is sick and projects this at 2 ms-1 at an angle of 30o North of West. Determine the resultant velocity of the sick? (3)

5. A farm trailer is moving north at 3.6ms-1 while the sheepdog in it walks east across the floor at 2.7ms-1. Use a scale diagram to find the dog's resultant velocity. (3)

6. State what is meant by the *resultant* of a number of forces. (1)

7. What are the **x** and **y** components of a vector 25 units long making an angle of 30o to the X-axis? (2)

8. A pond skating insect is blown east by a force of 5.1x10-3 N and pushed by the water with a northerly force of 6.8x10-3 N while its little feet paddle it west with a force of 10.2x10-3 N. Calculate the resultant force on it. (3)

# Acceleration Review

1. State the measurements you need to take in finding the *acceleration* of an object, and state how you use them to calculate its value. (3)

2. State the *definition* of acceleration? (1)

3. Sketch the corresponding acceleration-time graph. (2)



4. a) Describe this graph in words. (2)

b) State whether the results below represent a constant velocity or acceleration? (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Velocity /ms-1 | 25 | 32 | 39 | 46 | 53 |
| Time /s | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 |

5. a) State the definition derived from the equation **v = u + at.** (1)

b) Use the following graph to derive the equation (2)

time (s)

velocity (ms-1)

*v*

*u*

**t**

0



6. An object is fired at 60o to the horizontal at 100ms-1.

a) Calculate the vertical and horizontal components of its velocity. (2)

b) Calculate the time taken for the object to reach its maximum height? (2)

c) Determine the maximum height reached by the object. (2)

d) Calculate the range of the object. (1)

7. A man leaves the end of a ski-jump travelling horizontally at 40ms-1. He lands 45m vertically below the launch pad.

a) Determine his vertical velocity on landing. (2)

b) Calculate his time in the air. (2)

c) Determine the range of the ski jumper. (1)

# Force Mass Acceleration and Energy Review

1. State what gives an acceleration of 1ms-2 to a 1kg mass. (1)

2. a) An object is accelerated at 1.8ms-2 by a force of 17N. Calculate the mass of the object. (2)

b) 2x104N acts on a mass of 1.25x103kg. Calculate the acceleration caused. (2)

3. A bird's wings gives it a forward force of 10N while its body gives it a drag of 8N. Its mass is 2kg and its flight is horizontal.

a) Draw a free-body diagram for the bird. (2)

b) Determine the bird's acceleration. (2)

4. a) A girl who weighs 500N runs up a flight of stairs in a time of 20s. If each step is 0.2m high and there are 60 steps in the flight, calculate the girl’s power. (2)

b) A pendulum bob of mass 1.0 kg is moved sideways until it has risen by a height of 0.45m. Calculate the speed of the bob at its lowest point. (Take *g* as 10Nkg-1 ). (2)

# Momentum Review

1. State the definition of *momentum*? (1)

2. State under what circumstances does the law of conservation of momentum **not** apply. (1)

3. State what is meant by an *elastic collision*? (1)

4. State what is meant be an *inelastic collision*? (1)

5. A 5kg trolley moving at 10ms-1 catches up with and interacts with a 3kg trolley moving at 5ms-1. If the lighter trolley moves on with a speed of 9ms-1 after the collision,

a) What is the new speed of the heavier trolley? (3)

b) Is this collision elastic or inelastic (Justify your answer) (2)

6. A 5kg rifle fires a 6**g** bullet at 312.5ms-1. What is the recoil velocity of the rifle? (2)

7. How does the law of conservation of momentum show that for two bodies moving along the same straight line, the forces acting on each body are equal in size but opposite in direction when the bodies collide? *(Use the equations from this section).* (3)

8. What is the definition of *impulse* that uses the idea of force? (1)

9. What is the definition of *impulse* that uses the idea of momentum? (1)

10. A 10kg boulder moving at 5ms-1 runs into a stationary 8kg boulder. If the lighter boulder moves off at 4ms-1, what is the impulse on the 10kg boulder? (2)

# SECTION 2.1 TEST

1. What effect does an electric field always have on any electric charge in it? (1)

2. What effect does an electric field have when applied to a conductor?(1)

3. What must the electric charge do if work is done on it? (1)

4. What is the definition of the *potential difference* (that is the voltage, *V*) between two points? (1)

5. What is the definition of the *volt*? (1)

6. If ***W*** stands for *work done,* and ***Q*** is the *quantity of electric charge*, how do we use them to calculate the *voltage,* ***V***? (1)

7. a) How much work is done when an electric field moves 2.5C through a potential difference of 20V? (2)

b) 1500J are required to move some electric charge through a resistor which has a p.d. across it of 60V. How much electric charge moves through the resistor? (2)

