Sample Exam Papers

NATIONAL UNIVERSITY of SINGAPORE
NANYANG TECHNOLOGICAL UNIVERSITY

HANOI, 2013

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UNIVERSITY ENTRANCE EXAMINATION
PHYSICS

Time: 9.30am to 11.30am
Duration: 2 hours

Please read the following instructions carefully.

1. This examination has TWO (2) sections – A and B, and comprises SEVEN (7) printed pages.

2. Answer all questions in section A.
    i.   For each question, five suggested answers are given. Choose the most appropriate one and indicate it on the answer paper provided.
    ii. Each question is allotted 2 marks. Marks will not be deducted for wrong answers.
    iii. You are advised to spend about 45 minutes on this section.

3. Answer any THREE (3) questions from section B.
    i.   Write your answers on the answer paper provided. Begin each question on a fresh sheet of paper. Write the question number beside each question.
    ii. Each question is allotted 20 marks.

4. At the end of the examination, attach the cover paper on top of your answer script. Complete the information required on the cover paper. The cover paper for this examination is BLUE.

5. Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

SECTION A (40 marks)

1. Which one of the following products may not be expressed in units of energy?

   A. surface tension x area
   B. force x distance moved
   C. pressure x volume
   D. mass x (speed of light)^2
   E. potential difference x current

2. A stone is thrown from P and follows a parabolic path. The highest point reached is T. The vertical component of acceleration of the stone

   A. is zero at T
   B. is greatest at T
   C. is greatest at P
   D. is the same at P as at T
   E. decreases at a constant rate

3. For a particle moving in a horizontal circle with constant angular velocity,

   A. the linear momentum is constant but the energy varies
   B. the energy is constant but the linear momentum varies
   C. both energy and linear momentum are constant
   D. neither the linear momentum nor the energy is constant
   E. the speed and the linear velocity are both constant

4. On braking, 500 kJ of heat were produced when a vehicle of total mass 1600 kg was brought to rest on a level road. The speed of the vehicle just before the brakes were applied was

   A. 0.625 ms^{-1}
   B. 0.79 ms^{-1}
   C. 25 ms^{-1}
   D. 62.5 ms^{-1}
   E. 625 ms^{-1}

5. A body of mass m moves at constant angular speed ω in a horizontal circle of radius r. What is the work done on the body in one revolution?

   A. zero
   B. $2\pi mr^2\omega^2$
   C. $\pi mr^3\omega^3$
   D. $mr^2\omega^2$
   E. $mr^2\omega^2/2$

6. The critical angle for an air-glass interface is

   A. the smallest angle of incidence for which light in air can enter glass
   B. the largest angle of incidence for which light in air can enter glass
   C. the angle at which white light is just dispersed into its constituent colours
   D. the largest angle of incidence for which light in glass can enter air
   E. the smallest angle of incidence for which light in glass can enter air

7. The energy carried by a wave-train is proportional to the square of the wave amplitude. If two waves of the same frequency are superposed in phase, the total energy carried is proportional to

   A. the sum of the energies carried by the separate waves
   B. the mean value of the energies carried by the separate waves
   C. the square of the mean value of the two amplitudes
   D. the square of the difference of the two amplitudes
   E. the square of the sum of the two amplitudes

8. Which one of the following characteristics of electromagnetic waves is needed to explain the spectrum produced when white light falls on a diffraction grating? Electromagnetic waves can

   A. interfere
   B. be linearly polarized
   C. change speed in passing from one material into another
   D. be reflected with little, if any, loss in intensity
   E. be shown to exchange energy with matter in quantised amounts

9. For the construction of a thermometer, one of the essential requirements is a thermometric substance which

   A. remains liquid over the entire range of temperature to be measured
   B. has a property that varies linearly with temperature
   C. has a property that varies with temperature
   D. obeys Boyle's law
   E. has a constant expansivity

10. The average kinetic energy of the molecules of an ideal gas in a closed, rigid container is increased by a factor of 4. What happens to the pressure of the gas?

    A. It remains the same
    B. It increases by a factor of 2
    C. It increases by a factor of 4
    D. It increases by a factor of 8
    E. It increases by a factor of 16

11. A $2\mu F$ capacitor is charged to a potential of 200 V and then isolated. When it is connected in parallel with a second capacitor which is initially uncharged, the common potential becomes $40V$. The capacitor of the second capacitor is

    A. $2\mu F$
    B. $4\mu F$
    C. $6\mu F$
    D. $8\mu F$
    E. $16\mu F$

12. The resistance of a semiconductor decreases rapidly with increasing temperature. The main factor contributing to this effect is the rapid increase, with increasing temperature, of

    A. the speed of the random motion of the free charge carriers
    B. the concentration of the free charge carriers
    C. the drift velocity of the free charge carriers
    D. the frequency of vibration of the atoms of the semiconductor
    E. the amplitude of vibration of the atoms of the semiconductor

13. A mutual inductor consists of two coils X and Y arranged so that one quarter of the magnetic flux produced by X links with Y. When X is used as the primary coil and Y as the secondary, the mutual inductance is M. What is the mutual inductance when Y is used as primary and X as the secondary?

    A. $M/4$
    B. $M/2$
    C. M
    D. $2M$
    E. $4M$

14. When an electron moving with constant speed in a vacuum enters a magnetic field in a direction at right angles to the field, its subsequent path is

    A. a straight line parallel to the field
    B. a parabola in a plane normal to the field
    C. a circle in a plane normal to the field
    D. undeviated
    E. a spiral with the direction of the field as axis

15. Drops X and Y, of the same oil, remained simultaneously stationary in air so long as a vertical electric field was applied. After the field had been switched off, X fell more quickly than Y. Which one of the following deductions can be made?

    A. X had a greater charge than Y
    B. Y had a greater charge than X
    C. Both X and Y were positively charged
    D. X lost its charge while Y remained charged
    E. The charges on X and Y were identical in sign and magnitude

16. The wavelength of a 5 MeV γ- ray is

    A. 4.95×10^{-38} m
    B. 8.89×10^{-32} m
    C. 8.89×10^{-30} m
    D. 2.48×10^{-13} m
    E. 2.48×10^{-10} m

[electron charge $= -1.6 \times 10^{-19}$ C; Planck constant $= 6.6 \times 10^{-34}$ Js; speed of light $= 3.0 \times 10^{8}$ ms^{-1}]

17. A student connects a photocell to a supply and finds that when the cell is exposed to monochromatic radiation, a current flows only when the potential difference across the cell is less than 1.6V. What is the maximum energy of the emitted electrons?

    A. 1.0×10^{-19} J
    B. 2.6×10^{-19} J
    C. 4.8×10^{-11} J
    D. 1.6 J
    E. $1.0 \times 10^{+19}$ J

[electronic charge $= -1.6 \times 10^{-19}$ C]

18. The wave nature of electrons is suggested by experiments on

    A. line spectra of atoms
    B. the production of X-rays
    C. the photoelectric effect
    D. electron diffraction by a crystalline material
    E. β-decay of nuclei

19. A naturally occurring isotope of radium, $^{226}_{88}R_a$ has a half-life of 1622 years. Its radioactive decay may be represented by the equation

$$^{226}_{88}R_a \rightarrow X + a + \gamma$$
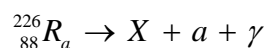
where X is a daughter nuclide, a is an alpha-particle and γ is a gamma-ray photon. The atomic number of X is

    A. 86
    B. 88
    C. 89
    D. 224
    E. 227

20. The radioactive decay of a certain nuclide is governed by the following relationship:

$$\frac{dn}{dt} = -\lambda n \quad where \quad \lambda = 2.4 \, x 10^{-8} \, s^{-1}$$

What is the half-life of the nuclide?

    A. 2.9 x 10⁷s
    B. 1.3 x 10⁷s
    C. 1.2 x 10⁸ s
    D. 3.4 x 10⁸ s
    E. 8.0 x 10⁸ s

SECTION B (60 marks)

1. (a) State the laws of conservation of linear momentum and energy. [6 marks]

    (b) A proton of mass *m* moving with velocity *u* makes a head-on, perfectly elastic collision with a stationary nucleus of mass *M*. The velocities of the proton and the nucleus after collision are ν and *V* respectively.

    (i) Write down the equations that summarise the application of the laws of conservation of linear momentum and energy. [4 marks]

    (ii) Show that the fractional loss of kinetic energy $\Delta E / E$ of the proton is given by

    $$\frac{\Delta E}{E} = \frac{4(M/m)}{(1+M/m)^2}$$

    [6 marks]

    (iii) Assume the nucleus has a mass 4 times that of the proton, calculate the fraction of the kinetic energy of the proton which is transferred to the nucleus. [4 marks]

2. (a) State the principle of superposition of waves and use it to account the following observations.

    (i) The interference of light produced in Young's double-slit experiment.
    (ii) The diffraction of parallel light with fringe pattern produced by a single slit.

    [8 marks]

    (b) Explain how the wavelength of monochromatic light is measured by using a diffraction grating and a spectrometer. [6 marks]

    (c) A parallel beam of sodium light is incident normally on a diffraction grating having 400 lines per mm. The angle between the two first order spectra on either side of the normal is $27°16'$. Find the wavelength of the light. [6 marks]

3. (a) Define the specific latent heat of vaporisation of water and describe a method for its determination. [8 marks]

    (b) At a temperature of $100°C$ and a pressure of $1.01 x 10^5 Pa$, 1.00 *kg* of steam occupies $1.67m^3$ but the same mass of water occupies only 1.04 x 10^{-3} m^3. The specific latent heat of vaporization of water at $100°C$ is *2.26 x 10^6 J kg^{-1}*. For a system consisting of *2.00 kg* of water changing to steam at $100°C$ and $1.01 x 10^5 Pa$, find

    (i) the heat applied to the system,

    (ii) the work done by the system, and

(iii) the increase in the internal energy of the system.

[12 marks]

4. (a) (i) Describe, with the aid of a labelled diagram, the structure of a single beam cathode-ray oscilloscope tube.

   (ii) What is the function of the linear time-base in an oscilloscope? Sketch a graph showing the variation of the time-base voltage with time.

   [10 marks]

   (b) A cathode-ray oscilloscope has its voltage sensitivity (Y-deflection) set at 10Vcm^{-1} and its time-base (X-deflection) set at 2 ms cm^{-1}. A sinusoidal input is suitably applied to give a steady trace on the screen. If the trace has a total peak to peak height of 4.0 cm and a horizontal distance for one complete cycle of 2.0 cm, determine

   (i)   the r.m.s voltage, and

   (ii)   the frequency of the input signal.

   [10 marks]

5. A typical fission reaction is $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{148}_{57}La + ^{85}_{35}Br + neutrons$.

   (a)   Explain the term fission reaction. [5 marks]

   (b)   What is meant by 235 and 92 in $^{235}_{92}U$? [4 marks]

   (c)   How many neutrons are released in this reaction? What is the importance of these neutrons in a nuclear reactor? [6 marks]

   (d)   Calculate the energy released in this reaction.

   [mass of $^{235}_{92}U = 235.1u$,   mass of $^{1}_{0}n = 1.009u$

   mass of $^{148}_{57}La = 148.0u$,   mass of $^{85}_{35}Br = 84.9u$

   $1u = 931 MeV$]

   [5 marks]

7

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

PHYSICS

Duration   : 2 hours

Please read the follow instructions carefully.

1.   This examination has TWO (2) sections – A and B, and comprises **SEVEN (7)** printed pages.

2.   Attempt all sections.

3.   Answer all questions in section A.   Indicate your answers on the answer paper provided.   Each question carries 2 marks.   Marks will not be deducted for wrong answers.

4.   Answer any THREE (3) questions in section B. Write your answers on the answer paper provided.   Begin each question with a fresh sheet of paper.   Write the question number clearly.   Each question carries 20 marks.

5.   A non-programmable scientific calculator may be used.

6.   At the end of the examination, attach the cover paper on top of your answer script.   Complete the information required on the cover page and tie the papers together with the string provided.

7.   Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Answer all questions in this section.   Each question carries 2 marks.

1. A car accelerates uniformly from 10 to 20 ms^{-1} in a distance of 150m; How long after that will it reach 40 ms^{-1} ?

    A   40s .
    B   20s .
    C   45s .
    D   15s .
    E   30s .

2. A parachuter of mass 75 kg falls towards the earth at a speed of 25 ms^{-1}. What is the resultant force acting on the person?

    A   750N .
    B   450N .
    C   1,350N .
    D   No net force .
    E   1,500N .

3. Light travels at different speed through different materials. If it travels at speed c_1 in a medium of refractive index 1.2, what is its speed in a medium of refractive index 1.6?

    A $1.3c_1$.
    B $0.67c_1$.
    C $2c_1$.
    D $1.7c_1$.
    E $0.55c_1$.

4. Speed of sound in air is $340ms^{-1.}$ A shot is fired and the echo is heard 2 s after the shot was fired.   How far is the reflecting surface?

    A   340m .
    B   680m .
    C   170m .
    D   85m .
    E   34m .

5. The oscillation of a pendulum is simple harmonic when the amplitude is small compared to its length. This is because:

    A   a long pendulum loses less energy .
    B   the restoring force is proportional to displacement at small angles .
    C   friction of the pivot is smaller when the pendulum is long .
    D   a long pendulum is more massive.
    E   it has a higher length to mass ratio.

6.   A coil of wire stores energy in the form of

   A   charge .
   B   potential difference .
   C   magnetic field .
   D   A and B .
   E   A and C .

7.   The angular frequency of a wave is 2,000π and its phase velocity is 320ms^{-1}. Its period is

   A 10^{-3}s .
   B 5×10^{-4}s .
   C   10 ms .
   D   100μs .
   E   0.05s .

8.   A motor has both resistance and inductance. A motor rated at 1 hp input operating at 240V draws 4 A of current because

   A   power is lost due to resistance .
   B   magnetic saturation robs power .
   C   inductance does not consume power .
   D   friction in the bearings of the motor.
   E   A and B .

9.   A sinusoidal alternating current is fullwave rectified. The rectified current will produce in the same load

   A   the same power .
   B   0.71 times the power .
   C   1.41 times the power .
   D   half the power .
   E   twice the power .

10.   Capacitance is measured in

   A   Farads .
   B   Henrys .
   C   Ohms.
   D   Pascal .
   E   Watts .

11. Fluorescent lamps use phosphors to produce visible light from UV light. This is done by absorbing the UV light and then re-radiating it using a different wavelength. This is a

   A   one way process .
   B   reversible process.
   C   process that produces continuous spectrum .
   D   process that produces a single wavelength only .
   E   process that is very inefficient .

12. The property of a transparent material that makes it useful as material for a lens is

   A   refraction .
   B   diffraction .
   C   polarization .
   D   dispersion .
   E   absorption .

13. Which of the properties listed below determines the energy of a photon

   A   wavelength .
   B   intensity of the beam .
   C   speed of the photon.
   D   polarization .
   E   frequency .

14. The conservation of linear momentum in a collision does not apply if

   A   sound is generated during impact .
   B   the collision is inelastic .
   C   frictional forces are present .
   D   the objects do not collide head-on .
   E   The collision is partially elastic only .

15. A simple glass lens do not focus the image of an object correctly under white light because

   A   the lens absorbs light .
   B   the glass has some colouration due to impurities .
   C   the surface of the lens reflect some light .
   D   a glass prism splits sunlight into different colours .
   E   glass absorbs UV light .

16. When measured with a digital multimeter, the potential difference of a dry cell is 1.6V. When it was used in a 2 cell flashlight with a lamp current of 0.75A, the lamp was found to be working at 2.4V. This is due to internal resistance. The internal resistance of a cell is

    A 0.533Ω .
    B 1.07Ω .
    C 3.20Ω .
    D 1.10Ω .
    E 0.107Ω .

17. Heat is used to change a liquid to its gaseous state at the same temperature as the liquid. This is because of the property of the liquid called

    A   heat capacity .
    B   latern heat .
    C   specific heat capacity .
    D   conductivity .
    E   boiling point .

18. The shadow cast by an object on a wall by the light from a point source of light at a smaller distance from the object compared to one with the light source placed further away from the object has a sharpness of edge that is

    A   reduced .
    B   the same .
    C   increased .
    D   the same at first and then reduces .
    E   the same at first and then increases .

19. Two weights of mass 10kg are hung at two ends of a rope that is passed over a frictionless pulley fixed on the ceiling. The tension in the rope is

    A   98N .
    B   196N .
    C   49N .
    D   147N .
    E   73.5N .

20. Two metal plates carrying charge Q is separated by a distance d. The capacitance of the resultant charged capacitor is then decreased by moving the plates. The energy stored in the capacitor

    A   stays the same .
    B   increases .
    C   decreases .
    D   stays the same if the plates are moved parallel to each other .
    E   decreases if the plates are moved parallel to each other .

Answer not more than THREE (3) questions in this section. Each question carries 20 marks.

1.   A kettle rated at 240V10A is placed on an electronic weighing scale and turned on. When the liquid is boiling, the kettle is found to be losing weight at the rate of 10g in 10s .

Calculate

(a)   Power rating of the kettle

[2 marks]

(b)   The specific heat of vapourisation of the liquid

[8 marks]

(c)   Site one source of error in the determination of the value of (b)

[5 marks]

(d)   Suggest how this error may be reduced.

[5 marks]

2.   A toy car of mass 0.50kg works with a wound spring that exerts a force as shown in the table below. The car was initially at rest. The spring is wound at the car set in motion on a horizontal surface.

Time (s)	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
Force (N)	0.20	0.18	0.15	0.12	0.10	0.08	0.05	0.02	0.00

(a)   Plot a graph of force vs. time using the table above. Determine from the graph the speed of the car 8 s after being released.

[8 marks]

(b)   The car then crashes into a stationary car of mass 1.50kg. and is stuck to the second car. Calculate the speed of the two   cars   after collision.   Show if the collision is elastic or not.

[12 marks]

3. **(a)** State what is an electric current.

[2 marks]

(b) A car battery can supply current of 1A for 45 hours. Its potential difference is 12V. Calculate the energy stored in a fully charged battery

[6 marks]

(c) A heater rated at 2,000W operating at 250V is used on a supply of 230V. if the resistance of the heater is independent of temperature, calculate the power absorbed by the heater.

[6 marks]

(d) You are given a number of 100 Ω resistors. Draw circuits that will form a total resistance of (i) 50Ω; (ii) 150Ω (iii) 67Ω.

[6 marks]

4. A grinding wheel has a diameter of 0.12m and spins horizontally at 1,200 revolutions per minute about a vertical axis. A particle of mass 1×10^{-4}kg sticks to the wheel .

(a) Calculate the magnitude of the angular velocity, acceleration and force acting on the particle

[5 marks]

(b) The radial force that keeps the particle on the wheel is 2.5N . Calculate the angular velocity at which the particle will leave the wheel.

[5 marks]

(c) If the wheel exceeds the angular speed in (b), calculate the speed and direction of motion of the particle just after it leaves the surface of the wheel.

[10 marks]

5. A mass is suspended on a spring. When the mass is displaced and then freed, the amplitude of oscillation is found to be 6mm. The period of oscillation is 3.2s .

(a) Caculate the maximum acceleration of the mass.

[6 marks]

(b) Sketch a graph with scales to show acceleration of the mass as a function of displacement.

[8 marks]

(c) Suggest and explain one reason why the mass may not oscillate in simple harmonic motion.

[6 marks]

END OF PAPER

UNIVERSITY ENTRANCE EXAMINATION

NUS
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PHYSICS

Duration : 2 hours

Please read the following instructions carefully.

1.   This paper is made up of 50 Multiple-Choice questions and comprises **ELEVEN** (**11**) printed pages.

2.   **Do not write on the question paper**.

3.   Answer all questions and indicate your answers on the answer sheet provided. Marks will not be deducted for wrong answers.

4.   Do not take any paper, including the question paper or unused answer sheets, out of the examination hall.

Answer all questions in this section.

1. The mass of an isotope of uranium $^{238}_{92}U$ is 238.05 g mol^{-1}. Its density is 19.1 g cm^{-3} at room temperature. Which of the following is closest to the number of $^{238}_{92}U$ atoms in 1 cm^3 of this isotope?
    A 2.53×10^{21}
    B 3.29×10^{22}
    C 4.83×10^{22}
    D 6.02×10^{23}
    E 7.51×10^{24}

2. An isotope of plutonium $^{239}_{94}Pu$ decays by alpha emission. Which of the following is the decay product?
    A $^{243}_{96}Cm$
    B $^{235}_{94}Pu$
    C $^{239}_{93}Np$
    D $^{235}_{92}U$
    E $^{234}_{90}Th$

3. A compact disc of diameter 120 mm is spinning at a speed of 500 revolutions per minute. Which of the following is closest to the linear speed of the outer edge of the disc?
    A   0.50 m s^{-1}
    B   1.0 m s^{-1}
    C   1.6 m s^{-1}
    D   3.1 m s^{-1}
    E   60 m s^{-1}

4. A steel wire is stretched and clamped between two fixed points that are spaced 1.0 m apart. Which of the following is closest to the fundamental wavelength that can exist on this wire?

    A   0.25 m
    B   0.50 m
    C   1.0 m
    D   2.0 m
    E   4.0 m

5. A thin converging lens of focal length 20 cm is used to shape light from a lamp filament into a parallel beam. Which of the following is closest to the required distance between the lamp filament and the lens?

    A   5.0 cm
    B   10 cm
    C   20 cm
    D   40 cm
    E   80 cm

6. A metallic sphere of radius 1.0 cm is charged with 1.0×10^9 electrons in air. Which of the following is closest to the electric potential difference between the surface of this sphere and a point far away? [The electric potential of a charged metallic sphere varies with distance r from the centre of the sphere according to $V = \dfrac{1}{4\pi \cdot \varepsilon_o} \dfrac{q}{r}$ for $r \geq r_o$, where r_o is the radius of the sphere.]