8. What is the definition of the *e.m.f. of a source* ? (1)

9. What do we regard an electric source as being equivalent to? (1)

10. Give an outline of a method for measuring the *e.m.f.* and the *internal resistance* of an electrical source. (3)

11. a) What is an *open circuit p.d.*? (1)

b) Why are there no 'lost volts' in an electrical source when it is in *open circuit*? (1)

c) Why is the measured voltage across an open circuit source equal to the e.m.f. of that source? (1)

12. How do we tell when an electric charge enters an electric field? (1)

13. What causes movement of the free charges present in a conductor? (1)

14. What is the name for the work done in moving one coulomb of charge between two points? (1)

15. If we count all the e.m.f.'s in a circuit and then measure all the potential differences round the circuit, we find they are equal. Why must this be true? (2)

16. Derive the equation which gives the total resistance of two resistors connected *in series.*  (2)

17. Derive the equation which gives the total resistance of two resistors connected *in parallel.*  (2)

18.



a) What is the name for this type of circuit? (1)

b) If the ammeter shows a zero reading, what is the relationship among the resistors shown? (1)

c) If R1=400Ω, R2 = 1kΩ and R4 = 750Ω, what is the value of R3? (2)

19. If we start with a balanced Wheatstone bridge and then change the value of one resistor by a small amount, what effect does it have on the p.d. between the centres of the two bridge arms? (1)

20. a) Write a sentence which shows the terms *terminal p.d.* and *e.m.f.* used correctly. (2)

b) Write a sentence which shows the connection between the *load resistor* in a circuit and the *lost volts.* (2)

# SECTION 2.2 TEST

1.



Time base is set at 10ms/DIV

What is the frequency of the wave drawn above? (2)

2. a) What does *r.m.s.* stand for? (1)

b) How do we calculate the *peak value* of a supply when we know its r.m.s. value? (1)

3. If we have a peak voltage of 8.485 V, what is its r.m.s. value? (2)

4.



If the current is 2A when the frequency is set at 100Hz, what is it when the frequency is 200Hz? (1)

# SECTION 2.3 TEST

1. If we have two parallel conducting plates with a p.d. of *V volts* between them while they hold a charge of *Q* coulombs, what is the relationship between *V*  and *Q* ? (1)

2. Give an outline of how we show that the charge on a capacitor's plates is directly proportional to the p.d. across them? (3)

3. What is the name given to the ratio of *charge* to *potential difference*? (1)

4. What unit is the same as *one coulomb per volt*? (1)

5. a) A capacitor has 25V across it and is carrying a charge of 50**m**C. Calculate its capacitance? (2)

b) A 1000µF capacitor holds 0.4C. Calculate the voltage across it. (2)

6. Describe what happens when a capacitor is charged and explain why work must be done during the process. (3)

7.



How do you use this graph to calculate the *work done* in charging the capacitor to the voltage V? (2)

8. a) State with what the expression  *½ QV* equates. (1)

b) Write a different expression which gives a measure of the same quantity as the one above. (1)

9. a) What energy is stored in a capacitor holding 1.2C at a potential difference of 40V? (2)

b) What energy is stored in a 1000µF capacitor with 15V p.d. across it? (2)

c) What energy is stored in a 2000 micro-farad capacitor holding 0.2 coulombs of charge? (2)

10.



Sketch the graphs of *voltage against time*, and *current against time* for

a) the **charging** of the capacitor; (2)

b) the **discharging** of the capacitor. (2)

11.



The capacitor is in the process of being charged and has a p.d. of 8V across it. Calculate the current in the resistor. (3)

12. State the relationship between current and frequency in a capacitive circuit (1)

13. Describe an experiment to show how current varies with frequency in a capacitive circuit. (3)

14. Describe and explain the role of a capacitor in the following situations:

a) storing energy;

b) smoothing;

c) blocking d.c whilst passing a.c.

# SECTIONS 4.1 & 4.2 TEST

Please return to these sections of the work and ensure that you have revised them thoroughly.

1. What size of capacitor would be in a circuit if it 1mC of charge flowed on to a capacitor and produced a voltage of 3V across it?

2. Use the results in the following table to calculate:

a) the size of the capacitor;

b) the energy stored in the capacitor when the p.d is 300V.