A 70 V
B –70 V
C 140 V
D –140 V
E 8.99×10^{20} V

7. Which of the following is closest to the wavelength of an electron of energy 1.0 eV?
A 1.2 nm
B 15 nm
C 50 nm
D 350 nm
E 1240 nm

8. Which of the following is most suitable to measure the temperature of red hot molten steel?
A bimetallic strip thermometer
B thermocouple
C optical pyrometer
D mercury-in-glass thermometer
E silicon diode thermometer

9. Which of the following is closest to the mean distance between air molecules at room temperature and pressure (298 K and 101325 Pa)? Assume air is made of 79% N_2 and 21% O_2 by moles.
A 0.4 nm
B 4 nm
C 40 nm
D 400 nm
E 4 μm

10. The linear thermal expansion coefficient of invar is 1.3×10^{-6} K^{-1}. Which of the following is closest to the change in length of a 10-cm-long invar rod subjected to a change in temperature of +100ºC?
A +0.13 μm
B +1.3 μm
C +13 μm
D +130 μm
E +1.3 mm

11. A typical capacitor in an MP3 player has $C = 0.10\,\mu F$. If a voltage of $12.0\,V$ is placed on the capacitor, what is the charge on it?

A $1.2\,\mu C$
B $120\,\mu C$
C   1.2 C
D   120 C
E $1.2 \times 10^8 C$

12. A long, straight wire of length 1.4 m carries a current of $i = 3.5\,A$. If a magnetic field of magnitude $B = 1.5\,T$ is directed parallel to the wire, what is the magnitude of the force on the wire?

A   7.4 N
B   6.7 N
C   5.2 N
D   3.7 N
E   0 N

13. Two point charges are separated by a distance r. If the separation is reduced by a factor of 3/2, by what factor does the **electric potential** between them change?

A   3/2
B   2/3
C   9/4
D   4/9
E $\sqrt{3/2}$

14. The surface of the Sun has a temperature of about 6000 K. What is the root-mean-square speed of a hydrogen atom in the Sun's atmosphere?

A   6100 m/s
B   7900 m/s
C   9300 m/s
D   8600 m/s
E   12000 m/s

15. What is the critical for total internal reflection for light travelling between diamond (n = 2.42) and water (n = 1.33)?

A $24.4°$
B $33.3°$
C $36.6°$
D $48.8°$
E $90.0°$

16. A rectangular gold plate has an area of $0.40\,\text{m}^2$ at $15°\text{C}$. If it is heated until its area has increased by $2.5\times10^{-3}\,\text{m}^2$, what is the final temperature of the plate? For gold, the coefficient of expansion is $14\times10^{-6}\,\text{K}^{-1}$.

A $115°\text{C}$

B $145°\text{C}$

C $175°\text{C}$

D $205°\text{C}$

E $235°\text{C}$

17. A pot of very cold water $(0°\text{C})$ is placed on a stove with the burner adjusted for maximum heat. It is found that the water just begins to boil after 3.0 min. How much longer will it take the water to completely boil away?

A   1.6 min

B   3.6 min

C   16 min

D   18 min

E   19 min

18. A proton with $v=200\,\text{m/s}$ is moving through a region in which the magnetic field is $B=2.5\,\text{T}$. If the magnitude of the force on the proton is $6.4\times10^{-17}\,\text{N}$, what angle does the proton's velocity make with $\vec{B}$?

A $23°$

B $35°$

C $46°$

D $53°$

E $80°$

19. The work function for a metal is 5.0 eV. What is the maximum photon wavelength that can just eject an electron from the metal?

A   750 nm

B   500 nm

C   250 nm

D   125 nm

E   100 nm

20. The number of atoms in your body is closest to

A 1×10^{36}

B 2×10^{32}

C 3×10^{32}

D 4×10^{28}

E 5×10^{24}

21. The period of a physical pendulum can be calculated by $T = 2\pi\sqrt{\dfrac{I}{mgd}}$. The quantity d has the unit of m. What is the unit of I?

A $\text{kg}^{-2}\cdot\text{m}^2$

B $\text{kg}\cdot\text{s}^2$

C $\text{m}^2\cdot\text{s}^{-2}$

D $\text{m}^{-2}\cdot\text{s}^2$

E $\text{kg}\cdot\text{m}^2$

22. Balancing the nuclear equation ${}^{238}_{94}\text{Pu} \rightarrow X + \alpha$

A $X = {}^{236}_{90}\text{Th}$

B $X = {}^{240}_{90}\text{Th}$

C $X = {}^{234}_{92}\text{U}$

D $X = {}^{240}_{92}\text{U}$

E $X = {}^{236}_{94}\text{Pu}$

23. A particle is moving along a straight line. The position of the particle as a function of time is $x(t) = 6 + 8t + 10t^2$. What is the average speed of the particle between $t = 1$ and $t = 2$?

A   8

B   18

C   28

D   38

E   48

24. A soccer ball with mass 0.45 kg is initially moving with speed 2.00 m/s. A soccer player kicks the ball, exerting a constant force of magnitude 30.0 N in the same direction as the ball's motion. Over what distance must the player's foot be in contact with the ball to increase the ball's speed to 4.00 m/s?

A   0.06 m

B   0.09 m

C   0.12 m

D   0.15 m

E   None of the above

25. A laboratory centrifuge makes 2000 rpm (rev/min) and produces an acceleration of $6.00g$ at its outer end. What is the acceleration at a point halfway out to the end?

A $1.50g$

B $3.00g$

C $6.00g$

D $12.00g$

E $24.00g$

26. A student tries to raise a chain consisting of three identical links. Each link has a mass of 200 g. The three-piece chain is connected to a light string and then suspended vertically, with the student holding the upper end of the string and pulling upward. Because of the student's pull, an upward force of 15.0 N is applied to the chain by the string. Find the force exerted by the top link on the middle link.
    A   3.0 N
    B   6.0 N
    C   8.0 N
    D   10.0 N
    E   None of the above

27. What is the percent difference between your apparent weight in Singapore, near the sea level, and at the top of Mount K2, which is 8611 m above sea level?
    A   0%
    B   0.07%
    C   0.13%
    D   0.27%
    E   None of the above

28. A student originally charges a fixed capacitor to have a potential energy of 1 J. If the student wishes to give the capacitor a potential energy of 4 J, then the student should

    A   quadruple the potential difference across the capacitor but leave the charge unchanged.
    B   double the potential difference across the capacitor but leave the charge unchanged.
    C   double both the potential difference across the capacitor and the charge.
    D   leave the potential difference across the capacitor unchanged while doubling the charge.
    E   leave the potential difference across the capacitor unchanged while quadrupling the charge.

29. The resistivity of gold is $2.44 \times 10^{-8} \Omega \cdot m$ at a temperature of $20.0°C$. A gold wire, 1.00 mm in diameter and 37.0 cm long, carries a current of 810 mA. The power dissipated in the wire is closest to
    A   1.9 mW
    B   3.3 mW
    C   4.7 mW
    D   6.1 mW
    E   7.5 mW

30. What is the root-mean-square current value for an alternating current with an amplitude of 10 A?
    A   3.1 A
    B   7.1 A
    C   10 A
    D   24 A
    E   28 A

31. A standing wave is set up in a 200 cm string fixed at both ends? The string vibrates in 5 distinct segments when driven by a 120 Hz source. What is the wave speed?

A 96 m/s
B 120 m/s
C 160 m/s
D 240 m/s
E 480 m/s

32. A 18 mm wide diffraction grating has rulings of 740 lines per mm. Light is incident normally on the grating. Monochromatic light of 555 nm wavelength is used. The largest angle from the normal at which an intensity maximum is formed is closest to

A $47°$

B $49°$

C $51°$

D $53°$

E $55°$

33. A laser pulse of duration 25 ms has a total energy of 2.0 J.   If the wavelength of this radiation is 481 nm, how many photons are emitted in one pulse?

A 4.8×10^{18}

B 5.8×10^{19}

C 1.2×10^{20}

D 1.9×10^{17}

E 3.8×10^{17}

34. An electron's de Broglie wavelength is $5.0\,\mu m$. What is its speed?

A 1.5×10^{2} m/s

B 8.0×10^{2} m/s

C 1.2×10^{5} m/s

D 4.0×10^{6} m/s

E 4.0×10^{7} m/s

35. The decay chain that leads from $^{238}_{92}U$ to $^{206}_{82}Pb$ consists a series of alpha decays and beta decays. How many beta particles are emitted?

A 4
B 5
C 6
D 7
E 8

8

36. The decay constant of a radioactive nuclide is $2.1\times10^{-3}\,\text{s}^{-1}$. The half-life of the nuclide, in minutes, is closest to

A 3.1
B 4.3
C 5.5
D 6.7
E 8.0

37. In general, if a vector **A** is to be subtracted from a vector **B** the magnitude of the resultant when $A \geq B$
A must equal $A + B$.
B must equal $A - B$.
C may be between A and $A + B$.
D may be between $B - A$ and $B + A$.
E may be between $A - B$ and $A + B$.

38. A train starts from rest and accelerates uniformly, until it has traveled 6.10 km and acquired a velocity of 23.0 m/s. The train then moves at a constant velocity of 23.0 m/s for 450 s. The train then slows down uniformly at 0.0650 m/s^2, until it is brought to a halt. The acceleration during the first 6.10 km of travel, is closest to

A $0.043\,\text{m/s}^2$

B $0.049\,\text{m/s}^2$

C $0.054\,\text{m/s}^2$

D $0.060\,\text{m/s}^2$

E $0.065\,\text{m/s}^2$

39. An object is moving in a circle at constant speed v. The magnitude of the rate of change of momentum of the object

A is proportional to v^3.
B is proportional to v^2.
C is proportional to v.
D is a nonzero constant independent of v.
E is zero.

40. An object undergoing simple harmonic motion has an amplitude of 2.3 m. If the maximum velocity of the object is 14 m/s, what is the object's angular frequency?

A $4.9\,\text{rad/s}$

B $5.5\,\text{rad/s}$

C $5.8\,\text{rad/s}$

D $6.1\,\text{rad/s}$

E $6.7\,\text{rad/s}$

41. A car accelerates uniformly from 10 to 20 ms^{-1} in a distance of 150m; How long after that will it reach 40 ms^{-1} ?

A 40s .
B 20s .
C 45s .
D 15s .
E 30s .

42. A parachuter of mass 75 kg falls towards the earth at a speed of 25 ms^{-1}. What is the resultant force acting on the person?

A 750N .
B 450N .
C 1,350N .
D No net force .
E 1,500N .

43. Light travels at different speed through different materials. If it travels at speed c_1 in a medium of refractive index 1.2, what is its speed in a medium of refractive index 1.6?

A $1.3c_1$.
B $0.67c_1$.
C $2c_1$.
D $1.7c_1$.
E $0.55c_1$.

44. Speed of sound in air is 340ms$^{-1.}$ A shot is fired and the echo is heard 2 s after the shot was fired. How far is the reflecting surface?

A 340m .
B 680m .
C 170m .
D 85m .
E 34m .

45. The oscillation of a pendulum is simple harmonic when the amplitude is small compared to its length. This is because:

A a long pendulum loses less energy .
B the restoring force is proportional to displacement at small angles .
C friction of the pivot is smaller when the pendulum is long .
D a long pendulum is more massive.
E it has a higher length to mass ratio.

46. A coil of wire stores energy in the form of

    A   charge .
    B   potential difference .
    C   magnetic field .
    D   A and B .
    E   A and C .

47. The angular frequency of a wave is 2,000π and its phase velocity is 320ms^{-1}. Its period is

    A 10^{-3}s .
    B 5×10^{-4}s .
    C   10 ms .
    D   100µs .
    E   0.05s .

48. A motor has both resistance and inductance. A motor rated at 1 hp input operating at 240V draws 4 A of current because

    A   power is lost due to resistance .
    B   magnetic saturation robs power .
    C   inductance does not consume power .
    D   friction in the bearings of the motor.
    E   A and B .

49. A sinusoidal alternating current is fullwave rectified. The rectified current will produce in the same load

    A   the same power .
    B   0.71 times the power .
    C   1.41 times the power .
    D   half the power .
    E   twice the power .

50. Capacitance is measured in

    A   Farads .
    B   Henrys .
    C   Ohms.
    D   Pascal .
    E   Watts .

END OF PAPER

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

PHYSICS

Duration   : 2 hours

Please read the following instructions carefully.

1.   This paper is made up of 50 Multiple-Choice questions and comprises **ELEVEN** (**11**) printed pages.

2.   **Do not write on the question paper**.

3.   Answer all questions and indicate your answers on the answer sheet provided. Marks will not be deducted for wrong answers.

4.   Do not take any paper, including the question paper or unused answer sheets, out of the examination hall.

Answer all questions in this section.

1. A car accelerates uniformly from 10 to 20 ms^{-1} in a distance of 150m; How long after that will it reach 40 ms^{-1} ?

    A   40s .
    B   20s .
    C   45s .
    D   15s .
    E   30s .

2. A parachuter of mass 75 kg falls towards the earth at a speed of 25 ms^{-1}. What is the resultant force acting on the person?

    A   750N .
    B   450N .
    C   1,350N .
    D   No net force .
    E   1,500N .

3. Light travels at different speed through different materials. If it travels at speed c_1 in a medium of refractive index 1.2, what is its speed in a medium of refractive index 1.6?

    A $1.3c_1$.
    B $0.67c_1$.
    C $2c_1$.
    D $1.7c_1$.
    E $0.55c_1$.

4. Speed of sound in air is 340ms$^{-1.}$ A shot is fired and the echo is heard 2 s after the shot was fired.   How far is the reflecting surface?

    A   340m .
    B   680m .
    C   170m .
    D   85m .
    E   34m .

5. The oscillation of a pendulum is simple harmonic when the amplitude is small compared to its length. This is because:

    A   a long pendulum loses less energy .
    B   the restoring force is proportional to displacement at small angles .
    C   friction of the pivot is smaller when the pendulum is long .
    D   a long pendulum is more massive.
    E   it has a higher length to mass ratio.

6. A coil of wire stores energy in the form of

    A   charge .
    B   potential difference .
    C   magnetic field .
    D   A and B .
    E   A and C .

7. The angular frequency of a wave is $2,000\pi$ and its phase velocity is $320 ms^{-1}$. Its period is

    A $10^{-3}s$.
    B $5 \times 10^{-4}s$.
    C   10 ms .
    D $100\mu s$.
    E   0.05s .

8. A motor has both resistance and inductance. A motor rated at 1 hp input operating at 240V draws 4 A of current because

    A   power is lost due to resistance .
    B   magnetic saturation robs power .
    C   inductance does not consume power .
    D   friction in the bearings of the motor.
    E   A and B .

9. A sinusoidal alternating current is fullwave rectified. The rectified current will produce in the same load

    A   the same power .
    B   0.71 times the power .
    C   1.41 times the power .
    D   half the power .
    E   twice the power .

10. Capacitance is measured in

    A   Farads .
    B   Henrys .
    C   Ohms.
    D   Pascal .
    E   Watts .

11. Fluorescent lamps use phosphors to produce visible light from UV light. This is done by absorbing the UV light and then re-radiating it using a different wavelength. This is a

A   one way process .
B   reversible process.
C   process that produces continuous spectrum .
D   process that produces a single wavelength only .
E   process that is very inefficient .

12. The property of a transparent material that makes it useful as material for a lens is

A   refraction .
B   diffraction .
C   polarization .
D   dispersion .
E   absorption .

13. Which of the properties listed below determines the energy of a photon

A   wavelength .
B   intensity of the beam .
C   speed of the photon.
D   polarization .
E   frequency .

14. The conservation of linear momentum in a collision does not apply if

A   sound is generated during impact .
B   the collision is inelastic .
C   frictional forces are present .
D   the objects do not collide head-on .
E   The collision is partially elastic only .

15. A simple glass lens do not focus the image of an object correctly under white light because

A   the lens absorbs light .
B   the glass has some colouration due to impurities .
C   the surface of the lens reflect some light .
D   a glass prism splits sunlight into different colours .
E   glass absorbs UV light .

16. When measured with a digital multimeter, the potential difference of a dry cell is 1.6V. When it was used in a 2 cell flashlight with a lamp current of 0.75A, the lamp was found to be working at 2.4V. This is due to internal resistance. The internal resistance of a cell is

A 0.533Ω .
B 1.07Ω .
C 3.20Ω .
D 1.10Ω .
E 0.107Ω .

17. Heat is used to change a liquid to its gaseous state at the same temperature as the liquid. This is because of the property of the liquid called

A heat capacity .
B latern heat .
C specific heat capacity .
D conductivity .
E boiling point .

18. The shadow cast by an object on a wall by the light from a point source of light at a smaller distance from the object compared to one with the light source placed further away from the object has a sharpness of edge that is

A reduced .
B the same .
C increased .
D the same at first and then reduces .
E the same at first and then increases .

19. Two weights of mass 10kg are hung at two ends of a rope that is passed over a frictionless pulley fixed on the ceiling. The tension in the rope is

A 98N .
B 196N .
C 49N .
D 147N .
E 73.5N .

20. Two metal plates carrying charge Q is separated by a distance d. The capacitance of the resultant charged capacitor is then decreased by moving the plates. The energy stored in the capacitor

A stays the same .
B increases .
C decreases .
D stays the same if the plates are moved parallel to each other .
E decreases if the plates are moved parallel to each other .

21. The velocity of a car which is decelerating uniformly changes from 30ms⁻¹ to 15ms⁻¹ in 75m. After what further distance will it come to rest?

A 25m
B 37.5m
C 50m
D 75m
E 100m

22. Which one of the following pairs of forces is not valid example of action and reaction to which Newton's third Law of Motion applies?

A the centripetal force holding a satellite in orbit round the Earth and the weight of the satellite
B the forces of repulsion experienced by each other of two parallel wires carrying currents in opposite direction
C the forces of attraction felt by each of two gas molecules passing near to each other
D the forces of attraction between an electron and a proton in a hydrogen atom
E the forces of repulsion between an atom in the surface of a table and an atom in the surface of a book resting on the table.

23. A helicopter of mass 3.0×10^3kg rises vertically with a constant speed of 25ms⁻¹. Taking the acceleration of free fall as 10ms⁻¹, what resultant force acts on the helicopter?

A Zero
B 3.0×10^4N downwards
C 4.5×10^4N upwards
D 7.5×10^4N upwards
E 10.5×10^4 upwards

24. Which one of the following is not measured in units of energy?

A couple x angle turned through
B moment of inertia x (angular velocity)²
C force x distance
D impulse x time
E mass x acceleration x distance

25. A car of mass m moving at a constant speed *v* passes over a humpback bridge of radius of curvature *r*. Given that the car remains in contact with the road, what is the net force *R* exerted by the car on the road when it is at the top of the bridge?

A $R = mg + mv^2/r$
B $R = mv^2/r$
C $R = mg - mv^2/r$
D $R = mg$
E $R = mv^2/r - mg$

26. Monochromatic light of wavelength λ_1 traveling in a medium of n_1 enters a denser medium of refractive index n_2. The wavelength in the second medium is

   A $\quad \lambda_1(n_1/n_2)$

   B $\quad \lambda_1(n_2/n_1)$

   C $\quad \lambda_1$

   D $\quad \lambda_1(n_2-n_1)/n_1$

   E $\quad \lambda_1(n_2-n_1)/n_2$

27. A sound wave of frequency 400Hz is traveling in air at a speed of 320ms^{-1}. What is the difference in phase between two points on the wave 0.2m apart in the direction of travel?

   A $\quad \pi/4$ rad

   B $\quad \pi/2$ rad

   C $\quad 2\pi/5$ rad

   D $\quad 4\pi/5$ rad

   E $\quad 8\pi/5$ rad

28. An opaque object 10cm wide casts a shadow when placed in a beam of light but has little effect on a beam of sound emitted by a small source of frequency 500 Hz. This is because

   A $\quad$ sound is a pressure wave whereas light is an electromagnetic wave

   B $\quad$ sound travels much more slowly than light

   C $\quad$ sound waves are longitudinal whereas light waves are transverse.

   D $\quad$ sound waves have a much longer wavelength than light waves

   E $\quad$ the power per unit area in a beam of sound is much lower than that in a beam of light

29. A solid X is in thermal equilibrium with a solid Y, which is at the same temperature as a third solid Z. The three bodies are of different materials and masses. Which one of the following statements is certainly correct?

   A $\quad X$ and Y have the same heat capacity

   B $\quad Y$ and Z have the same internal energy

   C $\quad$ There is no net transfer of energy if X is placed in thermal contact with Z

   D $\quad$ It is not necessary that Y should be in thermal equilibrium with Z

   E $\quad$ It is not necessary that X should be at the same temperature as Y

30. A fixed mass of gas at constant pressure occupies a volume V. The gas undergoes a rise in temperature so that the root mean square velocity of its molecules is doubled. The new volume will be

   A $\quad V/2$

   B $\quad V/\sqrt{2}$

   C $\quad V\sqrt{2}$

   D $\quad 2V$

   E $\quad 4V$

31. The densities of water and steam are $1.0 \times 10^3 \text{kgm}^{-3}$ and $6.1 \times 10^{-1} \text{kgm}^{-3}$ respectively. What is the ratio
average separation of steam molecules/average separation of water molecules?

    A   12
    B   40
    C   250
    D   1600
    E   61000

32. When electricity conduction is compared with heat conduction, the electrical analogue of rate of flow of heat is

    A   drift velocity of the charge carriers
    B   power dissipated
    C   electrical conductivity
    D   electric current
    E   potential gradient

33. The resistance of a semiconductor decreases rapidly with increasing temperature. The main factor contributing to this effect is the rapid increase, with increasing temperature of

    A   the speed of the random motion of the free charge carriers
    B   the concentration of the free charge carriers
    C   the drift velocity of the free charge carriers
    D   the frequency of vibration of the atoms of the semiconductor
    E   the amplitude of vibration of the atoms of the semiconductor

34. An alternating potential difference is connected across a pure resistor and the frequency of the supply is varied keeping the r.m.s voltage constant. The mean rate of production of heat in the resistor is

    A   proportional to $(\text{frequency})^2$
    B   proportional to frequency
    C   proportional to $(\text{frequency})^{1/2}$
    D   inversely proportional to frequency
    E   independent of frequency

35. Double-ionized oxygen atoms (O^{2-}) and singly-ionized lithium atoms (Li^+) are traveling with the same speed, perpendicular to a magnetic field which causes them to move in circular orbits. The relative atomic masses of oxygen and lithium are 16 and 7 respectively. What is the ratio radius of O^{2-} orbit/radius of Li^+ orbit?

    A   16/7
    B   8/7
    C   7/8
    D   7/16
    E   7/32

36. Photon is the name given to
   A an electron emitted from a metal surface by the action of light
   B a unit of energy
   C a positive charged atomic particle
   D an electron emitted from a metal surface by the action of heat
   E a quantum of electro-magnetic radiation

37. Which one of the following statements referring to photoelectric emission is always true?
   A No emission of electrons occurs for very low intensity illumination
   B For a given metal there is a minimum frequency of radiation below which no emission occurs.
   C The velocity of the emitted electrons is proportional to the intensity of the incident radiation.
   D The number of electrons emitted per second is independent of the intensity of the incident radiation.
   E The number of electrons emitted per second is proportional to the frequency of the incident radiation.

38. The intensity of a beam of monochromatic light is doubled. Which one of the following represents the corresponding change, if any, in the momentum of each photon of the radiation?
   A increased fourfold
   B doubled
   C the same
   D halved
   E reduced fourfold

39. Transition between three energy levels in a particular atom gives rise to three spectral lines of wavelengths, in increasing magnitudes, λ_1, λ_2 and λ_3. Which one of the following equations correctly relates λ_1, λ_2 and λ_3?
   A $\lambda_1 = \lambda_2 - \lambda_3$
   B $\lambda_1 = \lambda_3 - \lambda_2$
   C $\dfrac{1}{\lambda_1} = \dfrac{1}{\lambda_2} + \dfrac{1}{\lambda_3}$
   D $\dfrac{1}{\lambda_1} = \dfrac{1}{\lambda_3} - \dfrac{1}{\lambda_2}$
   E $\dfrac{1}{\lambda_1} = \dfrac{1}{\lambda_2} - \dfrac{1}{\lambda_3}$

40. When $^{238}_{92}U$ is bombarded with slow neutrons, it is transformed, absorbing a single neutron and subsequently emitting two β^- particles. The resulting nuclide is
   A $^{240}_{93}Np$
   B $^{240}_{91}Pa$
   C $^{239}_{94}Pu$
   D $^{239}_{90}Th$
   E $^{233}_{88}Ra$

41. The mass of an isotope of uranium $^{238}_{92}U$ is 238.05 g mol^{-1}. Its density is 19.1 g cm^{-3} at room temperature. Which of the following is closest to the number of $^{238}_{92}U$ atoms in 1 cm^3 of this isotope?

A 2.53×10^{21}
B 3.29×10^{22}
C 4.83×10^{22}
D 6.02×10^{23}
E 7.51×10^{24}

42. An isotope of plutonium $^{239}_{94}Pu$ decays by alpha emission. Which of the following is the decay product?

A $^{243}_{96}Cm$

B $^{235}_{94}Pu$

C $^{239}_{93}Np$

D $^{235}_{92}U$

E $^{234}_{90}Th$

43. A compact disc of diameter 120 mm is spinning at a speed of 500 revolutions per minute. Which of the following is closest to the linear speed of the outer edge of the disc?

A 0.50 m s^{-1}
B 1.0 m s^{-1}
C 1.6 m s^{-1}
D 3.1 m s^{-1}
E 60 m s^{-1}

44. A steel wire is stretched and clamped between two fixed points that are spaced 1.0 m apart. Which of the following is closest to the fundamental wavelength that can exist on this wire?

A 0.25 m
B 0.50 m
C 1.0 m
D 2.0 m
E 4.0 m

45. A thin converging lens of focal length 20 cm is used to shape light from a lamp filament into a parallel beam. Which of the following is closest to the required distance between the lamp filament and the lens?

A 5.0 cm
B 10 cm
C 20 cm
D 40 cm
E 80 cm

46. A metallic sphere of radius 1.0 cm is charged with 1.0×10^9 electrons in air. Which of the following is closest to the electric potential difference between the surface of this sphere and a point far away? [The electric potential of a charged metallic sphere varies with distance r from the centre of the sphere according to $V = \dfrac{1}{4\pi \cdot \varepsilon_o} \dfrac{q}{r}$ for $r \geq r_o$, where r_o is the radius of the sphere.]

A 70 V
B –70 V
C 140 V
D –140 V
E 8.99×10^{20} V

47. Which of the following is closest to the wavelength of an electron of energy 1.0 eV?
A 1.2 nm
B 15 nm
C 50 nm
D 350 nm
E 1240 nm

48. Which of the following is most suitable to measure the temperature of red hot molten steel?
A bimetallic strip thermometer
B thermocouple
C optical pyrometer
D mercury-in-glass thermometer
E silicon diode thermometer

49. Which of the following is closest to the mean distance between air molecules at room temperature and pressure (298 K and 101325 Pa)? Assume air is made of 79% N_2 and 21% O_2 by moles.
A 0.4 nm
B 4 nm
C 40 nm
D 400 nm
E 4 μm

50. The linear thermal expansion coefficient of invar is 1.3×10^{-6} K^{-1}. Which of the following is closest to the change in length of a 10-cm-long invar rod subjected to a change in temperature of +100ºC?
A +0.13 μm
B +1.3 μm
C +13 μm
D +130 μm
E +1.3 mm

END OF PAPER

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

ENTRANCE EXAMINATION

PHYSICS (SAMPLE)

Time Allowed: 2 hours

Date: _____ Exam Centre: _____

Name: _____

Passport /ID/Application Number: _____ Seat No.: _____

INSTRUCTIONS

1. This question and answer booklet contains TWENTY (20) questions.

2. Answer **ALL** questions.

3. You are required to show your working clearly in the space provided after each question.

4. Indicate your final answer to each question by circling one of the choices provided (a, b, c or d).

5. All questions carry equal marks.

6. This is a **CLOSED-BOOKED** examination.

7. All your solutions should be written in this booklet within the space provided after each question.

_____

For examiners:

Questions	**Total** (100)
Marks	

Question 1

An equation relating position, x, to time, t, is given by $x = b\,t^3 + c\,t^4$, where b and c are constants. The dimensions of b and c are respectively:

a. T^3, T^4.
b. $1/T^3, 1/T^4$.
c. $L/T^3, L/T^4$.
d. $L{\cdot}T^3, L{\cdot}T^4$.

Question 2

A steel sphere sits on top of an aluminum ring. The steel sphere ($\alpha = 1.10 \times 10^{-5}/\text{C}°$) has a diameter of 4.000 0 cm at 0°C. The aluminum ring ($\alpha = 2.40 \times 10^{-5}/\text{C}°$) has an inside diameter of 3.994 0 cm at 0°C. Determine the nearest temperature for the sphere to just fall through the ring.

a. 462°C
b. 208°C
c. 116°C
d. 57.7°C

Question 3

A helicopter is traveling at a constant altitude of 100 m over a level field. If a bag is thrown downwards off the helicopter with an initial vertical velocity component 2.0 m/s, determine the time taken for it to hit the ground. (g = 9.8 m/s^2 and air resistance negligible)

a. 5.0 s
b. 4.7 s
c. 4.3 s
d. 3.8 s

Question 4

Find the tension in each cable supporting the object of mass m = 51.0 kg as shown in the figure. (g = 9.80 m/s^2)

	T_1	T_2	T_3
a.	500N,	270N,	230N
b.	500N,	259N,	366N
c.	500N,	448N,	366N
d.	500N,	366N,	448N
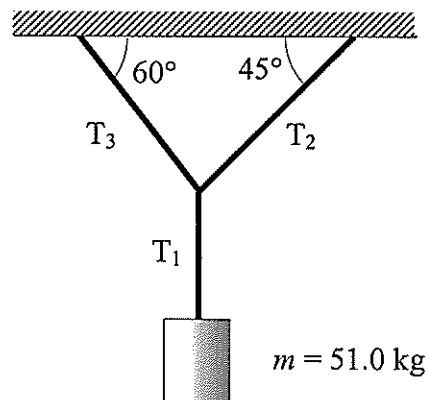
Question 5

Particle P has a mass of 1 kg and is confined to move along the smooth vertical slot due to the rotation of the arm AB. Assume that at the instant as shown, the acceleration of particle P is 2.46 m/s^2 upward. Determine the normal force N_{rod} on the particle by the rod and the normal force N_{slot} on the particle by the slot in the position shown. Friction forces are negligible.

	N_{rod}	N_{slot}
a.	14.2 N,	7.1 N
b.	10.5 N,	3.6 N
c.	7.1 N ,	14.2 N
d.	3.2 N ,	1.6 N
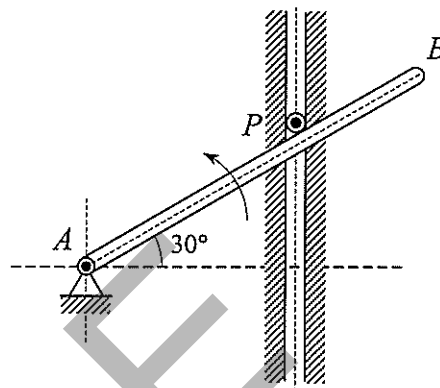
Question 6

As block B moves upward with constant speed 2 m/s, pin A glides through the semi-circular slot. At the position shown, determine the velocity of A.

a. 2.31∠60°
b. 2.00∠60°
c. 1.00∠0°
d. 1.89∠30°
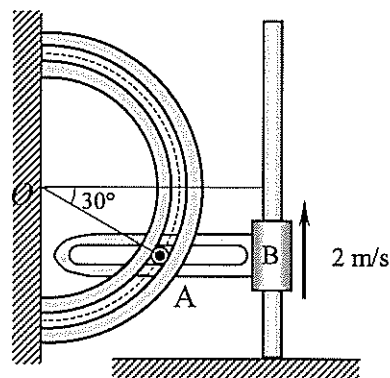
Question 7

A ball suspended from a 4.00-m cable has a speed $v_o = 4.00$ m/s when it is at its lowest point ($\theta = 0°$). Determine the highest position, θ_{max}, the ball can reach. ($g = 9.80$ m/s^2)

a. $\theta_{max} = 37.2°$
b. $\theta_{max} = 36.8°$
c. $\theta_{max} = 35.6°$
d. $\theta_{max} = 34.2°$

4 m

$\theta_{max} = ?$

v_o
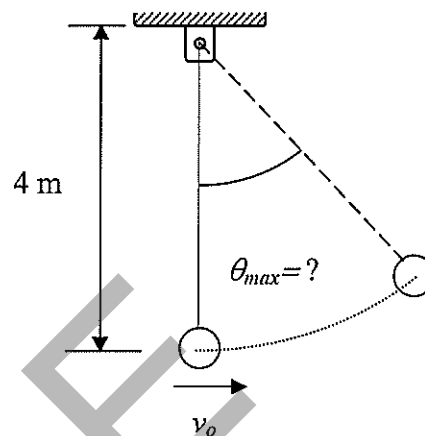
Question 8

A 20-N crate slides down from rest a rough 5.0-m long ramp, inclined at 25° with the horizontal. 20 J of energy is lost to friction. What is the speed of the crate at the bottom of the incline?

a. 0.98 m/s
b. 1.9 m/s
c. 3.2 m/s
d. 4.7 m/s

Question 9

A light spring with a force constant $k = 160$ N/m rests vertically on the bottom of a large beaker of water (a). A 5.00-kg block of wood (density = 650 kg/m^3) is connected to the spring, and the block–spring system is allowed to come to static equilibrium (b). What is the elongation ΔL of the spring?

a. 16.5 cm
b. 13.4 cm
c. 12.7 cm
d. 10.3 cm
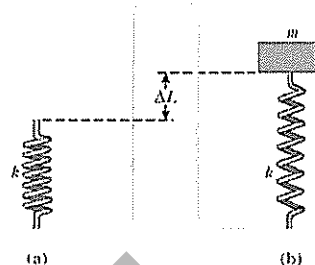
Question 10

A large block P executes horizontal simple harmonic motion as it slides across a frictionless surface with a frequency $f = 1.50$ Hz. Block B rests on it, as shown in the figure, and the coefficient of static friction (μ_s) between the two is 0.600. What is the maximum amplitude of oscillation of the system so that block B does not slip?

a. 5.54 cm
b. 6.62 cm
c. 7.02 cm
d. 7.16 cm
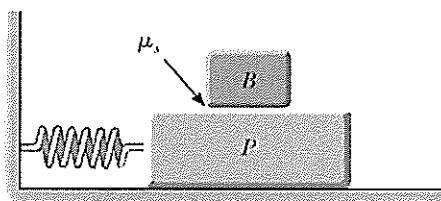
Question 11

A charged particle q = -8.0 mC is subjected to an electric field. It is released from rest at point A and moves toward point B. When the charged particle reaches point B, the kinetic energy of the particle is equal to 4.8 J. What is the electric potential difference between the points A and B, that is, $V_B - V_A$?

a. −0.60 kV
b. +0.60 kV
c. +0.80 kV
d. −0.80 kV

Question 12

A positive point charge q is placed at the center of an uncharged metal sphere insulated from the ground. The outside of the sphere is then grounded as shown. A is the inner surface and B is the outer surface of the sphere. Which of the following statements is correct?

a. The charge on A is $-q$; that on B is $+q$.
b. The charge on B is $-q$; that on A is $+q$.
c. There is no charge on either A or B.
d. The charge on A is $-q$; there is no charge on B.
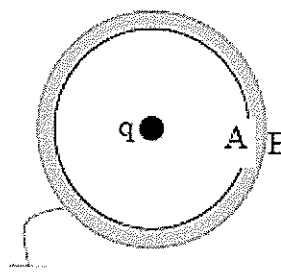
Question 13

What is the magnitude of the current in the 40 Ω resistor?

a. 0.41 A
b. 0.33 A
c. 0.77 A
d. 1.30 A
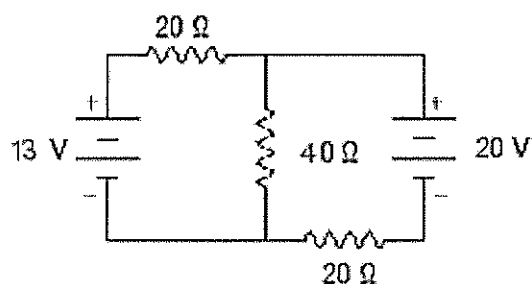
Question 14

A wire carries current in the plane of this paper toward the top of the page. The wire experiences a magnetic force toward the right edge of the page. The direction of the magnetic field causing this force is

a. in the plane of the page and toward the left edge
b. in the plane of the page and toward the bottom edge
c. upward out of the page
d. downward into the page

Question 15

What is the potential difference across C_2 when $C_1 = 4.4\ \mu F$, $C_2 = 17\ \mu F$, $C_3 = 34\ \mu F$ and $V_o = 30\ V$?

a. 20 V
b. 98 V
c. 36 V
d. 6.9 V
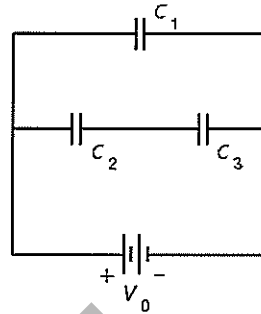
Question 16

What is the maximum kinetic energy (in eV) of a photoelectron when a surface, whose work function is 5 eV, is illuminated by photons whose wavelength is 400 nm?

a. 3.1
b. −1.89
c. 1.89
d. 0

Question 17

An electron is accelerated through a potential difference of 25000 V. What is the de Broglie wavelength of the electron (in m)?

a. 5.9×10^{-12}
b. 6.8×10^{-12}
c. 6.5×10^{-12}
d. 7.8×10^{-12}

Question 18

A planar loop consisting of four turns of wire, each of which encloses 300 cm^2, is oriented perpendicularly to a magnetic field that increases uniformly in magnitude from 10 mT to 25 mT in a time of 5.0 ms. What is the resulting induced current in the coil if the resistance of the coil is 5.0 Ω?

a. 72 mA
b. 12 mA
c. 0.2 mA
d. 48 mA

| Question 19 |

Assume electrons are accelerated through a potential difference of 20000 V inside a TV picture tube. What is the minimum wavelength that could be produced when the electrons strike the phosphor? ($1 \text{ Å} = 10^{-10}$ m)

a. 0.62 Å
b. 1.15 Å
c. 10.5 Å
d. 100.9 Å

| Question 20 |

How much energy is in a 63 kHz photon?

a. 1.0×10^{-38} J
b. 6.6×10^{-30} J
c. 4.2×10^{-29} J
d. 3.1×10^{-30} J

NUS
National University
of Singapore

MATHEMATICS ('A' level equivalent)

SAMPLE

Duration   : 2 hours

Please read the follow instructions carefully.

1.   This examination has TWO (2) sections – A and B, and comprises **THIRTEEN** (**13**) printed pages.

2.   Attempt all sections.

3.   Answer all questions in section A.   Indicate your answers on the answer paper provided.   Each question carries 2 marks.   Marks will not be deducted for wrong answers.

4.   Answer FOUR (4) questions from section B with not more than THREE (3) from any one option.   Write your answers on the answer paper provided.   Begin each question with a fresh sheet of paper.   Write the question number clearly.   Each question carries 15 marks.

5.   A non-programmable scientific calculator may be used.   However, candidates should lay out systematically the various steps in the calculation.

6.   At the end of the examination, attach the cover paper on top of your answer script.   Complete the information required on the cover page and tie the papers together with the string provided.

7.   Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Section A   (40 Marks)

Answer all questions in this section.

1. The minimum value of the function
$$f(x) = (x - 2006)(x - 2007)(x - 2008)(x - 2009)$$
   is

   (A) -1

   (B) 1

   (C) $\frac{1}{4}(2006)(2007)(2008)(2009)$

   (D) $(2006)(2007)(2008)(2009)$

   (E) none of the above

2. There are 3 women and 5 men who will split up into two 4-person teams. The number of ways in which this can be done is

   (A) 15

   (B) 70

   (C) 90

   (D) 140

   (E) none of the above

3. Every day Peter either walks to school or takes a bus to school. The probability that he takes a bus to school is $\frac{1}{4}$. If he takes a bus, the probability that he will be late is $\frac{2}{3}$. If he walks to school, the probability that he will be late is $\frac{1}{3}$. The probability that Peter will be on time for at least one out of two consecutive days is

   (A) $\frac{49}{144}$

   (B) $\frac{70}{144}$

   (C) $\frac{84}{144}$

   (D) $\frac{119}{144}$

   (E) none of the above

4. The expression

$$\frac{x^6 - 1}{x^2 - 1}$$

is equal to

(A) $x^4 - 1$

(B) $(x^2 + x + 1)(x^2 - x + 1)$

(C) $(x^2 + x + 1)(x^2 - x - 1)$

(D) $(x^2 + x - 1)(x^2 - x + 1)$

(E) none of the above

5. If $f(x) = \frac{-w+2x}{-1+x}$ and $f^{-1}(\frac{3}{2}) = 7$, then the value of w is equal to

(A) 2

(B) 3

(C) 4

(D) 5

(E) none of the above

6. The position vectors of the points A, B and C, relative to the origin O, are $12\mathbf{i} + 20\mathbf{j}$, $m\mathbf{i} + 4\mathbf{j}$ and $-8\mathbf{j}$ respectively. If $\overrightarrow{AC}$ is parallel to $\overrightarrow{AB}$, the value of m is equal to

(A) -4

(B) -2

(C) 2

(D) 4

(E) none of the above

7. Suppose $4x^2 - 24x + 35 = A(x-B)^2 + C$. Then

   (A) $A = 4$, $B = -3$ and $C = -1$

   (B) $A = 4$, $B = -3$ and $C = 1$

   (C) $A = 4$, $B = 3$ and $C = -1$

   (D) $A = 4$, $B = 3$ and $C = 1$

   (E) none of the above

8. The minimum value of the function

$$f(x) = (2004 \cos 2005x - 2006)^2 + 2007$$

   is

   (A) 2005

   (B) 2007

   (C) 2011

   (D) 4013

   (E) none of the above

9. The derivative of

$$\ln(\cos x)$$

   with respect to x is

   (A) $-\dfrac{1}{\sin x}$

   (B) $-\dfrac{1}{\cos x}$

   (C) $-\dfrac{1}{\tan x}$

   (D) $-\dfrac{1}{\cot x}$

   (E) none of the above

4

10. The derivative of $\sin(e^x)$ with respect to x is

    (A) $\cos(e^x)$

    (B) $-\cos(e^x)$

    (C) $e^x \cos(e^x)$

    (D) $-e^x \cos(e^x)$

    (E) none of the above

11. The equation $9x^2 - 12x + 11 = 0$ has roots α and β. The value of $\alpha^2\beta + \beta^2\alpha$ is

    (A) $-\frac{132}{9}$

    (B) $-\frac{132}{81}$

    (C) $\frac{132}{81}$

    (D) $\frac{132}{9}$

    (E) none of the above

12. The inequality $25 - |10x + 5| \geq |40x - 20|$ has solution

    (A) $[1, 2]$

    (B) $[0, 2]$

    (C) $[-1, 1]$

    (D) $[-1, 0]$

    (E) none of the above

13. The integral
$$\int \sin^2 2x \; dx$$
    equals

    (A) $\frac{1}{2}\sin^3 2x + C$

    (B) $\sin^3 2x + C$

    (C) $-\frac{1}{2}\cos^3 2x + C$

    (D) $-\cos^3 2x + C$

    (E) none of the above

14. The graph of the function $f(x) = -x^{2008} - \cos 2007x$ is symmetric about

   (A) the x-axis

   (B) the origin

   (C) the y-axis

   (D) the line $y = x$

   (E) none of the above

15. Suppose $3^x + 3^{-x} = k$. Then the value of $3^{2x} + 3^{-2x}$ is equal to

   (A) $k^2 - 2$

   (B) $k^2 - 1$

   (C) k^2

   (D) $k^2 + 1$

   (E) none of the above

16. Five cards each have a single digit written on them. The digits are $9, 9, 8, 7, 6$ respectively. The number of different 4-digit numbers that can be formed by placing four of the cards side by side is