Include the percentage errors in your answers, and how these errors could have arisen.

|  |  |  |  |
| --- | --- | --- | --- |
| p.d.(V) | charge on capacitor (mC) | | |
| 0 | 0.01 | 0.01 | 0.01 |
| 50 | 1.75 | 1.77 | 1.74 |
| 100 | 3.02 | 2.99 | 3.08 |
| 150 | 4.78 | 4.83 | 4.85 |
| 200 | 6.48 | 6.35 | 6.42 |
| 250 | 8.01 | 7.94 | 8.08 |
| 350 | 11.15 | 11.11 | 11.17 |

# SECTION 3.1 TEST (WAVES AND INTERFERENCE)

1 The frequency of a source is 10Hz and the speed of the waves it produces is

2ms-1. If these waves subsequently enter a medium where their speed

doubles to 4ms-1, what is their frequency? **(1)**

2. What is the relationship between *frequency* and *period*? **(1)**

3. What physical quantity depends on the *amplitude* of a wave? **(1)**

4. Fill in the blanks in the following sentence,

When light waves are all in \_\_\_\_\_\_\_\_\_\_, we say that they are c\_\_\_\_\_\_\_\_. When they are \_\_\_\_ of \_\_\_\_\_\_, there is no fixed relationship between the phases of the components that make up the beam. **(2)**

5. Use the idea of superposition of waves to explain the difference between

constructive and destructive interference. **(3)**

6. What test can be made to judge whether some phenomenon is a wave

process? **(1)**

7. All types of wave show the same characteristic behaviour, name two of these

characteristics. **(2)**

8..If we have two coherent sources of light, each with wavelength, **L**, what path

difference gives,

(a) a maximum in the interference pattern? **(1)**

(b) a minimum in the pattern? **(1)**

9. Two coherent light sources each produce light of wavelength 500nm. If the

path difference between a point **P** and each source is 1mm, what type of interference do we see at **P**? **(3)**

10. What effect does a grating have on a beam of monochromatic light? **(1)**

11. A grating has a line spacing of 0.01mm and causes a deviation of

17.46o between the central maximum and the 5th order maximum. What is the wavelength of the incident light? **(3)**

12. Make a list of the measurements we need when finding the wavelength of a

monochromatic light using a grating. **(1)**

13. What are the approximate wavelengths of *red, green,* and *blue* light? **(2)**

14. Describe a white light spectrum and how you can tell from its appearance whether

it is made by a prism or a grating. **(2)**

# REFRACTION

1. When light travels obliquely from medium (1) to medium (2), the ratio of what two

measurements remains constant? **(1)**

2. What is the *absolute refractive index, n* of a medium? **(1)**

3. Describe the procedure for measuring the absolute refractive index of glass using

monochromatic light. **(3)**

4 A glass block of absolute refractive index 1.56 has a ray of light incident upon it at

an angle of 45.1°. What is the angle between this ray and the normal inside the

block? **(2)**

5. What does the refractive index of a material depend on apart from the material

itself? **(1)**

6. When light moves from air into some transparent medium, what change does this

cause in the *speed* and *frequency* of the wave? **(2)**

7. A wave with velocity *V1* and wavelength *L1* in medium (1), moves into medium

(2) where its velocity is *V2* and its wavelength *L2*. What equations connect these quantities? **(2)**

8. (a) A wave travels at 3×108 ms-1 in air and at 2.5×108ms-1 in a clear plastic

material. If the wave travels through the air and is incident at an angle of 50.2° on the surface of the plastic, what is its angle of refraction? **(3)**

(b) The angles of incidence and refraction for light striking the surface of a pond are measured at 60.05and 41.8 respectively. If the wavelength of the light that strikes the water surface is measured at 650nm, what is its wavelength under the water? **(3)**

9. What is meant by *total internal reflection?* **(2)**

10. What is the difference in behaviour between light which strikes a boundary below

the critical angle, and light which strikes it above the critical angle? **(2)**

11. Describe how you measure the critical angle for a semi-circular glass block. **(3)**

12. Derive the equation connecting the absolute refractive index, ***n*** and its critical

angle, ***C****.* **(3)**

13. (a) What is the critical angle for a substance whose absolute refractive index is 1.45? **(2)**

(b) A new type of plastic has its critical angle measured at 33.7⁰. What does this give us for the value of its refractive index? **(2)**

# SEMICONDUCTORS

1. What is the definition of *intensity*? **(1)**

2. What is the relationship between intensity, *I* and the distance *r* from the source?

**(1)**

2. How do you show that the intensity of light at a surface is inversely proportional to the (distance)2 of that surface from the light source? **(3)**

3. A 60W bulb is suspended 0.5 m above a light-meter which gives a reading of 150 units. Calculate the reading when the bulb is placed 1.5m above the light meter. **(2)**

4. What are the conditions necessary for light to cause photoelectric emission from a surface? **(2)**

5. Increasing the intensity of radiation at a surface increases the power per unit area absorbed by the surface. If this radiation is below the threshold value of the surface, what effect does the increase in intensity have on photoelectric emission? **(2)**