   (A) 15

   (B) 24

   (C) 36

   (D) 60

   (E) none of the above

17. The line $\frac{1}{2}y + 18x - q = 2$ is a tangent to the curve $\frac{1}{2}y = 12x^2 + 7$. The value of q is

   (A) $-\frac{13}{4}$

   (B) $-\frac{7}{4}$

   (C) $\frac{7}{4}$

   (D) $\frac{13}{4}$

   (E) none of the above

6

18. The integral

$$\int \frac{\pi}{\sqrt[3]{\pi^2 x + \pi}} \, dx$$

equals

(A) $\frac{2\pi}{3}\sqrt[3]{(\pi^2 x + \pi)^2} + C$

(B) $\frac{3\pi}{2}\sqrt[3]{(\pi^2 x + \pi)^2} + C$

(C) $\frac{2}{3\pi}\sqrt[3]{(\pi^2 x + \pi)^2} + C$

(D) $\frac{3}{2\pi}\sqrt[3]{(\pi^2 x + \pi)^2} + C$

(E) none of the above

19. The interval on which the function $f(x) = 27x^3 - 108x^2 + 108x + 2008$ is decreasing is

(A) $[\frac{2}{3}, 2]$

(B) $[-\frac{2}{3}, 2]$

(C) $[-2, \frac{2}{3}]$

(D) $[-2, -\frac{2}{3}]$

(E) none of the above

20. The number of arrangements of all the eleven letters of the word

$$M\ I\ S\ S\ I\ S\ S\ I\ P\ P\ I$$

in which all the four letters I are consecutive is equal to

(A) $\frac{9!}{2!\,4!}$

(B) $\frac{8!}{2!\,4!}$

(C) $\frac{7!}{2!\,4!}$

(D) $\frac{6!}{2!\,4!}$

(E) none of the above

Section B   (60 Marks)

Answer FOUR (4) questions with not more than THREE (3) from any one option)

Option (a)- Pure Mathematics

21. (a) Find the integral $\int \dfrac{2x}{\sqrt{1 - 4x - 4x^2}}\, dx$.   [4]

    (b) Find the integral $\int x^2 \tan^{-1} x\, dx$.   [5]

    (c) Evaluate $\int_0^1 x^2\sqrt{1 - x^2}\, dx$.   [6]

22. (a) Prove by induction that

    $$\sum_{r=1}^{n} \frac{2}{(2r - 1)(2r + 1)} = 1 - \frac{1}{2n + 1}.$$ [5]

    (b) Given that $z = i + e^{\frac{\alpha}{2i}}$, where $-\pi < \alpha \le \pi$, find the exact value of α if $|z| = \sqrt{3}$.   [4]

    (c) Sketch in an Argand diagram the set of points representing all complex numbers z satisfying both of the following inequalities :
    $$|z + 1 - i| \le \sqrt{2} \quad \text{and} \quad |z| \le |z + 2|.$$
    Hence find the greatest and least values of $|z - 4 - i|$, given that $|z + 1 - i| \le \sqrt{2}$ and $|z| \le |z + 2|$.   [6]

8

23. (a) Determine the area enclosed between the line $4(2y - 1) = 3x$ and the curve $2y = \sqrt{3x} + 1$. [5]

(b) The parametric equations of a curve are $x = \frac{1}{1-t^3}$ and $y = \frac{t}{1-t^3}$, where t is the parameter. Find the equation of the normal to the curve at the point where $t = -1$. [5]

(c) Solve the inequality $\frac{2}{x+2} > \frac{x+1}{3}$. Hence solve $\frac{2}{|x-2|+2} > \frac{|x-2|+1}{3}$. [5]

24. (a) Solve the equation $\log_3(5x + 1) = \log_9(5(x + 1)^2)$. [4]

(b) By using the substitution $y = ux$, where u is a function of x, solve the differential equation $2xy\frac{dy}{dx} = x^2 + 2y^2$, expressing y^2 explicitly in terms of x. [5]

(c) Express $f(x) = \frac{x^2-x+3}{(x-2)(x^2+1)}$ in partial fractions.

Find the first three non-zero terms in the expansion of $f(x)$ in descending powers of x.

State the restriction which must be imposed on x. [6]

Option (b)- Particle Mechanics

[**In this section, take the acceleration due to gravity to be** $10\,\text{ms}^{-2}$.]

25. (a) Two particles of masses 8 kg and 5 kg are connected to the two ends of a light inextensible string which passes over a fixed smooth pulley. Initially each of the two particles are held at a position which is 5 m above a horizontal ground. The objects are then released from rest. Assuming that the particles never reach the pulley, and also that the particles do not rebound when they strike the ground,

   (i) find the tension in the string and the acceleration of each particle; [3]

   (ii) find the distance above the ground of the point H, the highest point reached by the 5 kg mass; [3]

   (iii) find the speed with which the system is jerked into motion and the impulse experienced by the string during the jerk. [3]

   (b) A particle of mass m kg is travelling in a horizontal straight line with velocity $u\,\text{ms}^{-1}$. It is brought to rest by means of a resisting force of magnitude $km(2u - v)$, where v is the velocity of the particle at any instant and k is a positive constant. Find the distance travelled by the particle while v decreases from u to zero. [6]

26. A car of mass 500 kg has a maximum speed of $40\,\text{ms}^{-1}$ on a level road with the engine of the car working at a constant power of 20 kW. The resistance to motion is proportional to the square of the speed.

   (i) Find its acceleration when the speed is $20\,\text{ms}^{-1}$. [5]

   (ii) Find the distance travelled while the speed increases from $20\,\text{ms}^{-1}$ to $30\,\text{ms}^{-1}$. [6]

   (iii) When the car reaches the speed $30\,\text{ms}^{-1}$, the power is switched off. Find the time required to reduce the speed from $30\,\text{ms}^{-1}$ to $20\,\text{ms}^{-1}$. [4]

27. Two particles A and B, of masses $2m$ kg and m kg respectively, are connected by a light inextensible string which passes over a fixed smooth pulley. The system is released from rest, with both portions of the string vertical and taut, while A and B are at the same height. Find the magnitude of the acceleration of the particles and the tension in the string. [4]

The string breaks when the speed of each particle is u ms^{-1}. Find, in terms of u, the difference in height between the particles A and B,

   (i) when the string breaks, [3]

   (ii) when B reaches its highest point, assuming that A has not reach the ground and B has not reached the pulley. [6]

Find the speed of A when B reaches its highest point. [2]

28. A light elastic string has natural length 1 m. One end of the string is attached to the fixed point O and a particle P of mass 4 kg is suspended from the other end of the string. When hanging in equilibrium, P is $\frac{6}{5}$ m below O. Find the modulus of elasticity of the string. [2]

When P is hanging in equilibrium, it is hit from below by a particle Q, of mass 2 kg, which is travelling vertically upwards. Immediately after the impact, P moves vertically upwards with a velocity u ms^{-1}. When the string is just taut, P is still moving vertically upwards with a velocity of $\sqrt{10}$ ms^{-1}. Find the value of u. [4]

Given that Q is moving with a velocity of $4\sqrt{3}$ ms^{-1} upwards before it hits P, show that it is momentarily at rest just after impact. [3]

Find the position of the lowest point, with respect to the equilibrium point, reached by P in the subsequent motion. [6]

11

Option (c)- Probability and Statistics

[In this section, probabilities should be expressed as either fractions in lowest terms or decimals with three significant figures.]

29. (a) Let A and B be two independent events. Suppose $P(A \cup B') = \frac{1}{3}$ and $P(A) = \frac{1}{4}$. Find the value of $P(B)$. [4]

   (Note : B' is the complement of B.)

   (b) An office employs two typists, Annie and Betty. The number of errors Annie and Betty make can be modeled by independent Poisson distributions with means of 0.1 and 0.07 per page respectively.

   (i) Betty is given a 200-page document to type. Using a suitable approximation, find the probability that she makes more than 21 errors in the document. [4]

   (ii) On another occasion, Annie is given a 10-page document to type, while Betty is given a 15-page document to type. Find the probability that the total number of errors in the 2 documents is less than 4. [3]

   (iii) On a third occasion, Annie is given 8 documents to type. Each document consists of 10 pages. Find the probability that at most 2 of the documents are error-free. [4]

30. Die A has 4 red faces and 2 green faces, whereas die B has 2 red faces and 4 green faces. A fair coin is flipped once. If it lands on a head, die A is tossed; otherwise, die B is tossed. Subsequently, the same die is tossed two more times.

   (i) Find the probability of obtaining a red face in the first throw. [2]

   (ii) Find the probability that red faces turn up in the first two throws. [2]

   (iii) What is the probability that no two consecutive green faces occur in the three throws ? [4]

   (iv) If the first two throws are both red, find the probability that

   (a) a red face is obtained at the third throw; [3]

   (b) *it is die A that is being tossed.* [4]

12

31. The continuous random variable X has cumulative distribution function given by

$$F(x) = \begin{cases} 0 & x \leq 0, \\ \frac{x^2}{k} & 0 \leq x \leq 1, \\ -\frac{x^2}{6} + x - \frac{1}{2} & 1 \leq x \leq 3, \\ 1 & x \geq 3. \end{cases}$$

(i) Find the value of k. [2]

(ii) Find the probability density function of X, and sketch its graph. [3]

(iii) Find the median of $\sqrt{X}$. [4]

(iv) Ten independent observations of X are taken. Find the probability that eight of these observations are less than 2. [3]

(v) Let A be the event $X > 1$ and B be the event $X > 2$. Find $P(B|A)$. [3]

32. The time, W minutes, for a teacher Mr. Robin to travel from home to school each morning may be modeled by a normal random variable with mean 45 and variance 10. The time, H minutes, for his journey home each evening may be modeled by a normal random variable with mean 60 and variance 35. All journeys may be considered to be independent.

(i) Calculate the probability that, on a particular day, the total time for Mr. Robin's two journeys is more than two hours. [3]

(ii) Mr. Robin makes each journey five times per week. Calculate the probability that, in a particular week, his total travelling time to and from school is less than $8\frac{1}{2}$ hours. [4]

(iii) Calculate the probability that, on a particular evening, his journey home takes more than one and a half times the time taken to travel to school that morning. [4]

(iv) Mr. Robin will be late for morning assembly if he takes more than 50 minutes to travel from home to school. Find the probability that in a 5-day working week, he will be late at least once. [4]

END OF PAPER

NANYANG
TECHNOLOGICAL
UNIVERSITY

ENTRANCE EXAMINATION

Mathematics at A-Level (Sample)

Time Allowed : **2 hours**

<u>INSTRUCTIONS</u>

1. This paper consists of **FIVE (5)** questions and comprises **TWO (2)** pages.

2. Answer any **FOUR (4)** questions only.

3. The marks are allocated at the end of each part/question.

4. Answers will be graded for content and appropriate presentation.

Question 1

(a) Sketch the graph of the function $y = f(x) = \dfrac{x+2}{x-2}$. Determine and show clearly on your diagram, the asymptotes, intercepts with the coordinate axes, and the coordinates of the stationary point(s), if any.

(12 marks)

(b) Explain how you can obtain, from the graph of f, a sketch of the graph of the function $y = g(x) = \left(\dfrac{x+2}{x-2}\right)^2$. Show this sketch of g on the same diagram as f. In addition, sketch $y = \dfrac{1}{g(x)}$.

(13 marks)

Question 2

(a) If $f(x + x^{-1}) = x^3 + x^{-3}$, determine the function f.

(7 marks)

(b) Let $f(x) = (m^2 - 1)x^2 + (m-1)x + n + 2$, $(m \neq 1)$, be an odd function and m and n are constants. Determine whether $g(x) = x^m + x^n$ is an even or an odd function, or neither.

(8 marks)

(c) Find the range of x for which
$$\frac{4x^2}{\left(1 - \sqrt{1+2x}\,\right)^2} < 2x + 9.$$

(10 marks)

Question 3

(a) Ten persons, $A, B, C, \ldots, J$, sit round a circular table. The chairs are all numbered. What is the probability that A and B sit next to each other?

(6 marks)

(b) Use the relationship $e^{i\theta} = \cos\theta + i\sin\theta$ to express $\cos 5\theta$ in terms of $\cos\theta$. Hence show that $x = \cos\left(\dfrac{1}{10}\pi\right)$ is a root of the equation $16x^4 - 20x^2 + 5 = 0$.

(10 marks)

(c) Points A and B are specified by the position vectors **a** and **b**. Prove that the equation of the plane bisecting the segment AB perpendicularly is

$$\mathbf{r} \cdot (\mathbf{a} - \mathbf{b}) = \frac{1}{2}\left(|\mathbf{a}|^2 - |\mathbf{b}|^2\right)$$

(9 marks)

Question 4

(a) By solving the equation $\sin 2\theta = \cos 3\theta$, find the value of $\sin 18°$. Show your answer in the form of $\dfrac{\sqrt{a} + b}{c}$, where a, b and c are natural numbers. A numerical value from your calculator or mathematical table is NOT acceptable.

(12 marks)

(b) Given $\left(x^2 - 6x + 9\right)^{x^2 - 4} = 1$, solve for all real values of x.

(7 marks)

(c) Determine the sum $\displaystyle\sum_{k=1}^{\infty} \frac{4^k + 3^{k-1} - 2^{k-2}}{5^{k+1}}$.

(6 marks)

Question 5

(a) Find the volume of the solid generated by revolving the area between the curve $y = \dfrac{\cos x}{x}$ and the x-axis for $\pi/6 \le x \le \pi/2$ about the y-axis.

(7 marks)

(b) Evaluate $\displaystyle\int x^2 e^x dx$.

(6 marks)

(c) Show that $\displaystyle\int_0^1 x^m (1-x)^n dx = \frac{n}{m+1} \int_0^1 x^{m+1} (1-x)^{n-1} dx$ for $m > 0$ and $n > 0$. Hence, or otherwise, show that $\displaystyle\int_0^1 x^m (1-x)^n dx = \frac{m! \, n!}{(m+n+1)!}$

(12 marks)

- END OF PAPER -

NANYANG TECHNOLOGICAL UNIVERSITY

ENTRANCE EXAMINATION

Mathematics at AO-Level (Sample)

Time Allowed : **2 hours**

INSTRUCTIONS

1.   This paper consists of **FIVE (5)** questions and comprises **THREE (3)** pages.

2.   Answer any **FOUR (4)** questions only.

3.   The marks are allocated at the end of each part/question.

4.   Answers will be graded for content and appropriate presentation.

Question 1

(a) Express $8 - 6x - x^2$ in the form $a - (x + b)^2$ and hence, or otherwise, find the range of the function $f(x) = 8 - 6x - x^2$ for real x.

(7 marks)

(b) Solve the simultaneous equations

$$3x + 7y = 1$$
$$2x^2 + 4y = 3$$

(6 marks)

(c) It is known that the variables x and y satisfy an equation of the form

$$\frac{x + y}{xy} = a$$

where a is a constant. The table below shows approximate experimental values of x and y:

x	2	3	4	5	6
y	3.0	2.5	1.8	1.6	1.5

However, one of the values of y has been wrongly recorded. Redefine the dependent and independent variables so that there is a linear relationship between them. Plot this *straight-line* graph, identify the incorrect value and estimate the value of a.

(12 marks)

Question 2

(a) Given that $\sin(A+B) = 2\sin(A-B)$, show that $\tan A = 3\tan B$. Hence find all the solutions of the equation $\sin(A+30°) = 2\sin(A-30°)$ for A in $(-\pi, \pi)$.

(9 marks)

(b) In a certain geometric series, the sum of the first n terms is 48, and the sum of the first $2n$ terms is 60. Find the sum of the first $3n$ terms.

(8 marks)

(c) By means of the substitution $y = 8^x$, find the exact values of x which satisfy the equation

$$64^x - 5(8^x) + 4 = 0$$

(8 marks)

Question 3

(a) Convert the parametric equations $x = \sec t$ and $y = \tan t$ into a Cartesian equation. Plot the curve.

(6 marks)

(b) How many licence plates can be made by using 2 English letters in uppercase followed by a 3-digit number? The first digit of a licence plate should not be a zero. How many of those licence plates have 2 vowels followed by 3 identical digits?

(7 marks)

(c) Three *unit* vectors $\hat{\mathbf{a}}$, $\hat{\mathbf{b}}$ and $\hat{\mathbf{c}}$ have the property that the angle between any two is a *fixed* angle θ.
  (i)   Find in terms of θ the length of the vector $\mathbf{v} = \hat{\mathbf{a}} + \hat{\mathbf{b}} + \hat{\mathbf{c}}$.
  (ii)   Find the largest possible value of θ.
  (iii) Find the cosine of the angle β between $\hat{\mathbf{a}}$ and $\mathbf{v}$.

(12 marks)

Question 4

(a) Chord AB intersects diameter CD at right angles as shown in Figure 4.1. Let the area of the circle be 36π cm^2 and the length of chord AB be $6\sqrt{3}$ cm. Determine the area of the shaded region.
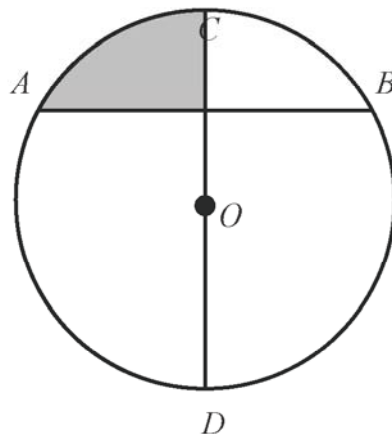

Figure 4.1

(10 marks)

(b) Find $\dfrac{dy}{dx}$ if $y = e^{\sin x}$.

(5 marks)

(c) A body moves along a horizontal line according to $s = f(t) = t^3 - 9t^2 + 24t$ where s is the displacement and t is the time.

    (i)   When is s increasing and when is it decreasing?

    (ii)   When is the velocity v increasing, and when is it decreasing?

    (iii)   Find the total distance travelled in the first 5 seconds of motion.

(10 marks)

Question 5

(a) Find $\dfrac{d^2 y}{dx^2}$ if $y = \dfrac{u-1}{u+1}$ and $u = \sqrt{x}$.

(8 marks)

(b) Find $\displaystyle\int \sin^4 x \cos^5 x \, dx$.

(9 marks)

(c) Find the area bounded by the curves $y = x^2 - 4$ and $y = 8 - 2x^2$.

(8 marks)

SAMPLE

- **END OF PAPER -**

UNIVERSITY ENTRANCE EXAMINATION
ENGLISH LANGUAGE

Time: 9.30am to 12.30pm
Duration: 3 hours

Please read the following instructions carefully.

1. This examination has TWO (2) parts – A and B, and comprises FIVE (5) printed pages.

2. Do both parts.

3. Read the instructions at the beginning of each part.

4. Write your answers on the answer paper provided.

5. At the end of the examination, attach the cover paper on top of your answer script. Complete the information required on the cover paper. The cover paper for this examination is YELLOW.

6. Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Part A (50 marks)

Write a **350 word** essay on one of the following topics to an educated reader with no specialist knowledge. You should spend about 90 minutes on this task. You should use your own ideas, knowledge and experience and support your arguments with examples and relevant evidence.

1. Man is a curious animal. Since time immemorial, he has not ceased to discover and to invent. Some discoveries and inventions have made unforgettable marks in the lives of human beings, but some have not. Think of such a discovery or invention that was made over the last 50 years; explain how this discovery or invention has added advantages and disadvantages to the lives of human beings so far.

2. Modern women in many developed and developing countries have had the opportunities to receive an education. With this education, numerous women are holding jobs outside their homes and are contributing significantly to their societies. To help these women work effectively without being bogged down by child rearing, do you agree that the government should build child-care centres and subsidise child-care expenses? Use specific reasons and details to support your answer.

3. It is common knowledge that players of certain sports like soccer, tennis, basketball and golf attract a large following of supporters. These supporters, from all walks of life, are willing to pay a hefty sum and make an effort to go watch their favourite sportsperson or team play in matches. Why do you think they do this? Support your answer with specific reasons and examples.

4. There is a Chinese saying that goes like this: "Learning comes not from reading thousands of books but from walking thousands of miles." Compare and contrast learning that is gained from experience and learning that is gained from books. In your opinion, which source is more important? Explain why using concrete evidence?

Part B (50 marks)

Read the passage below and answer the questions that followed. You should use about 90 minutes to do this task.

You Lose A Wrinkle Whenever You Learn

1   At 72, Ms Irene Ison cuts a deceptively diminutive, slightly bent figure. However,
2   up close, her mind is sprightly, her wit caustic and her sense of humour wicked.
3   Instead of enjoying her old age, the British grandmother has just finished a master's
4   course in photography and is hoping to do a doctorate after that. She wants to do a
5   thesis on creativity and eccentricity in old age.

6   So far, most of the universities she has approached have rebuffed her as a doctoral
7   candidate because she will be pushing 80 when - and if – she finishes it. But the
8   tough-talking woman is not easily discouraged; she is bent on pursuing the PhD
9   programme.

10 "This will not stop me, they can't stop me," she declares. "My son says when I die
11 he will have to turn my gravestone sideways to get all my degrees in."

12 Last week, she was invited here to take part in a lifelong learning forum at the
13 Singapore Learning Festival, which was organised by the Ministry of Manpower
14 and Reed Exhibitions. It was her first time in Asia; her first long-haul flight and her
15 first overseas speaking engagement. Her ankles were swollen but her spirits were
16 high.

17 During the question-and-answer session, when asked what drives her insatiable
18 quest to master new areas, she quips: "Learning is the fertiliser which makes your
19 cells grow. It makes you younger. Forget all those beauty shops and creams. Every
20 time you learn something, you lose a wrinkle."

21 Laughter erupts at her parting shot: "By the time I finish learning, I'm going to be
22 younger than you lot."

23 The hardest part in her learning experience, she says, was making that first journey
24 to the community college for her O-levels at age 42. It was plagued by self-doubt
25 and fear. After that, it became easier and she educated herself "one bite at a time".
26 After finishing her O-levels, she returned to full-time work to put her youngest
27 daughter through university before embarking on her A-levels at 52. She saved up
28 for several years before she enrolled at Warwick University to read literary and
29 cultural studies at 62.

30 At the close of the first semester, struggling with the bias and workload, she wanted
31 to quit, but she changed her mind when she was nominated for and won the
32 outstanding Adult Learners Award for Britain's Central Area in 1992.

33 While at Warwick, a play she wrote about acid-tongue American writer, Dorothy
34 Parker, picked up a £1,000 award, was produced in London and went on tour
35 around Britain.

36 In 1995, armed with a second upper-honours degree, she gave her mind a break.
37 However, after her son bought her a Minolta camera to tinker with, she decided to
38 pursue her lifelong love affair with photography formally at Tile Hill College in
39 Coventry. "My time at Warwick was very positive and supportive; so I was totally
40 unprepared for the treatment I received there," she recalls.

41 From day one, she suffered <u>verbal abuse</u> from her delinquent 16-year-old
42 classmates. Because of her habit of taking her arthritic feet out of her shoes during
43 lectures, they called her "smelly old cow" and stomped on her pictures.

44 "There was little point in telling the tutor. He encouraged <u>it</u> and barred me from his
45 lectures. A student was stationed at the door to keep me out," she relates.

46 So she went home in a huff and complained to the administering body, which kindly
47 sent her the teaching material for her courses and an external invigilator for her
48 examinations. Two years later, she scored five distinctions, adding with a curl of her
49 lip that "the rest of the class got two distinctions between them". She progressed on
50 to diplomas in illustration, community teaching and video, and recently finished her
51 master's degree in photography at De-Montford University in Leicester.

52 Although she has exceeded her own academic expectations, she says the road to
53 adult learning is still full of obstacles in <u>a greying Britain</u>. Student grants are
54 reserved for the young and getting a study loan is nearly impossible beyond one's
55 mid-50s because "<u>they</u> think you're going to die before you pay it back". But all
56 these road obstructions, she says, only prodded her to press on.

57 "Education is the saviour of old age. As long as you keep learning, you keep living.
58 You realise there are things you didn't know. You're thinking of tomorrow, not
59 yesterday."

60 She lives alone in her Coventry cottage with a 17-year old cat, Harry. She <u>reads</u>
61 <u>voraciously</u>, answers fan mail from other mature students, and lectures at the
62 community library.

63 At 72, she says she is much too old for tears or regrets.

64 "I have room only for laughter and learning in my life. So long as my children
65 remember to put a book in my coffin, I shall be all right," she says, then hastily
66 adds: "And, of course, a brochure of any likely courses there are in the <u>hereafter</u>."

Adapted from an article of the same title by Susan Long,
The Straits Times, 15th Nov 2002.

Reading Comprehension Questions

Answer **all** of the following questions. **Use your own words** as much as you can for mere copying from the text will be penalised. Do not copy the question on your answer paper. Write **the number of the question clearly** on the left margin. **Begin each answer on a fresh line**. Marks for each question are indicated in brackets.

1. Explain why the writer uses "deceptively" in line 1 to describe Ms Ison's appearance? (3 marks)

2. Why did Ms Ison's son say that he has to turn his mother's "gravestone sideways to get all the degrees in" when his mother dies (lines 10 and 11)? (3 marks)

3. What makes the writer use the phrase, "spirits were high", to describe Ms Ison? (3 marks)

4. Why does Ms Ison encourage people to forget all the beauty shops and creams (line 19)? (3 marks)

5. What do you think are the factors that helped Ms Ison win the outstanding Adult Learners Award for Britain's Central Area in 1992 (lines 31 and 32)? (3 marks)

6. What went on tour around Britain, and why did it go on tour (lines 34 and 35)? (4 marks)

7. What does each of the following words refer to   (4 marks)

    a. master's (line 3)
    b. master (line 18)
    c. it (line 44)
    d. they (line 55)

8. Explain the meaning of each of the following words or phrases as it is used in the passage. (7 marks)

    a. eccentricity in old age (line 5)
    b. rebuffed (line 6)
    c. parting shot (line 21)
    d. verbal abuse (line 41)
    e. a greying Britain (line 53)
    f. reads voraciously (lines 60 and 61)
    g. hereafter (line 66)

9. Describe the difficulties that Ms Irene Ison faced in her pursuit of education, and how she overcame them? Using only material from the passage, explain your answer in 120 words. The answer should be in an organised and continuous form. (20 marks)

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

ENGLISH LANGUAGE

Duration   : 2 ½ hours

Please read the following instructions carefully.

1.   This examination has TWO (2) sections – A and B, and comprises **FIVE (5)** printed pages.

2.   Attempt all sections.

3**.**   **Section A** comprises 60 Multiple Choice questions and you are given 50 minutes to complete this section.   Please use a 2B pencil to shade your answers on the optical mark sheet provided.

4.   **Section B** comprises 2 comprehension passages and an item of essay.   You are given 100 minutes to complete this section.   Please use a ball-point pen to write your essay on the ruled answer sheets given to you.

5.   Do not take any paper, including the question paper, out of the examination hall.

This Section comprises 60 Multiple Choice questions that will test you on your ability to understand and use English in the following areas:
   A. Grammar
   B. Vocabulary
   C. Grammar Cloze
   D. Text Coherence
   E. Reading Comprehension

*(The following are examples of **Grammar and Vocabulary** questions. The correct answer to each of the questions is underlined.)*

1   Choose the **MOST APPROPRIATE RESPONSE** to the following questions:

1.1   They need to achieve _____ weight reduction of at least 40 per cent compared to steel materials in order to be effective.
            A. <u>a</u>
            B. an
            C. the

1.2   Pain is an unpleasant experience that compels changes in physical activity and this _____ to _____ in everyday behavior of the affected person, reported a research team at the Department of Physiology.
            A. may led // changes
            B. <u>may lead // changes</u>
            C. may led // change
            D. may lead // change

1.3   The equipment has deteriorated after years of poor _____.

            A. conservation
            B. <u>maintenance</u>
            C. restoration
            D. refurbishment

2.   Choose the option that is **NOT AN APPROPRIATE RESPONSE** to the following questions:

2.1   There have been intense protests against the development of _____ in this region.

            A. <u>nuclear reactor</u>
            B. nuclear reactors
            C. a nuclear reactor
            D. the nuclear reactor

2.2   He did not give any _____ to my questions despite many written reminders.
            A. response
            B. answer
            C. reply
            D. <u>reaction</u>

*(The following is an example of a **Text Coherence** question)*

Read the following sentences and choose the order of sentences that is most appropriate to make a coherent paragraph.

   I. These figures play a significant role in framing current international policy debates about the future direction of global agriculture.

   II. In the last couple of years, scientists, politicians and agricultural industry representatives have been arguing that there is a need to increase global food production by 50% by the year 2030, and for food production to double by 2050 to meet future demand.

   III. In particular, the statistics have dominated the policy and media discussions about food and farming and are often used to justify the need for more intensive agricultural practices including the need for further expansion of GM crops.

   A. I, II, III
   B. <u>II, I, III</u>
   C. III, II, I
   D. II, III, I

SECTION B – Comprehension & Essay (Time given : 100 minutes)

This Section focuses on writing, and it tests your ability to understand two passages and then use the relevant ideas gathered from the passages to support your opinions/views in an essay.

(The following is an example of the reading passages and essay prompt.)

Passage 1

Adapted from Research on the Effects of Media Violence
Media Awareness Network. Retrieved on October 7, 1010 from http://www.media awareness.ca/english/issues/violence/effects_media_violence.cfm

Whether or not exposure to media violence causes increased levels of aggression and violence in young people is the perennial question of media effects research. Some experts, like University of Michigan Professor L. Rowell Huesmann, argue that fifty years of evidence show "that exposure to media violence causes children to behave more aggressively and affects them as adults years later." Others, like Jonathan Freedman of the University of Toronto, maintain that "the scientific evidence simply does not show that watching violence either produces violence in people, or desensitizes them to it."

Andrea Martinez at the University of Ottawa conducted a comprehensive review of the scientific literature for the Canadian Radio-television and Telecommunications Commission (CRTC) in 1994. She concluded that the lack of consensus about media effects reflects three "grey areas" or constraints contained in the research itself.

First, media violence is notoriously hard to define and measure. Some experts who track violence in television programming, such as George Gerbner of Temple University, define violence as the act (or threat) of injuring or killing someone, independent of the method used or the surrounding context. Accordingly, Gerber includes cartoon violence in his

data-set. But others, such as University of Laval professors Guy Paquette and Jacques de Guise, specifically exclude cartoon violence from their research because of its comical and unrealistic presentation.

Second, researchers disagree over the type of relationship the data supports. Some argue that exposure to media violence causes aggression. Others say that the two are associated, but that there is no causal connection. (That both, for instance, may be caused by some third factor.) And others say the data supports the conclusion that there is no relationship between the two at all.

Third, even those who agree that there is a connection between media violence and aggression disagree about how the one affects the other. Some say that the mechanism is a psychological one, rooted in the ways we learn. For example, Huesmann argues that children develop "cognitive scripts" that guide their own behaviour by imitating the actions of media heroes. As they watch violent shows, children learn to internalise scripts that use violence as an appropriate method of problem-solving.

Other researchers argue that it is the physiological effects of media violence that cause aggressive behaviour. Exposure to violent imagery is linked to increased heart rate, faster respiration and higher blood pressure. Some think that this simulated "fight-or-flight" response predisposes people to act aggressively in the real world.

Still others focus on the ways in which media violence primes or cues pre-existing aggressive thoughts and feelings. They argue that an individual's desire to strike out is justified by media images in which both the hero and the villain use violence to seek revenge, often without consequences.

In her final report to the CRTC, Martinez concluded that most studies support "a positive, though weak, relation between exposure to television violence and aggressive behaviour." Although that relationship cannot be "confirmed systematically," she agrees with Dutch researcher Tom Van der Voot who argues that it would be illogical to conclude that "a phenomenon does not exist simply because it is found at times not to occur, or only to occur under certain circumstances."

Passage 2

Adapted from The Psychological Effects of Violent Media on Children
Tompkins, A. 2003 All Psych Journal. December 14
Retrieved on 17 September,2010 from http://allpsych.com/journal/violentmedia.html

Violent situations are all too common in everyday entertainment and there are far less programming choices that are non-violent than there are violent. The National Coalition on Television Violence reported that there has been a consistent increase in the number of violent themed video games. These games increased from fifty-three percent in 1985 to eighty-two percent in 1988 (Cesarone, 1994). A study conducted in 1989, on video game usage and content found that most of the arcade games contained "antisocial values of a violent nature" (Ivory, 2001).

Even if programming choices did exist, the research has proven that parents actually have no clue as to what their children watch on television. Researchers say that parents need to be attentive to the content these programmes have and question whether they are appropriate for the age of their child. Parents should also monitor the amount of time their children spend playing video games. Generally children in America have a lot of time to spend on playing video games and on watching television. A multicultural study found that among six different nations young Americans had the least amount of work responsibility assigned to them. Also, instead of going outside to participate in

activities, they are encouraged to stay inside and watch television or play video games alone. This excessive exposure to violent media has had negative effects.

The agreement amongst researchers on television violence is that there is a significant increase from 3% to 15% in individuals' aggressive behavior after watching violent television (Cesarone, 1994). In addition, a 1995 study revealed that both impulsive and reflective young adults showed increased amounts of violent aggression towards play objects after playing violent and non-violent video games. However, in a contradictory study it was found that there was no difference between children who were exposed to violent media and those who were exposed to non-violent media.

One point researchers do agree on is that violent media is not the only cause of children committing violent acts. The involvement of parents in what their children watch, how the family interacts with each other, what the children are exposed to in their environment are also indicators of how they will behave and what value system they will follow. Nonetheless, research is stronger towards media violence being a precursor to increased aggression in children and young adults. This fact alone should be enough for parents to become more involved in what their children are exposed to.

Although the results seem quite negative, the research thus far only suggests possible short term effects of media violence. There is no strong evidence on the long term effects of media violence. In summary, not one research conducted could prove either positive or negative long term outcomes of violent media. It is clear, however, that parents need to pay more attention to their children's lives and not sit them in front of the television, whether it is for movies, video games, or general television shows. Raising a child is hard enough in this day and age but when you add all the outside media violence it makes it ten times harder to steer your child in the right direction.

Essay
WRITE AN ESSAY of about 500 words to a university lecturer to express your opinion on the following:

The government of your country plans to prohibit people below 18 years old from watching or playing with all forms of media that contain violence or encourage violence. The university has invited members of the student body to submit their views on this proposal. Would you support the government's proposal? Support your answer with convincing reasons.

Please note that you need to properly acknowledge all information you use from the reading passages.

END OF PAPER

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

ENTRANCE EXAMINATION

ENGLISH LANGUAGE
FORM A

Time allowed: 3 hours

INSTRUCTIONS

1.   This examination contains FIVE (5) sections and comprises TEN (10)
      printed pages.

2.   All 5 sections are compulsory.

3.   Read the instructions at the beginning of each section, which specify
      the marks allocated and give time recommendations.

4.   Write all your answers in the ANSWER BOOK provided.

5.   Dictionaries should NOT be used.

1

Section A – Writing

Directions – *Choose **one** of the following topics & clearly state the topic in the title of your composition. The length should be **350-500** words. It is recommended that you spend no longer than 60 minutes to complete this section of the test. Allow 10 minutes for organizing, 45 minutes for writing and 5 minutes for proofreading.*

1. The pace of technological change has been extraordinarily rapid throughout the past decade. What do you predict will be the major technological advances that may occur within the next decade? Explain your view.

2. As population growth around the region continues, there is tremendous pressure on land use. Many previously untouched areas, including forests and jungles, are now being converted into urban areas. Should governments prioritise the conservation of natural areas or is their destruction an inevitable consequence of population growth? Support your view.

3. Some countries in the region have been trying to attract more foreign talent to boost their economic competitiveness. This has, however, caused some concern in those countries which are faced with a "brain drain", where their own talented professionals have left to seek better employment opportunities and higher wages in other countries. Do you agree with this practice? Support your view.

4. Social scientists and natural scientists are not always regarded as equal when it comes to financial compensation for the work they have done in their own fields of study. Some people feel that natural scientists, including medical doctors and geneticists, should be paid higher wages, as their work makes a more obvious contribution to the development of mankind. Do you agree with this? Support your view.

5. Computers are becoming a standard feature in school classrooms throughout the world. Can computers be effectively used in the teaching of every subject? Support your view.

TOTAL: 30 MARKS

Section B - Reading Comprehension

Read the following passage and answer the questions that follow it. You are advised to spend a maximum of 50 minutes on the reading section.

THE FUELWOOD CRISIS

1	Two billion people are caught in a specific energy crisis – the shortage of fuelwood. Nearly half of humanity has not yet entered the age of fossil fuels and depends on wood for warmth, light and cooking. But as trees are cut down, fuelwood is becoming scarce over large parts of sub-Saharan Africa, the Middle East and Asia.

2	Fuelwood accounts for a large proportion of all energy consumption in many developing countries. More than 90 per cent of energy use in such nations as Tanzania, Nepal and Ethiopia comes from wood. It even supplies more than four fifths of oil-rich Nigeria's needs, and many other countries get half to three quarters of their energy from wood.

3	Already 100 million people in developing countries cannot get sufficient fuelwood to meet their minimum energy needs, and close to 1.3 billion are consuming fuelwood resources faster than they are being replenished. If present trends continue, the Food and Agriculture Organization of the United Nations (FAO) predicts that, in the next decade, another 1 billion people will be faced with chronic fuelwood shortages.

4	Thus within a decade, more than half of the population of developing countries will not be able to meet their minimum needs for energy or will be forced to consume wood faster than it can be grown. There is little chance that they could find any other source of heat and light. Usually there are no viable alternative fuels and, where there are alternatives, they cost too much. Already even a few sticks of wood can be prohibitively expensive in areas affected by severe shortages. It costs some rural families in India and Pakistan as much to heat the evening dinner bowl as it does to fill it. Health and nutrition are affected, as boiling water becomes an unaffordable luxury. Mothers are forced to feed their children on cereals, which cook quickly, rather than slower cooking and more nutritious foods, like beans.

5	Even in wood-rich areas like the Amazon, some towns are feeling the energy pinch. In Manuas, Brazil, for example, the majority of the poorer residents depend on charcoal for preparing meals. As the jungle recedes further away every year, due to expanding agriculture and logging, the cost of trucking in fuel rises. A week's supply of charcoal for an average family costs around $2 – a considerable amount of money in a town where the average wage is $2 a day.

6	As supplies dwindle, villagers – mainly women and children – have to spend more time searching for wood. Women in the village of Kalsaka in Africa walk three and a half hours through searing heat to collect wood that used to be available close to their huts. Families in the uplands of Nepal spend 230 person-days a year on fuelwood collection to meet family needs. Inevitably, less time can be spent in growing food.

7	**Ostensibly**, the fuelwood shortage has been attributed to the over-exploitation of forests and woodlots by the rural poor as human numbers and energy needs increase. This is an important factor. Yet the roots of the fuelwood crisis are more intricate: rampant logging, in combination with animal foraging and slash-and-burn cultivation, contribute to the fuelwood deficit. Deforestation is followed by erosion, desert encroachment, loss of biomass productivity and reduced water retention capacity of the soil.

3

8   Another consideration, often overlooked, is the increasing consumption of wood and charcoal by urban dwellers. Urbanization concentrates people and puts increasing stress on basic necessities such as food, energy, drinking water and shelter, exacting a heavy toll on the surrounding countryside. A study by the Beijer Institute of Stockholm, made for the Kenyan Government, found that proportionally one of the major contributors to deforestation was not rural fuelwood use, which was found to be mostly sustainable, but the wholesale conversion of wood to charcoal for sale to people living in towns and cities.

9   Charcoal is used to meet city needs because it is so much lighter than the original wood, and therefore much cheaper to transport. But converting wood to charcoal in traditional earthen pits consumes more than half its energy. So each town dweller uses twice as much wood for a given amount of energy as a country person who continues to use the original wood.

10   The World Bank estimates that meeting the fuelwood crisis will require planting 55 million hectares with fast-growing trees at a rate of 2.7 million hectares a year, five times the present annual rate of 555,000 hectares. But simply planting more trees, even fast-growing ones, is only part of the solution. The right species have to be selected for each particular environment, taking into account growth rates, water and mineral needs, and adaptability, among other things. Above all, the trees have to be planted where they will be used and by the people who will use them. This implies an emphasis on community woodlots, not the creation of huge fuelwood plantations filled with monocultures, located too far from where the wood is needed.

11   Some species show great promise. The *Leucaena* or *ipil ipil*, a native of Mexico, is one of the world's fastest growing trees. It can reach heights of 20 meters in six years. A *Leucaena* plantation can provide up to 50 metric tons of wood per hectare per year, or five times the average for cultivated pines in temperate regions. Its nitrogen-fixing roots also replenish the soil.

12   At the same time, more efficient stoves must be developed to allow the wood to burn longer, extracting more energy from each stick. The traditional three-stone fire is a very inefficient way of burning wood; its conversion efficiency may only reach 6 per cent of the fuel value of the wood. Unfortunately, many improved stoves have proved unworkable because they have technical problems or are made with material too expensive or too difficult to obtain. Improved stoves, however, must respond to local needs. The materials for building them have to be locally available, easily accessible and relatively cheap. The Lorena stove from Guatemala cuts fuelwood consumption in half. Molded from mud and sand, and fitted with a simple metal damper and pipe, **it** costs the equivalent of $5. The World Bank estimates that the use of more efficient stoves- together with fuel substitution where practicable- could reduce fuelwood consumption by a quarter.

13   The threat of massive fuelwood shortages in the next century should prompt governments and international agencies to commit money and manpower to solving this crisis now, before it turns into a human tragedy.

Questions: The Fuelwood Crisis

This section consists of FIFTEEN (15) multiple choice questions. Choose the correct answer from the alternatives given. In your ANSWER BOOK, write the correct answer (a), (b), (c) or (d) next to the question number. Write in one column. Each multiple choice question carries two marks.

1. The main idea of this reading passage as a whole is that
a) Charcoal is a substitute for fuelwood, and its widespread use can alleviate the fuelwood crisis.
b) As supplies of fuelwood decrease, we need to develop new approaches to its production and use.
c) The development of fast growing trees will help to avert the impending fuelwood crisis.
d)   The fuelwood crisis has occurred as a direct result of rapid urbanization in developing countries.

2. According to the information in paragraph 2, which of the following is NOT correct?
a) Less than 10% of energy use in nations including Tanzania, Nepal and Ethiopia comes from sources other than wood.
b) Fuelwood is consumed in large quantities for energy use in developing countries.
c) Ethiopian wood supplies more than 80% of Nigeria's energy needs.
d) Less than 20% of Nigeria's energy needs are met by sources other than wood.

3. Within ten years it is likely that
a) fewer people in developing countries will be faced with continuing fuelwood shortages.
b) over 50% of people in developing countries will not be able to meet their energy needs.
c) other sources of heat and light will be discovered.
d) low cost alternatives to fuelwood will be developed.

4. The example of mothers feeding their children cereal is given in order to
a) illustrate regional variations in cooking.
b) support the view that cereal is the most nutritious food for children.
c) explain the process by which children suffer from malnutrition.
d) show that the high cost of fuelwood can impact on health and nutrition.

5. The example of women in Kalsaka walking to collect wood is given in order to
a) illustrate the point that supplies of wood are not as plentiful now.
b) show that the situation is now better than it was in the past.
c)   explain the process of deforestation in Kalsaka.
d) support the view that physical exercise is necessary for a healthy life.