6. Monochromatic radiation whose frequency is above the threshold value is incident on a surface. What is the connection between the intensity of this radiation and the photoelectric current it produces? **(2)**

7. If *h* is Planck's constant and *f* is the frequency of a beam of radiation, what is *E=hf* and how is it used in describing the radiation? **(2)**

8. Radiation of frequency 500THz is incident on a surface. What is the energy carried by each of its photons? **(2)**

9. Explain why the expression *I=Nhf* gives us the intensity at a surface on which *N* photons per second are incident per unit area. **(3)**

10. Photons are ejected from a surface with a maximum kinetic energy of *Ek* which is the difference between the energy of an incident photon and the work function of the surface. If the threshold frequency of the surface is *fo* , what is the equation that gives us the value of *Ek* ? **(2)**

11. How do we describe the energy carried by electrons in a free atom? **(2)**

12. Draw a diagram that represents the energy levels of a hydrogen atom. **(2)**

13. Write a sentence, which shows the following terms used correctly:

*ground state, excited state, ionisation level.*  **(3)**

14. What is the mathematical expression which describes an emission line in a spectrum resulting from an electron moving between an excited energy level *W2* and a lower level *W1*? **(2)**

15. What is the mathematical expression which describes an absorption line in a spectrum resulting from an electron taking in radiation of energy *hf* when it occupies energy level *W1* and hence moving to excited energy level *W2*? **(2)**

16. Explain the occurrence of absorption lines in the spectrum of sunlight. **(2)**

17. What do *spontaneous emission* and *radioactive decay* have in common? **(2)**

18. What is the likely result of radiation of energy *hf* being incident on an excited atom? **(2)**

19. When dealing with stimulated emission, what is the connection between the incident radiation and the emitted radiation? **(2)**

20. What is the condition inside a laser that allows us to use the word *amplification* in describing the light beam? **(2)**

21. Explain the function of the mirrors in a laser. **(2)**

22. Explain why a beam of laser light with a power of only 0.1mW may cause eye damage. **(2)**

22. Calculate the power of a laser capable of producing an intensity of 200 W m-2 in a beam of 1 mm diameter **(2)**

23. Into what three groups do we divide materials according to their electrical properties? **(2)**

24. Name one example each of *conductors, insulators* and *semiconductors*. **(2)**

25. What is the result of adding impurity atoms to a pure semiconductor? **(2)**

26. Explain how doping can form an n-type semiconductor in which the majority of the charge carriers are negative. **(3)**

27. Describe the movement of the charge carriers in a forward biased p-n junction **(3)**

28. In the junction region of a forward biased p-n junction diode, positive and negative charge carriers may recombine. What is the result of this recombination? **(2)**

29. What is a *photo-diode*? **(2)**

30. What is the purpose of a photodiode used in *photovoltaic mode*? **(2)**

31. What is the purpose of a photodiode used in *photoconductive mode*? **(2)**

32. In a reverse-biased photodiode operating below the breakdown voltage, how does the leakage current depend on the light intensity falling on it? In some photoconductive detectors, the electrons in the detector material are released and can act as charge carriers, so reducing the resistance of the detector. How does this come about? **(3)**

33. What do we know about the speed at which photodiodes can switch from one conduction to another? **(1)**

# NUCLEAR REACTIONS

1. Describe how Rutherford showed that the nucleus has a relatively small diameter compared with that of the atom. **(3)**

1. Describe how Rutherford showed that most of the mass of the atom is concentrated in the nucleus. **(3)**

2. Explain what is meant by alpha, beta and gamma decay of radionuclides. **(2)**

3. Put the following equations into words:

(a)  U=Uranium, Th=Thorium, He=Helium

(b)  Np=Neptunium, Pu=Plutonium **(4)**

4. What happens when a nucleus with a large mass number undergoes fission? **(2)**

5. In which two ways may fission occur? **(2)**

6. Describe (in terms of the nuclei) what occurs when fusion takes place. **(1)**

7. Explain mathematically how fission and fusion products acquire large amounts of kinetic energy. **(2)**

8. Calculate the energy released when the following fission reaction takes place:



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Nuclei |  |  |  |  |  |
| Mass of nuclei (kg) | 3.9009 × 10-25 | 1.6249 × 10-25 | 2.2555 × 10-25 | 3.32 × 10-30 | 1.675 × 10-27 |

and when the following fusion reaction takes place:



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nuclei |  |  |  |  |
| Mass of nuclei (kg) | 5.004 × 10-27 | 3.342 × 10-27 | 6.642 × 10-27 | 1.675 × 10-27 |

**(2)**