6. The main purpose of paragraphs 7-9 is to
a) explain the complex causes of the fuelwood crisis.
b) compare the effectiveness of charcoal and wood as energy sources.
c) show that the rural poor are responsible for the fuelwood crisis .
d) explain the way in which the fuelwood crisis has influenced urbanization.

7. **One disadvantage of the use of charcoal, as opposed to wood, is**
a) its weight.
b) its cost to transport.
c) the energy consumption involved in producing it.
d) the difficulty of producing charcoal in earthen pits.

8. **Planting more trees will not work if**
a) the trees grow extremely rapidly.
b) the appropriate kind of tree is chosen for each special environment.
c) the people who will use the trees plant them in a convenient location
d) only fuelwood plantations filled with monocultures are developed.

9. **People living in cities have contributed to the fuelwood crisis**
a) because of their reliance on the use of wood and charcoal for energy.
b) by polluting the atmosphere and destroying large tracts of forests.
c) because of their preference for wood as a source of energy.
d) to a lesser degree than rural dwellers, who continue to cut down trees.

10. **More efficient stoves have not been widely used because**
a) the traditional three stone fire is the most efficient way of burning wood.
b) there have been technical problems that have made their use difficult.
c) it is not possible to make money from producing stoves for developing countries.
d) the materials used to make them have been easy to get.

11. **The writer warns that the consequences of the developing fuelwood crisis will be disastrous unless**
a) governments spend more and devote more human resources to solving the fuelwood crisis.
b) the World Bank spends more on developing large forests that suit the needs of local populations.
c) governments control the price of wood and charcoal.
d) governments delay acting until they have fully established the causes of the fuelwood crisis.

12. **Which of the following would be the best replacement for the underlined part of the sentence from paragraph 5?**
"Even in wood-rich areas like the Amazon, some towns are <u>feeling the energy pinch.</u>"
a) stealing wood from neighbouring towns
b) using only wood to supply the energy needs of their population
c) having no difficulties meeting the energy needs of their population
d) finding it a strain to meet their energy needs of their population

13. **The word " ostensibly " (paragraph 7) is closest in meaning to**
a) unfortunately, given the circumstances
b) appearing to be true, but not necessarily so
c) erronously, with the intent to deceive
d) infrequently

14. "<u>it</u> costs the equivalent of $5 (paragraph 12). <u>It</u> refers to
a) the Lorena Stove
b) fuelwood consumption
c) a simple metal damper and pipe
d) Guatemala

15. **This reading would probably have appeared in**
a) a daily newspaper
b) an elementary school science textbook
c) a senior high school environmental science textbook
d) a specialist environmental science journal

TOTAL: 30 MARKS

Section C—Word Forms

In the following, give the correct form of the word or verb in the brackets for each numbered blank. In your answer book, write down the number and your answer against it. DO NOT write out the whole passage. Each answer carries one mark. You are advised to spend a maximum of 30 minutes on this section.

Conservation

Conservation is the sustainable use of natural resources, such as soils, water, plants, animals, and minerals. The natural resources of any area constitute its basic capital, and …1… (waste) use of those resources constitutes an …2… (economy) loss. From the aesthetic viewpoint, conservation also includes the …3… (maintain) of national parks, wilderness areas, …4… (history) sites, and wildlife.

Natural resources are of two main types, renewable and nonrenewable. Renewable resources …5… (including) wildlife and natural vegetation of all kinds. The soil itself can be considered a renewable resource, although severe damage is …6… (extreme) difficult to repair because of the slow rate of soil-forming processes. The natural …7… (drain) of waters from the watershed of a region can be maintained indefinitely by careful …8… (manage) of vegetation and soils, and the quality of water can be controlled through …9… (pollute) control. Nonrenewable resources are those that cannot be replaced or that can be replaced only over …10… (incredible) long periods of time. Such resources comprise the fossil fuels (coal, petroleum, and natural gas) and the metallic and other ores.

Although the conservation of natural resources has been recognized as …11… (desire) by many peoples since ancient times, frequently the …12… (base) principles of sound land use have been ignored, with …13… (disaster) results. Major losses—for example, the silting of rivers and the flooding of lowlands—resulted from the …14… (destroy) of the forests and grasslands that …15… (protection) watersheds in northern China and the Tigris-Euphrates area of Asia. Large areas in North Africa and the Middle East were rendered barren by centuries of uncontrolled livestock grazing, unwise cultivation, and …16… (excess) cutting of woody plants for fuel. Similar damage has also occurred in most of the more …17… (recent) developed regions of the world, sometimes through the unwise …18… (introduce) of species into new environments. The …19… (increase) industrialization of nations around the world continues to present grave conservation problems although international cooperation efforts have also evolved in certain areas, such as the protection of some …20… (endanger) species.

TOTAL: 20 MARKS

Section D—Fill in the blanks

Supply a suitable word for each of the numbered blanks (you are given the beginning letter of the required word). In your answer book, write down the number and your answer (the entire word) against it. Do not write out the whole passage. Each answer carries ½ mark. You are advised to spend a maximum of 25 minutes on this section.

Acid Rain

Acid rain, a form of air pollution, is currently a subject of great controversy because of widespread environmental d__1__ for which it has been blamed. It forms w__2__ oxides of sulfur and nitrogen combine with atmospheric moisture to yield sulfuric and nitric acids, w__3__ may then be carried long distances from their source b__4__ they are deposited by rain. The pollution may also take the form of snow or fog or be precipitated i__5__ dry forms. The dry form of such precipitation is just as damaging to the environment a__6__ the liquid form.

The problem of acid rain originated w__7__ the Industrial Revolution, and it has been growing ever since. The severity of its e__8__ has long been recognized in local settings, as exemplified b__9__ the spells of acid smog in heavily industrialized areas. The widespread destructiveness of acid rain, h__10__, has become evident only in recent decades. One large area that has been studied extensively is northern Europe, w__11__ acid rain has eroded structures, injured crops and forests, and threatened or depleted life in freshwater lakes. In 1984, for example, environmental reports indicated that a__12__ half of the trees in Germany's Black Forest had been damaged by acid rain. The northeastern United States and eastern Canada have been p__13__ affected by this form of pollution. Damage has a__14__ been detected in other areas of these countries and other regions of the world.

Industrial emissions have been blamed as the m__15__ cause of acid rain. Because the chemical reactions involved i__16__ the production of acid rain in the atmosphere are complex and as yet little understood, industries have tended to challenge s__17__ assessments and to stress the need for further studies; and b__18__ of the cost of pollution reduction, governments have tended to support this attitude. Studies released by the U.S. government in the e__19__ 1980s, however, strongly implicated industries as the main s__20__ of acid rain, in the eastern U.S. and Canada.

TOTAL: 10 MARKS

Section E- Paraphrasing

Read Sentence A carefully. Complete Sentence B in your answer book, keeping as closely as possible to the meaning in Sentence A. You are advised to spend a maximum of 15 minutes on this section. Each answer carries one mark.

Example:

    A. This story doesn't amuse me.

    B. don't find...........

➢ *Answer: I don't find this story amusing.*

    A. He ran away as soon as he saw a policeman
    B. The moment …

2. A. The discipline mistress reprimanded our class for making too much noise.
    B. Our class …

3. A. Between Lin Yang and Wong Lu, one of them has to finish the job.
    B. Either …

4. A. Although Jane won the second prize in the story telling competition, she was not happy.
    B. In spite of …

5. A. The man is too old to do anything.
    B. The man is so …

6. A. The experience is fantastic!
    B. What …

7. A. Could you do me a favour?
    B. Would you mind …

8. A. The librarian denied me entry into the library because I didn't have a membership card.
    B. I was …

9. A. I am very familiar with the environment here.
    B. The environment here …

10. A. The movie was interesting.
    B. I ….

TOTAL: 10 MARKS

- END OF PAPER -

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

SAMPLE ENTRANCE EXAMINATION

ENGLISH LANGUAGE

Time Allowed: **2 hours**

INSTRUCTIONS

1. This examination contains **THREE (3)** sections and comprises **SEVEN (7)** printed pages.

2. All 3 sections are compulsory.

3. Read the instructions at the beginning of each section, which specify the marks allocated and give time recommendations.

4. Write all your answers in the **ANSWER BOOK** provided.

5. Dictionaries should **NOT** be used.

SECTION A — WRITING

Directions – *Choose **one** of the following topics and write an essay of **350-400 words** in your **ANSWER BOOK**. You are writing for an educated reader who does not have specialized knowledge in the topic area you have chosen.*
It is recommended that you spend no longer than 60 minutes to complete this section of the test. Allow 10 minutes for organizing – there is space provided for your essay plan/notes in the answer booklet, 45 minutes for writing and 5 minutes for proofreading.

1.   Many universities are adopting Internet-based e-learning to replace or support traditional, face-to-face teaching. Which would you prefer? Support your view.

2.   Energy sources such as solar power, wind power and wave power have been criticised as being relatively ineffective and expensive to implement, compared with fossil fuels such as coal and oil. Should the development of these alternative sources of energy be continued? Support your view.

3.   Pollution emitted from vehicles has made many cities unpleasant and possibly dangerous areas in which to live. One proposed solution to this problem is the banning of cars in city centres, with people commuting by public transport. Do you think that this would be effective? Support your view.

4.   Large companies with massive marketing budgets often portray an artificial and unrealistic view of life. Health and beauty products such as slimming pills are sold to users who believe they can quickly lose weight. The consequences, though, can be fatal. Should health and beauty products be banned or more strictly regulated? Support your view.

5.   It is becoming increasingly easy to track people's movements through signals from their cell phones, records of their computer use and security cameras. Is the tracking of people as they go about their daily lives justified? Support your answer.

TOTAL: 40 MARKS

SECTION B — READING COMPREHENSION

Read the following passage and answer the questions that follow it. You are advised to spend a maximum of 55 minutes on the reading section.

1   Modern genetics has granted us significant new powers over the process of biological inheritance. It has provided us with techniques for splicing together genes from distantly related species, deciphering the cryptic chemical messages of genetic molecules and analyzing and even altering individual genotypes.

2   We will continue to reap enormous benefits from this scientific knowledge – in medicine, agriculture, industry and other areas of application. But we will also continue to pay a heavy price for this and other forms of scientific knowledge. For the insights of modern genetics – like those of astronomy, atomic physics and other disciplines – have forced us to re-examine the place of our species in the natural world and even **to reassess what it means to be human**.

3   The impact of science and technology on modern society has been so profound that it has shaken the foundations of our myths, religions and other traditional reservoirs of wisdom and moral values for our species. Ironically, the muting of traditional voices of moral authority by modern science has taken place at precisely the same time modern science is forcing us to face a growing number of difficult ethical issues – many of them unprecedented in human history.

4   Given the extraordinary accomplishments of science over the past century, it is not surprising that some of us tend to respond to such issues by substituting a blind faith in scientific progress and in scientific ways of knowing for individual moral responsibility. But that faith is misplaced unless we recognise that science offers a very limited view of the world. As one of genetics' most eloquent spokesmen, French Nobel Prizewinning molecular biologist Francois Jacob, said:

> *For the only logic that biologists really master is one-dimensional. As soon as a second dimension is added, not to mention a third one, biologists are no longer at ease... However, during the development of the embryo, the world is no longer merely linear. The one-dimensional sequence of bases in the genes determines in some way the production of two-dimensional tissues and organs that give the organism its shape, its properties, and ... its four dimensional behaviour. How this occurs is a mystery.*

5   For the most part, it is the business of science to systematically dissect nature into manageable bits and pieces. Most scientists explore the natural world by focusing on one small part of it, isolating that part from the complexities that surround it and studying it under carefully controlled conditions. As history demonstrates, this is an extraordinarily powerful approach to learning about nature, and it has unveiled useful secrets that have already paid rich dividends. But the methods of science do have built-in limitations, and we ignore them at our own peril.

3

6   In the first place, the fruits of scientific inquiry are not necessarily facts. They are best described as tentative truths – unfinished ideas about nature's workings that are subjected to continuous criticism, modification and rejection by other researchers. In the second place, scientific explanations of the natural world are necessarily fragmentary. For science is condemned to see nature as a mosaic of arbitrarily defined, component parts. The methods of science are simply incapable of encompassing the dazzling complexity of whole systems – whether they are living cells, thinking brains of self-sustaining ecosystems in the tropical forest.

7   By sacrificing the whole for the part, scientists are able to understand the workings of isolated areas of natural systems and to gain control over these processes. When science creates new technological tools, they often yield instant social and financial rewards. But these successes can blind us to the fact that science seldom has much to say about the possible future effects of these applications on our societies and ecosystems. We need look no further than the long-term effects of the automobile, nuclear fission, agricultural pesticides or the personal computer to appreciate **the myopia of science**. The effects of each of these applications of science extend far beyond the immediate uses for which they were intended.

8   In many ways, the accelerating pace of scientific and technological advances has thrown us out of balance with the natural world. Technology has equipped our species with the mechanical equivalent of muscle power that now greatly exceeds that of any species that has ever lived. It has provided us with the resource base with which to multiply into the largest and most far-flung population of large mammals on earth. And a whole host of human activities – from commercial farming and forestry to the combustion of oil and coal – have altered the face of the planet in ways that are easily visible from outer space.

9   The tragedy is that in the process most of us have lost any clear sense of our species' place in global ecosystems and of our biological kinship with other living things. We must not lose sight of this larger context as we continue to tinker with genes and shape the hereditary futures of species. For as we embark on this new era of applied molecular genetics, we are in some ways incredibly shortsighted. We are so intent on rushing to exploit our newly acquired insights that we often do not have the faintest idea of the long-term consequences of our technologies.

10   Science and technology are in themselves neither good nor evil. They are the product of human curiosity – the mind's relentless urge to explore, to know, to change. And that is a quality that we must always nourish. But we must also recognize the need for a moral framework within which scientific inquisitiveness can be expressed without exposing human populations and their surroundings to unacceptable risks or irreparable harm.

11   Such a system would have to be just and broadly acceptable. It would have to be resilient enough to make room for new scientific truths as they emerge. And **it** would have to embody humanity's most cherished – and most vulnerable – values. Even with such a moral framework in place, we would be naïve to expect it to provide answers to every difficult ethical dilemma arising from science. But such a framework might at least inspire us to ask ourselves different kinds of questions of science, to search for different kinds of scientific applications and to seek different kinds of long-term goals than do some of the most influential institutions of moral authority in Western society today.

Questions

*This task consists of **TEN (10)** multiple choice questions, and **FIVE (5)** short answer questions. For the multiple choice questions, choose the correct answer from the alternatives given. Write the correct answer (a), (b), (c) or (d), in your **ANSWER BOOK**. For the short answer questions, write a short answer (a word, phrase, or sentence) in response to the question next to the appropriate number in your **ANSWER BOOK**. Each multiple choice question carries two marks and each short answer question carries five marks.*

1. The main idea of paragraph 3 is that
a) scientific advances are completely to blame for the ethical dilemmas we currently face.
b) scientific advances have both created dilemmas and weakened traditional answers.
c) people no longer believe in myths, religion and traditional sources of wisdom.
d) there are many precedents throughout history to help us face ethical problems.

2. "We" as used throughout the text, are
a) human beings throughout history.
b) the scientific community.
c) the author and the reader.
d) human beings at this point in time.

3. Which of the following is NOT given as an achievement of modern genetics in paragraphs 1 and 2?
a) It has resulted in progress in the field of agriculture.
b) Scientists now understand the chemistry of genetic molecules.
c) It has led to advances in astronomy and atomic physics.
d) Scientists are now able to change individual genotypes.

4. The writer's purpose in paragraph 9 is to
a) warn of the consequences if we do not consider the long term effects of advances in genetics.
b) emphasize the connection between human beings and every other life form on earth.
c) show that scientists are not proceeding quickly enough in the development of genetics.
d) persuade us that all research into molecular genetics should immediately cease.

5. The example of biologists' logic in paragraph 4 is given in order to
a) show that biologists have made a significant contribution to the development of genetics.
b) explain the process through which biologists understand four dimensional behaviour.
c) support the argument that science does not offer a complete view of the world.
d) demonstrate the difficulties experienced by scientists when faced with mysterious behaviour.

6. The writer believes that technology and science
a) are inherently destructive.
b) are the result of human curiosity.
c) can provide answers to our dilemmas.
d) are inherently beneficial to mankind.

7. **In paragraph 11, (line 2) "it" refers to**
a) a new scientific truth.
b) irreparable harm.
c) scientific inquisitiveness.
d) a moral framework.

8. **The expression "to reassess what it means to be human" in paragraph 2 is closest in meaning to**
a) question our previous beliefs about what constitutes a human being.
b) reconsider the origin of our species from a historical perspective.
c) reflect on our human ability to think through problems and assess solutions.
d) test our understanding of human biology again.

9. **In which of the following does the pair of words or phrases NOT have the same meaning?**
a) equipped (8) -- provided (8)
b) profound (3) -- eloquent (4)
c) accomplishments (4) -- advances (8)
d) curiosity (10) -- inquisitiveness (10)

10. **The best title for this reading passage would be**
a) Scientific Achievements
b) Genes and Human Evolution
c) Advances in Genetics
d) The Limits of Science

11.   **Give <u>one</u> example from the reading that illustrates the imbalance in our natural world resulting from rapid scientific and technological developments.**

12.   **What have scientists given up in order to understand the way in which discrete areas of natural systems work?**

13.   **What does the writer mean by the "myopia of science" (paragraph 7)?**

14.   **What are <u>two</u> limitations of scientific methods?**

15.   **The writer believes that a moral framework is important. Give <u>two</u> essential characteristics of this framework, according to the writer.**

TOTAL: 45 MARKS

SECTION C — FILL IN THE BLANKS

*Supply a suitable word for each of the fifteen numbered blanks (you are given the first letter of the required word). Write the correct answer in your **ANSWER BOOK**. Do not write out the whole passage. Each item carries 1 mark. You are advised to spend a maximum of 20 minutes on this section.*

Example: My local high s__(0) __ has many talented teachers.
Answer: (0) school

Maps and Places

Maps demonstrate a vital rule of geography: that places on the Earth have their own distinctive properties which, taken t__(1)__, give each place its own character. No place is e__(2)__ like another and a map is the best way to demonstrate this. Geographers study b__(3)__ the physical and human properties of places. The Earth's s__(4)__, its elevation and relief, slopes and drainage, soils, natural vegetation, and atmospheric conditions (climate and weather) form the physical setting. The uses to w__(5)__ people put this setting – in the form of settlement layout, population patterns, transport networks, land use, and other human activity – create the human imprint. Together, these physical and human features constitute the overall geographic character of a p__(6)__ place.

Geographers therefore have a special interest in the quality of places. W__(7)__ it's a fishing village on China's c__(8)__ or a bustling Arab town, geographers want to know how the people have implanted their traditions on that locale, why they have done so, what sustains them now, and how they i__(9)__ with the outside world. It is impossible, of course, to study all these aspects at once, s__(10)__ geographers tend to s__(11)__ in certain features of places. Some study the street layout and architecture of a town; others concentrate on the transport systems that serve it; still others f__(12)__ on the business and industry that sustain the local e__(13)__. In the process, a kind of geographic overview of the place emerges. If you were to become a professional geographer and found y__(14)__ assigned to study, say, the growth of suburbs around Santiago, the capital of Chile, you would first read what geographers (and others) have already written about that city. With the many specialized maps they have prepared, you would be w__(15)__ informed before you ever set foot in the field.

TOTAL: 15 MARKS

- END OF PAPER -

NANYANG TECHNOLOGICAL UNIVERSITY

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

ENTRANCE EXAMINATION SAMPLE PAPER

ENGLISH LANGUAGE

Time allowed: **2 hours**

INSTRUCTIONS

1. This examination contains THREE (3) sections and comprises SEVEN (7) printed pages.

2. All THREE (3) sections are compulsory.

3. Read the instructions at the beginning of each section, which specify the marks allocated and give time recommendations.

4. Write all your answers in the **ANSWER BOOK** provided.

5. Dictionaries should **NOT** be used.

SECTION A – Writing

Choose <u>**one**</u> *of the following topics and write an essay of **350 words** in your **ANSWER BOOK**. You are writing for an educated reader who does not have specialized knowledge in the topic area you have chosen.*

It is recommended that you spend no longer than 50 minutes to complete this section of the test. Allow 5 minutes for organizing, 45 minutes for writing and 5 minutes for proofreading. (There is space provided for your essay plan/notes in the answer book.)

1. In future, through the use of the Internet, students can receive their formal education at home rather than in school. Do you think that the Internet will ever replace face-to-face learning?

2. Married women should give up their jobs to look after their children. What are your views on this statement? Justify your views with examples.

TOTAL: 40 MARKS

Read the following passage and answer the questions that follow it. You are advised to spend a maximum of 50 minutes on this section.

1. Cultural shock generally goes through five stages; excitement or initial euphoria, crisis or disenchantment, adjustment, acceptance, and re-entry. Davis and Krapels (2005) visualize cultural shock as being represented by a U-shaped curve, with the top of the left of the curve representing the positive beginning, the crisis stage starts down the left side to the base of the U, the adjustment phase starts at the base of the curve, then acceptance moves up the right side of the curve, and re-entry into the original culture is at the top of the right side of the curve.

2. The first stage is excitement and **fascination** with the new culture, which can last only a few days or several months. During this time, everything is new and different; you are fascinated with the food and the people. Sometimes this stage is referred to as the "honeymoon" stage, during which your enthusiasm for the new culture causes you to overlook minor problems, such as having to drink bottled water and the absence of central heating or air conditioning (Black et al., 1999).

3. During the second stage, the crisis or disenchantment period, the "honeymoon" is over; your excitement has turned to disappointment as you encounter more and more differences between your own culture and the new culture. Problems with transportation, unfamiliar foods, and people who do not speak English now seem overwhelming. The practice of bargaining over the purchase price of everything, an exercise originally found amusing, is now a constant source of irritation. Emotions of homesickness, irritation, anger, confusion, resentment, helplessness, and depression occur during the second stage. People at this stage often cope with the situation by making **disparaging** remarks about the culture; it is sometimes referred to as the "fight-back" technique. Others deal with this stage by leaving, either physically, emotionally, or psychologically. Those who remain may withdraw from people in the culture, refuse to learn the language, and develop coping behaviors of excessive drinking or drug use. Some individuals actually deny differences and will speak in glowing terms of the new culture. This second stage can last from a few weeks to several months.

4. In the third stage, the adjustment phase, you begin to accept the new culture or you return home. You try new foods and make adjustments in **behavior** to **accommodate** the shopping lines and the long waits for public transportation. You begin to see the humor in situations and realize that a change in attitude toward the host culture will make the stay abroad more rewarding.

5. In the fourth phase, the acceptance or adaptation phase, you feel at home in the new culture, become involved in activities of the culture, cultivate friendships among the nationals, and feel comfortable in social situations with people from the host culture. You learn the language and may **adopt** the new culture's style of doing things. You even learn to enjoy some customs such as afternoon tea and the midday siesta that you will miss when you return to the home country.

6. The final phase is re-entry shock, which can be almost as traumatic as the initial adjustment to a new culture, particularly after an extended stay abroad. Many individuals are shocked at the fact that they feel the same emotional, psychological, and physical reactions they did when they entered the new culture. Re-entry shock is experienced on returning to the home country and may follow the stages identified earlier: initial **euphoria**, crisis or disenchantment, adjustment, and acceptance or adaptation. You would at first be happy to be back in your own country but then become disenchanted as you realize that your friends are not really interested in hearing about your experiences abroad, your standard of living goes down, and you are unable to use such new skills as a foreign language or bargaining in the market. You then move into the adjustment stage as you become familiar with new technology and appreciate the abundance and variety of foods and clothing and the improved standards of cleanliness. You finally move into the acceptance stage when you feel comfortable with the mores of the home culture and find yourself returning to many of your earlier views and behaviors.

7. Although re-entry shock is typically shorter than the first four stages of cultural shock in a new culture, expatriates who have made a good adjustment to the host culture may go through a rather long period of adjustment, lasting six months or more when they are confronted with the changes that have taken place in their absence. Some of these changes are work-related; expatriates may feel "demoted" when they return to middle-management positions without the bonuses, perks, and professional contacts that they enjoyed abroad. In other situations, changes have taken place in the home country, including politics and styles of clothing, which require re-adjustment. In research conducted by Chaney and Martin (1993), the four types of re-entry shock **experienced** by college students who had travelled abroad that were statistically significant were re-adjusting to changes in social life, re-adjusting to changes in standard of living, and re-establishing friendships.

8. Some re-entry problems are personal in nature. Many repatriates have changed; they have acquired a broadened view of the world and have **undergone** changes in **values** and attitudes. Personal problems may include unsuccessful attempts to renew personal and professional relationships as the realization sets in that their former friends do not share their enthusiasm for their overseas experiences and accomplishments. They must make new friends who share this common experience. Children of expatriates encounter similar readjustment problems when returning to schools in the United States.

9.   Because re-entry shock is a natural part of cultural shock, multinational corporations must provide training for repatriates to ensure that the transition to the home culture is a favorable experience. In the absence of such training, you can do much to counteract re-entry shock by sharing your feelings (not your experiences) with sympathetic family members and friends, particularly those who have lived abroad. Correspond regularly with members of the home culture; ask questions concerning changes that are taking place. Subscribe to the home newspaper to stay abreast of current events. Keep in touch with professional organizations and other groups with which you may want to **affiliate**. Many repatriates have found that maintaining ties with the home culture cushions the shock associated with re-entry.

Adapted from Chaney L.H. & Martin J.S., 2007, Intercultural Communication, NJ: Pearson.

Questions

This task consists of TEN (10) multiple choice questions and TWO (2) short answer questions.

For the multiple choice questions, choose the correct answer from the alternatives given. Write the correct answer (a), (b), (c) or (d), in your ANSWER BOOK. Each multiple choice question carries two marks.

1. The main purpose of the reading passage is
a) to present the reasons behind cultural shock.
b) to argue for better training to counter cultural shock.
c) to show that cultural shock is a natural phenomenon.
d) to explain the different stages of cultural shock.

2. According to the passage, which of the following symptoms does not represent a person who is in the crisis stage?
a) He or she displays negative emotions.
b) He or she rebels against the new culture.
c) He or she experiences a period of denial.
d) He or she resists bargaining at the market.

3. The word "disparaging" (paragraph 3) means
a) insulting.
b) complaining.
c) reprimanding.
d) annoying.

4. What does not happen during the third stage of cultural shock?
a) The individual accommodates the new culture.
b) The individual changes his or her perspective.
c) The individual rejects the new culture.
d) The individual accepts the new culture.

5. According to paragraph 6, re-entry shock includes
a) feeling excited initially about returning home.
b) realizing that the experience has matured you.
c) discovering that your friends have changed.
d) understanding the difference between cultures.

6. Which of the following pair of words has the same meaning?
a) fascination (2) – euphoria (6)
b) accommodate (4) – adopt (5)
c) behavior (4) – values (8)
d) experienced (7) – undergone (8)

7. Based on paragraph 8, which of the following statements is true about reentry problems?
a) They are largely professional problems.
b) They are mainly personal problems.
c) They involve relationship problems.
d) They include marriage problems.

8. The term "affiliate" in paragraph 9 is closest in meaning to
a) relate.
b) represent.
c) associate.
d) adopt.

9. The writer's purpose in paragraph 9 is to
a) illustrate the approaches toward re-entry shock.
b) highlight the importance of training for cultural shock.
c) emphasize the organization's role in handling re-entry shock.
d) present the strategies to counteract cultural shock.

10. The best title for this reading passage would be
a) The Process of Cultural Shock
b) The Effects of Cultural Shock
c) Overcoming Cultural Shock
d) Handling Cultural Shock

For the short answer questions, write a short answer (of not more then 100 words) in response to the question next to the appropriate number in your ANSWER BOOK. Each short answer question carries ten marks.

11.   According to the passage, the second stage of cultural shock is known as the "disenchantment period" (paragraph 3). In your own words, explain how people behave negatively during this period.

12.   In paragraph 6, the writer asserts that "many individuals are shocked at the fact that they feel the same emotional, psychological and physical reactions they did when they entered the new culture." In your own words, explain why the writer made this assertion.

TOTAL: 40 MARKS

SECTION C— Fill in the blanks

*Supply a suitable word for each of the twenty numbered blanks (you are given the first letter of the required word). Write the correct answer in your **ANSWER BOOK**. Each item carries 1 mark. You are advised to spend a maximum of 20 minutes on this section.*

Example: My local high s__(0) __ has many talented teachers.
Answer: (0) school

Healing Power of Stress

"Humans should not try to avoid stress any more than they would shun food, love or exercise," said Dr Hans Selye, the first physician to document the effects of stress on the body. While there's no question that prolonged stress is harmful, several studies suggest that challenging situations in which you're able to rise to the occasion can be good for you.

In a 2001 study of 158 h__(1)__ nurses, those who faced considerable work d__(2)__ but coped with the challenge were m__(3)__ likely to say they were in g__(4)__ health than those who felt they were u__(5)__ to get the job done.

Stress that y__(6)__ can manage may also boost immune f__(7)__. In a study at the Academic Centre for Dentistry i__(8)__ Amsterdam, researchers put volunteers through two s__(9)__ events. In the first, a timed t__(10)__ that requires memorising a list followed b__(11)__ a short test, subjects believed they h__(12)__ control over the outcome. In the s__(13)__, they weren't in control. They have t__(14)__ sit through a gory video on surgical p__(15)__. Those who did well on the m__(16)__ test had an increase in levels o__(17)__ immunoglobulin A, an antibody that's the body's f__(18)__ line of defence against germs. The video-watchers e__(19)__ a downturn in the antibody count.

Stress p__(20)__ the body to produce adrenaline and the stress hormone cortisol. In short bursts these hormones have a positive effect, including improved memory function. "Cortisol and adrenaline enhance how nerve cells handle information and put it into storage," says Bruce McEwen, head of the laboratory of neuro-endocrinology at Rockefeller University in New York. But long term these hormones can have a corrosive effect on the body and brain.

"Sustained stress is not good for you," says Richard Marimoto, a researcher at Northwestern University in Illinois studying the effects of stress on longevity. "It's the occasional burst of stress or brief exposure to environmental or physiological stress that could be protective."

Adapted from Colino, S., Reader's Digest, June 2004.

TOTAL: 20 MARKS

- END OF PAPER -

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

CHEMISTRY

Duration   : 2 hours

SAMPLE

Please read the follow instructions carefully.

1.   This examination has TWO (2) sections – A and B, and comprises **SIX (6)** printed pages.

2.   Attempt all sections.

3.   Answer all questions in section A.   Indicate your answers on the answer paper provided.   Each question carries 2 marks.   Marks will not be deducted for wrong answers.

4.   Answer any THREE (3) questions in section B. Write your answers on the answer paper provided.   Begin each question with a fresh sheet of paper.   Write the question number clearly.   Each question carries 20 marks.

5.   At the end of the examination, attach the cover paper on top of your answer script.   Complete the information required on the cover page and tie the papers together with the string provided.

6.   Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Answer All Questions. (2 marks for each question).

1. How many lone pairs are there at C in CO_3^{2-}?

    A   0
    B   0.5
    C   1
    D   1.5
    E   2

2. How many lone pairs are there at N in NH_4^+?

    A   0
    B   0.5
    C   1
    D   1.5
    E   2

3. Reaction between NH_3 with BH_3 is an example of _____ reactions.

    A   redox
    B   addition
    C   disproportionation
    D   condensation
    E   none of the above

4. CH_2N_2 readily liberates CH_2. This statement is most likely _____

    A   correct
    B   wrong
    C   only correct if H is replaced by R
    D   only correct if N is replaced by S
    E   unable to judge as the molecule is too unstable

5. The reaction $CO_2 + H_2O \rightarrow H_2CO_3$ is most likely to produce quantitative yield of the product. This statement is most likely _____

    A   correct
    B   wrong
    C   correct if CO_2 is in excess
    D   correct if the solution is very diluted
    E   unable to judge since the pH is not known

6. The N-N bond in N_2H_4 is likely to be _____

    A   weak and reactive
    B   weak and unreactive
    C   strong and reactive
    D   strong and unreactive
    E   unable to judge

7. Which of the following is a good example of a compound with π bond?

    A H_3BO_3
    B B_2H_6
    C NF_3
    D   all of the above
    E   none of the above

8. An important biosynthesis of carbohydrates in plants is _____

    A   esterification
    B   photosynthesis
    C   Aldol condensation
    D   trans-esterification
    E   enzymatic photo-oxidation

9. In pyrophosphoric acid $H_4P_2O_7$, there is/are _____ P-H bonds.

    A   0
    B   1
    C   2
    D   3
    E   4

10. Which of the following is (comparatively) most alkaline?

    A   sea water
    B   tomatoes
    C   black coffee
    D   (unpolluted) rain
    E   urine

11. The conjugate base of C_2H_5OH is _____

    A OH^-
    B $C_2H_5O^-$
    C $C_2H_5^+$
    D CH_3O^-
    E O^{2-}

12. 10^{-9} is commonly expressed as ___

    A   micro
    B   nano
    C   pico
    D   molecular
    E   meso

13. In H^-, the s orbital is _____

    A   fully filled
    B   half-filled
    C   empty
    D   half-filled but only in the excited state
    E   fully filled but only in the excited state

14. In H^+, the s orbital is _____

    A   fully filled
    B   half-filled
    C   empty
    D   half-filled but only in the excited state
    E   fully filled but only in the excited state

15. In the solid state structure of $BeCl_2$, the major force among individual $[BeCl_2]$ molecules is likely to be _____ interactions.

    A   dipole-dipole interaction
    B   van der Waal interaction
    C   ionic
    D   covalent
    E   two of the above

16. Scattering of light by a colloidal system is commonly called _____ effect.

A Dalton
B Perkin
C Raman
D Tyndall
E Esosteric

17. The reaction between carboxylic acid and amine can be considered a/an _____ reaction.

A condensation
B addition
C redox
D hydrolysis
E metathesis

18. The reaction between NH_4Cl and $AgNCO$ gives urea, NH_2COCH_2. In the process, Ag^+ undergoes _____

A oxidation
B reduction
C disproportionation
D hydrolysis
E none of the above

19. When table sugar dissolves in water, it mostly undergoes _____

A hydrolysis
B solvolysis
C dissociation
D all of the above
E none of the above

20. How many pi (π) bonds are there in H_2CO?

A 0
B 1.0
C 1.5
D 2.0
E none of the above

Answer three (3) of the following five (5) questions (20 marks for each question).
(If there is any physical constant or data that you need in your calculation but which is not found in the question, you may denote them as "x", "y"… etc, explain them, and indicate such clearly in your working process and answers)

1.   "Since H^+ is highly acidic and since H_2O undergoes protonation easily to give H_3O^+, it is likely that the latter would further react with H^+ to give H_4O^{2+} readily".

Examine this statement carefully by determining whether it is true or false and, if false, under what situation would the statement be valid. Explain.

2.   A mixture of acetaldehyde CH_3CHO and propanal C_2H_5CHO under basic conditions would readily yield four products. Identify them and sketch carefully their structures.

3.   You are given the following ions, namely (a) CH_3^+; (b) CH_2R^+; (c) CHR_2^+; (d) CR_3^+.

Arrange them in a descending order of stability and explain your arrangement carefully.

4.   Sketch the Lewis structures of the following:

    (a) H_2SO_5

    (b) HNO_3

    (c) $HClO_3$
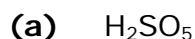
5.   What is the concentration of H_3O^+ in a 1.00×10^{-2} M NaOH solution? State clearly the assumptions, if any, you make.
($K_w = 1.00 \times 10^{-14}$)

END OF PAPER

UNIVERSITY ENTRANCE EXAMINATION
CHEMISTRY

Time: 1 pm to 3 pm
Duration: 2 hours

Please read the following instructions carefully.

1. This examination has TWO (2) printed pages.

2. Answer all questions. Write your answers on the answer paper provided.

3. At the end of the examination, attach the cover paper on top of your answer script. Complete the information required on the cover paper. The cover paper for this examination is GREEN.

4. Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Question 1

a.   Propose a reasonable acid-base reaction (with balanced equation) and identify the acid and base in the substrates.

b.   Propose a reasonable redox reaction (with balanced equation) and identify the reducing and oxidizing agents.

c.   Propose a reasonable disproportionation reaction (with balanced equation). Is this a variant of redox reaction? If so, what is reduced and what is oxidized (in the reaction that you have proposed)? If not, why not?

(30 marks)

Question 2

Examine and discuss the validly of the following statement critically and concisely:

"NCl_5 is a reasonable and stable compound because the five electrons on nitrogen can form bonds with the five surrounding chloride."

(35 marks)

Question 3

What is the pH of a 0.015 M solution of sodium acetate, $NaCH_3CO_2$? State your assumptions, if any, clearly.
(Water ionization constant $K_w = 1.0 \times 10^{-14}$ at 25°C; equilibrium constant K_b (CH_3COO^-) = 5.6 x 10^{-10})

(35 marks)

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

ENTRANCE EXAMINATION
CHEMISTRY (Sample)

Time Allowed : **2 hours**

INSTRUCTIONS

1.   This paper consists of **TWO (2)** Sections and comprises **EIGHT (8)** pages.

2.   Answer **ALL** the questions in Section A and Section B.

3.   For Section A, each multiple choice question carries 2 marks. Section B consists of 3
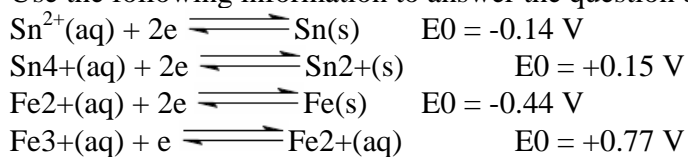   questions (total 40 marks).

SECTION A

This section consists of **THIRTY (30)** multiple choice questions. Answer **ALL** questions in this
section.

1. Which of the following has no permanent dipole moments?

    a. $CHCl_3$
    b. CH_2Cl_2
    c. C_2Cl_4
    d. C_2HCl_3

2. Which is the most abundant element in the universe?

    a. Hydrogen
    b. Helium
    c. Carbon
    d. Oxygen

3. Which one of the following equilibrium mixture will not be affected by a change in
    pressure?

    a. $CH_3CH_2CH_2OH(g) \rightleftharpoons CH_3CH=CH_2(g) + H_2O(g)$
    b. $BaCO_3(s) \rightleftharpoons BaO(s) + CO_2(g)$
    c. $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$
    d. $O_2(g) + 2Hg(l) \rightleftharpoons 2HgO(s)$

4. Calcium with elemental chlorine yields calcium chloride. Write a balanced chemical equation for this reaction.

   a. $Ca(s) + Cl2(g) \rightarrow CaCl(s) + Cl(g)$
   b. $Ca(s) + Cl2(g) \rightarrow CaCl2(s)$
   c. $Ca(s) + 2\,Cl2(g) \rightarrow CaCl4(s)$
   d. $2\,Ca(s) + Cl2(g) \rightarrow 2\,CaCl(s)$

5. On heating, 0.09 mole of an element M reacts with 0.135 mole of oxygen gas. The empirical formula of the oxide of M is

   a. M_2O_2
   b. M_3O_2
   c. M_4O_6
   d. M_2O_3

6. Given that $\Delta H^0_f(FeCl_2(s)) = -341.8$ kJ/mol and that $\Delta H^0_f(FeCl_3(s)) = -399.5$ kJ/mol, what is ΔH_{rxn} for the reaction: $FeCl_2(s) + \frac{1}{2}\,Cl_2(g) \rightarrow FeCl_3(s)$

   a. -57.7 kJ
   b. +714.3 kJ
   c. 0 kJ
   d. +57.7 kJ

7. Iron has a atomic number of 26. What is the electron configuration of the iron in $FeCl_3$?

   a. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
   b. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$
   c. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$
   d. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$

8. A microwave oven emits radiation at a wavelength of 0.500 cm. What is the frequency of this radiation?

   a. $1.67 \times 10^{-11}\ s^{-1}$
   b. $6.67 \times 10^{-7}\ s^{-1}$
   c. $6.00 \times 10^{10}\ s^{-1}$
   d. $2.00\ s^{-1}$

9. The radioactive decay of sodium-24 has a half-life of 14.66 hours. How many grams of the radioactive sodium-24 will be left after 73 hours if the initial weight of the sample is 4g?

   a. 0.125g
   b. 0.032g
   c. 0.064g
   d. 0.26g

2

10. Use the following information to answer the question below:
    $Sn^{2+}(aq) + 2e \rightleftharpoons Sn(s)$ E0 = -0.14 V
    $Sn4+(aq) + 2e \rightleftharpoons Sn2+(s)$ E0 = +0.15 V
    $Fe2+(aq) + 2e \rightleftharpoons Fe(s)$ E0 = -0.44 V
    $Fe3+(aq) + e \rightleftharpoons Fe2+(aq)$ E0 = +0.77 V

    Under standard conditions, which of the following statements is correct?

    a. Sn(s) can reduce Fe(s)
    b. Fe(s) can oxidize $Sn^{2+}(aq)$
    c. $Sn^{2+}(aq)$ can reduce $Fe^{3+}(aq)$
    d. $Fe^{3+}(aq)$ can reduce $Sn^{4+}(aq)$

11. What is the pH of a solution of HNO_3 with a concentration of 0.0013M?

    a. 2.89
    b. 6.64
    c. 1.30
    d. 11.10

12. The maximum number of electrons in the shell having the principle quantum number of n = 3 is

    a. 18
    b. 26
    c. 28
    d. 36

13. The hybridization of the nitrogen atom in the molecule NF_3 is

    a. sp^2
    b. spd
    c. sp^3
    d. sp^3d

14. Which of the following statements is true about the elements in Group II of the Periodic Table?

    a. The ionic radius decreases down the group
    b. The electronegativity decreases down the group
    c. They form stable oxidation states of two and four
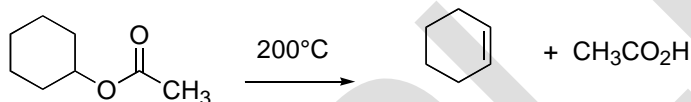   d. The atomic radius increases down the group

15. The oxidation number of Chromium in the ion CrO_4^{2-}

   a. +4
   b. +7
   c. +6
   d. +3

16. Which of the following compounds would react most rapidly with NaCN?

   a. 1-bromobutane
   b. (R)-2-bromobutane
   c. (S)-2-bromobutane
   d. 1-bromo-2-methylpropane
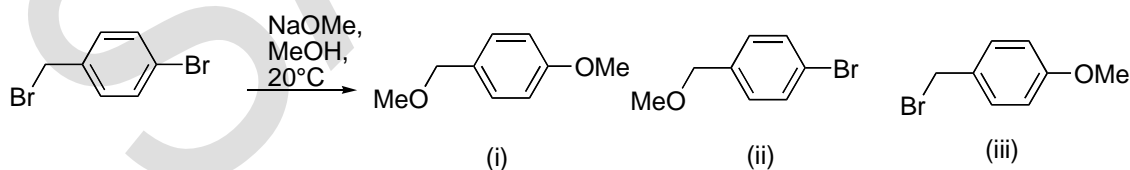
17. The following reaction can be classified as

   a. eminination
   b. substitution
   c. oxidation
   d. rearrangement

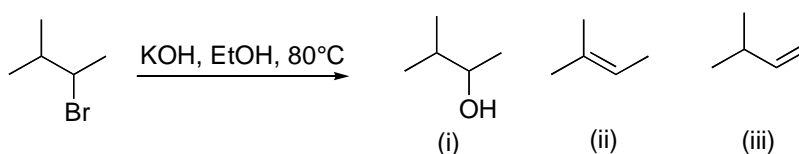18. Reaction of benzene with benzoyl chloride and aluminium trichloride will give as the product:

   a. benzophenone
   b. chlorobenzene
   c. no reaction
   d. benzoic acid

19. What will be the product(s) of the following reaction:

   a. (iii) only
   b. (ii) only
   c. (i) and (ii)
   d. (i), (ii) and (iii)

4

20. What will be the product(s) of the following reaction

a. (i) only
b. (ii) only
c. (ii) and (iii)
d. (iii) only

21. Phosphorus forms three well known compounds containing chlorine: phosphorus trichloride (PCl_3), phosphorus pentachloride (PCl_5) and phosphorus oxychloride ($POCl_3$). What are the oxidation numbers of phosphorus in the compounds?

	PCl_3	PCl_5	$POCl_3$
a.	–3	–5	–5
b.	+1	+1	+3
c.	+3	+5	+4
d.	+3	+5	+5

22. Which of the following is the formula for a covalent network?

a. N_2O_4
b. P_4O_{10}
c. CO_2
d. SiO_2

23. Which of the following is a pure compound?

a. Milk
b. Ice cream
c. Lava
d. Distilled water

24. Which of the following electron configurations represents the ground state of an element?

a. $[Ne]3s^13p^1$
b. $[He]2s^12p^3$
c. $[Ne]3s^23p^33d^1$
d. $[Ne]3s^23p^3$

25. Formic acid (HCO_2H) has $K_a = 1.8 \times 10^{-4}$. What is the value of K_b for the formate ion (HCO_2^-)?

a. -1.8×10^{-4}
b. 1.8×10^{10}

c. 5.6×10^{-11}
d. 5.6×10^{4}

26. Which of the following molecules/ions has non-zero dipole moments?

    a. *cis*-HClC=CHCl
    b. O_2
    c. BF_3
    d. ICl_4^-

27. An increase in temperature increases the reaction rate because

    a. a greater fraction of the collisions have the correct orientation of molecules
    b. the activation energy of the reaction will decrease.
    c. temperature acts as a catalyst in chemical reactions.
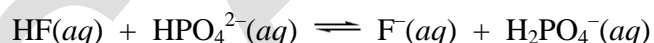   d. more collisions will have enough energy to exceed the activation energy.

28. Calculate the equilibrium constant for the reaction using the provided equilibrium concentrations.

    $H_2(g) + I_2(g) \rightleftharpoons 2 HI(g)$
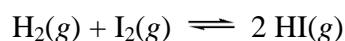
    $[H_2] = 0.0057 \text{ mol L}^{-1}$, $[I_2] = 0.0057 \text{ mol L}^{-1}$, $[HI] = 0.0345 \text{ mol L}^{-1}$

    a. 9.4×10^{-4}
    b. 0.027
    c. 37
    d. 1.1×10^{3}

29. In the following reaction:

    $HF(aq) + HPO_4^{2-}(aq) \rightleftharpoons F^-(aq) + H_2PO_4^-(aq)$

    a. HF is an acid and F^- is its conjugate base.
    b. HF is an acid and HPO_4^{2-} is its conjugate base.
    c. HPO_4^{2-} is an acid and $H_2PO_4^-$ is its conjugate base.
    d. $H_2PO_4^-$ is an acid and F^- is its conjugate base.

30. The ionization energies (IE) of Ti are as follows:

I	II	III	IV	V
6.82	13.58	27.49	43.27	99.22 eV

Stable oxidation states are expected when the difference in successive IE's exceeds 12 eV for valence electrons. What stable oxidation states are expected for Ti?

a. Ti(I) only
b. Ti (I) and Ti(V)
c. Ti(I), Ti(II) and Ti(IV)
d. Ti(II), Ti(III) and Ti(IV)

SECTION B

This section consists of **THREE (3)** questions. Answer **ALL** questions in this section.

1. (a) Using dots to represent electrons, draw the electron distribution diagram (Lewis structure) of ClF_3. Use Valence Shell Electron Pair Repulsion theory (VSEPR) to explain the shape of this molecule.

   (b) Draw and label all the valence orbitals found in chlorine atom.

2. Data for the reaction $2\ NO(g) + O_2(g) \rightarrow 2\ NO_2\ (g)$ are given in the table.

	Concentration (mol/L)		Initial Rate
Experiment	[NO]	[O_2]	(mol/L · h)
1	3.6×10^{-4}	5.2×10^{-3}	3.4×10^{-8}
2	3.6×10^{-4}	1.04×10^{-2}	6.8×10^{-8}
3	1.8×10^{-4}	1.04×10^{-2}	1.7×10^{-8}
4	1.8×10^{-4}	5.2×10^{-3}	?

   (a) Determine the rate constant and write down the rate equation for the above reaction.

   (b) What is the initial rate of the reaction in experiment 4?

3. (a) Discuss the difference in reactivity between the following pairs of compounds under the conditions given
   (i) benzene and phenol with bromine
   (ii) 1-hexanol and 2-hexanol with chromium trioxide in acid
   (iii) ethylamine and acetamide with dilute hydrochloric acid

7

(iv) sodium methoxide and sodium t-butoxide with 1-bromopropane

(b) How would you carry out the following transformation? More than one step may be required.
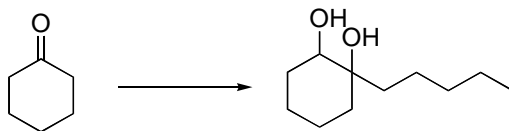
- END OF PAPER -

UNIVERSITY ENTRANCE EXAMINATION
HUMANITIES

Time: 3.30pm to 6.30pm
Duration: 3 hours

Please read the following instructions carefully.

1. This examination has THREE (3) sections – A, B and C, and comprises FOUR (4) printed pages.

2. Answer FIVE (5) questions from any of the three sections. Candidates intending to offer Economics or Computing must answer at least THREE (3) questions from the Economics section, i.e. section A.

3. Write your answers on the answer paper provided. Begin each question on a fresh sheet of paper. Write the question number beside each question.

4. At the end of the examination, attach the cover paper on top of your answer script. Complete the information required on the cover paper. The cover paper for this examination is PINK.

5. Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

SECTION A - ECONOMICS

1. ABC Telecoms, one of the two long-distance telephone companies in the country, recently cut its rates on all international telephone calls.
    a. Distinguish between price elasticity of demand, cross elasticity of demand, and income elasticity of demand. (10 marks)
    b. How relevant would knowing the various elasticities of demand help in explaining the move by ABC Telecoms? (10 marks)

2. "Monopoly is a more efficient market structure than monopolistic competition." Comment. (20 marks)

3. The external value of many Asian currencies plunged during the Asian Financial Crisis.
    a. What does it mean to say that a currency depreciates in value? What might cause such a change? (12 marks)
    b. Is depreciation of a country's currency always detrimental to the health of its economy? (8 marks)

4. Do you think monetary policy is sufficient to achieve a low rate of inflation? (20 marks)

5. Given below is the amount of beef OR computers that a Canadian or a Mexican worker can produce in a day.

	Canada	Mexico
Beef	9	5
Computer	3	2

    a. Which country has the absolute advantage in computer production? Explain. (6 marks)
    b. Which country has the comparative advantage in computer production? Explain. (6 marks)
    c. If they specialize in production, what are the limits to the terms of trade? (8 marks)

SECTION B – GEOGRAPHY

1. Discuss the negative and positive implications for rural – urban migration with reference to a particular country in East or Southeast Asia. (20 marks)

2. Why is sustainable natural resource management difficult to achieve? Illustrate this with specific examples. (20 marks)

3. Why are regional human geography differences important within the European Union? (20 marks)

4. Critically examine some of the causes of river pollution and its impacts with reference to specific examples. (20 marks)

5. With reference to a particular place, examine the significance of global – local interactions on the human landscape. (20 marks)

SECTION C – HISTORY

1. "Western imperialism in Southeast Asia was driven by strategic rather than economic concerns." State whether you agree or disagree with this statement, and explain why. (20 marks)

2. What is the origin of the imagined communities that Benedict Anderson argues lie at the heart of Southeast Asian nationalism? (20 marks)

3. India and Southeast Asia both have populations that speak many different languages, practice different religions, and follow different cultural norms. India emerged from colonial rule as a single state, but Southeast Asia did not. Why is this the case? (20 marks)

4. Compare and contrast the globalisation of early twentieth century imperialism and that of late twentieth century capitalism. (20 marks)

5. Most Asian countries trace their modern history to the actions of one or at most two or three national leaders (such as Ghandi and Nehru, Sukarno and Hatta, Ho Chi Minh, Mao Tse-tung and so on). Japan does not. Why do you think this is the case? (20 marks)

UNIVERSITY ENTRANCE EXAMINATION

National University
of Singapore

HUMANITIES

Duration   : 3 hours

Please read the follow instructions carefully.

1.   This examination has THREE (3) sections – A, B and C, and comprises **SIX (6)** printed pages.

2.   Answer FIVE (5) questions from any of the three sections.   Candidates intending to offer Economics or Computing must answer at least THREE (3) questions from the Economics section, i.e. section A.

3.   Write your answers on the answer paper provided.   Begin each question with a fresh sheet of paper.   Write the question numbers clearly.   Each question carries 20 marks.

4.   At the end of the examination, attach the cover paper on top of your answer script.   Complete the information required on the cover page and tie the papers together with the string provided.

6.   Do not take any paper, including the question paper and unused answer paper, out of the examination hall.

Each question carries 20 marks.   Candidates intending to offer Economics or Computing must answer at least THREE (3) questions from the Economics section, i.e. section A.

A1.

(a)   Using a graph, illustrate and explain the effect that an increase in production costs will have on the equilibrium price and quantity of a good.

(4 marks)

(b)   Suppose that the government increases a tax paid by employers for hiring workers. Using a graph, illustrate and explain the likely effects on real wages, output and employment? What are the likely magnitudes of these effects?

(10 marks)

(c)   What are the three properties of money?

(6 marks)

A2.

(a)   The table below shows the population and real GDP in 2021 for two countries, A and B, for the years 2021 and 2031. Which of these two countries experienced a faster increase in the standard of living between 2021 and 2031?

(5 marks)

	Troy		Pompeii	
	2021	2031	2021	2031
Real GDP	$175 billion	$189 billion	$476 billion	$547 billion
Population	62.3 million	63.7 million	73.6 million	82.4 million

(b)   How would a nation's central bank's reduction of the reserve ratio requirement affect money creation?

(5 marks)

(c)   How would a central bank's sale of government bonds on the open market affect money creation?

(5 marks)

(d)   Explain how automatic stabilizers work.

(5 marks)

A3.

(a) Explain why financial intermediaries are necessary to facilitate the movement of funds from savers to investors and how they provide benefits to both groups.

(5 marks)

(b) Explain what is meant by a devaluation of a currency. Under what circumstances would a country devalue its currency?

(5 marks)

(c) The following are some changes that may take place in the market for textbooks. For each of the following, indicate what will happen to either the demand for or the supply of textbooks by listing which curve is affected and then the terms: "<u>shift right</u>", "<u>shift left</u>", or "<u>movement along</u>".

    (i) an increase in student enrollment at universities across the country

    (ii) a decrease in the price of ink used to print textbooks

    (iii) a drop in income (textbooks are a normal good)

    (iv) an improvement in the technology used to print textbooks

    (v) an increase in college tuition

(10 marks)

A4.

(a) Would consumers benefit more from a tariff or a quota on imports?

(5 marks)

(b) Distinguish the current account from the capital account.

(5 marks)

(c) The market for restaurant pizza in Chicago is currently in equilibrium at a price of $8 and 2,000 pizzas are sold each day. Explain what will happen to the equilibrium price and quantity of pizzas sold and <u>why</u> (which curve has changed) for each of the following situations:

    (i) delivery personnel form a labour union and demand to be paid $7.50 per hour (a large increase in their wage).

    (ii) fast-food hamburger restaurants (Burger King & McDonalds) cut their prices in half.

(10 marks)

3

A5.

	Quantities Produced		Prices	
	DVDs	DVD Player	DVDs	DVD Player
Year 2004	100	200	20	110
Year 2005	120	210	22	120

(a) Calculate real GDP using prices from 2004. By what percent did real GDP grow from 2004 to 2005?

(5 marks)

(b) Calculate the value of the price index for GDP for 2005 using 2004 as the base year. By what percent did prices increase?

(5 marks)

(c) Consider an economy in which: $C = 200 + 0.5y$ and $I = 200$.

(i) Find equilibrium income.

(ii) What is the multiplier for investment spending for this economy?

(iii) What is the savings function?

(iv) What is the level of savings at the level of equilibrium income?

(10 marks)

SAMPLE

Answer a total of FIVE (5) questions only.   These five questions may be **from any of the three sections**.   Each question carries 20 marks.   Candidates intending to offer Economics or Computing must answer at least THREE (3) questions from the Economics section, i.e. section A.

B1.   Examine the likely contributing causes to the Southeast Asian "haze" phenomenon.

B2.   What is "eco-tourism"? Why may it bring both costs and benefits to rural areas?

B3.   Discuss the reasons for the development of mega-cities with reference to specific examples you know of.

B4.   Why is it necessary to consider the physical – human geography interface when examining issues of environmental degradation?

B5.   Why are human geographers so interested in the concept and meanings of "place"?

Instructions to Candidates:

Write an extended, coherent, well-organised and factually supported answer in English.

Each question is worth 20 marks.

C1. "Nationalism is responsible for most of the wars of the 20th century." Do you agree? Discuss in relation to any **ONE** of these regions: Southeast Asia, East Asia or South Asia.

C2. Discuss why European powers could not and did not need to fully dominate Asian countries from 1500 to 1800?

C3. "Colonised societies would be nothing more than backward polities had it not been for western colonialism." Using the example of any Southeast Asian country, argue for or against this statement.

C4. What was the significance of the Meiji Restoration in Japanese history?

C5. What themes can we use to discuss the history of Asia that do not place an emphasis on geographic categories such as "Southeast Asia", "East Asia" and "South Asia"? Discuss at least three themes and show how they cut across all the regions listed above while using examples to illustrate your points.

END OF PAPER

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

BIOLOGY

Duration   : 2 hours

Please read the following instructions carefully.

1. This paper is made up of 60 Multiple-Choice questions and comprises **THIRTEEN** (**13**) printed pages.

2. **Do not write on the question paper**.

3. Answer all questions and indicate your answers on the answer sheet provided. Marks will not be deducted for wrong answers.

4. Do not take any paper, including the question paper or unused answer sheets, out of the examination hall.

Answer all questions in this section.

1. Which of the following has cell wall made of cellulose?

    A   Cells taken from a mushroom.
    B   Stomach of a spider.
    C   Lung tissue of a chicken.
    D   Flower of a rose plant.

2. A skin is

    A   an organelle.
    B   a tissue.
    C   an organ.
    D   an organ system.

3. The ecological relationship between humans and bacterial infections like tuberculosis is best described as

    A   predation.
    B   parasitism.
    C   mutualism.
    D   symbiosis.

4. A student examined the egg cell in an ovule of a plant and found that it contains 18 chromosomes. How many chromosomes are there in each of the root-tip cells of this plant?

    A   36.
    B   18.
    C   9.
    D   None of the above.

5. Which of the following secretion does NOT contain enzymes?

    A   Gastric (stomach) secretions.
    B   Bile.
    C   Saliva.
    D   Pancreatic juice.

6. Which of the following does not have membrane-bound nuclei in their cells?

    A   Insects.
    B   Prokayotes.
    C   Bryophytes.
    D   Gymnosperms.

7. The part of the digestive tract (in human) with lowest pH is the

    A   stomach.
    B   small intestine.
    C   mouth.
    D   rectum.

8. Which of the following is autotrophic?

    A   A fern growing on the tree.
    B   A mushroom growing on dead wood.
    C   *Penicillium* growing on an orange.
    D   None of the above is autotrophic.

9. Which of the following is NOT true of chlorophyll?

    A   It absorbs light at the red and blue ends of the spectrum.
    B   It does not absorb green wavelengths of light.
    C   It is found in mitochondria.
    D   All the above are not true of chlorophyll.

10. The oxygen molecules released during photosynthesis come from

    A CO_2 .
    B H_2O .
    C   ATP .
    D $C_6H_{12}O_6$.

11. If *A* is a dominant gene and *a* is recessive, in the cross between *Aa* x *aa*, the percentage of individuals with the *A* phenotype is:

A   0.
B   25.
C   50.
D   100.

12. The leaves (fronds) of a fern are parts of the _____ phase of the plant.

A   haploid
B   diploid
C   triploid
D   tetraploid

13. Which of the following segregates during anaphase of meiosis I ?

A   Sister chromatids.
B   The spindle.
C   Homologous chromosomes.
D   Endoplasmic recticulum

14. A plant's tendency to bend toward a source of light is called

A   phototropism.
B   photoperiodism.
C   gravitropism.
D   thigmotropism.

15. A virus basically consists of

A   RNA or DNA and a membrane.
B   RNA or DNA and a protein coat.
C   proteins and cell membrane.
D   enzymes and a protein coat.

16. If red blood cells, white blood cells and platelets are removed from a blood sample, what is left is

A   cytoplasm.
B   plasma.
C   lymph.
D   albumin.

17. At the end of meiosis II, the number of gametes that produced from a single germ cell is

A   2.
B   4.
C   8.
D   16.

18. Which of the following types of muscle tissue is under voluntary control?

A   Smooth muscle.
B   Cardiac muscle.
C   Skeletal muscle.
D   Intestinal muscle.

19. The physical home of a species is its

A   community.
B   ecosystem.
C   predator.
D   habitat.

20. In higher plants, sugar synthesized in the leaves is transported to other parts of the plant through the

A   xylem.
B   stomata.
C   phloem.
D   epidermis.

21. DNA can be found in which of the following components of a plant cell?

    A   Nucleus and cell wall.
    B   Nucleus and vacuoles.
    C   Nucleus, mitochondria and chloroplasts.
    D   Cell wall, vacuoles and chloroplasts.

22. The DNA of a certain organism has guanine as 30% of its bases. What percentage of its bases would be adenine?

    A   0.
    B   10.
    C   20.
    D   30.

23. A student took some plant tissues and ground them up in a buffer. After centrifugation, he obtained some organelles from the pellet in the test tube. The organelles were able to take up CO_2 and give off O_2. The organelles are most likely

    A   nuclei.
    B   ribosomes.
    C   chloroplasts.
    D   mitochondria.

24. Which of the following has cell wall made of chitin?

    A   Earthworm.
    B   Rose.
    C   Mushroom.
    D   Snail.

25. A group of cells that perform a similar function are known as

    A   tissues.
    B   organs.
    C   organ systems.
    D   organisms.

26. A fern is

A a gymnosperm.
B a pteridophyte.
C a bryophyte.
D an angiosperm.

27. Which of the following is heterotrophic?

A A fern.
B A rose plant.
C A snail.
D An orchid plant.

28. A scientist obtained a mutant albino seedling in the laboratory. The albino seedling would

A photosynthesize under white light.
B fail to thrive.
C synthesize glucose indefinitely, using stored ATP and NADPH.
D become parasitic in order to survive.

29. Which of the following are produced during light-dependent photosynthetic reactions?

A ATP, NADPH, O_2
B ATP, NADPH, CO_2
C Glucose, ATP, O_2
D Glucose, ATP, CO_2

30. The acidic fluid in the stomach becomes slightly basic after it leaves the stomach because the acids

A become neutralized by sodium bicarbonate secreted from the pancreas.
B remain in the stomach and never enter the small intestine.
C become neutralized by amylase from intestine.
D are absorbed by the small intestine.

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31. Which of the following secretion does NOT contain enzymes?

    A   Intestinal wall secretions.
    B   Bile.
    C   Saliva.
    D   Pancreatic juice.

32. In human, amylase is produced by the

    A   salivary glands only.
    B   small intestine only.
    C   pancreas only.
    D   both salivary glands and pancreas.

33. Which of the following is NOT an example of two organisms in a parasitic relationship?

    A   A pitcher plant and the insect it captures.
    B   Bird flu virus and the bird it infected.
    C   Tape worm and the animal it lives in.
    D   Flea and the cat it lives on.

34. In the lungs, oxygen moves from air to blood by

    A   diffusion.
    B   osmosis.
    C   bulk flow.
    D   active transport.

35. Most of the oxygen in the blood is bound to

    A   hemoglobin.
    B   white blood cells.
    C   carbon dioxide molecules.
    D   plasma membrane.

36. A student examined the root-tip cells of a plant and found that there are 18 chromosomes in each cell. How many chromosomes are there in the generative cell of its pollen grain?

A 36.
B 18.
C 9.
D 0.

37. During asexual reproduction in the black bread mold (*Rhizopus sp*), the spores produced are

A haploid.
B diploid.
C triploid.
D tetraploid.

38. If you cross-pollinate homozygous white (recessive) flowers and homozygous purple (dominance) flowers of pea plants, which of the following type(s) of offspring you will obtain?

A All of the offspring will produce pink flowers.
B All the offspring will have purple flowers.
C All the offspring will have white flowers.
D Half of the offspring will produce purple flowers and half will produce white flowers.

39. Which of the following is NOT found in the epidermis of plants?

A Root hairs.
B Guard cells.
C Pericyle.
D All the above can be found in the epidermis of plants.

40. An "ecological niche" is best defined as

A the physical environmental factors needed for survival.
B the organism's habitat.
C an organism's interactions with other organisms.
D all the aspects of an organism's way of life.

41. Which of the following is NOT a characteristic of animals?

A Sexual reproduction.
B Eukaryotic.
C Autotrophic.
D Intra-specific competition.

42. Which of the following consists of nothing but a protein coat that surrounds genetic material?

A Bacteria.
B Pollen grains.
C Viruses.
D Algae.

43. The fluid portion of the blood is called the

A lymphatic fluid.
B platelet.
C collagen.
D plasma.

44. A group of organs that function in a coordinated manner is known as

A tissues.
B organelles.
C organ systems.
D organisms.

45. Which is smallest?

A Artery.
B Arteriole.
C Capillary.
D Venule.

46. Which of the following are involved in conducting dissolved minerals from roots to the rest of the plants?

A Companion cells, sieve tubes.
B Tracheids, vessel elements.
C Companion cells, vessel elements.
D Tracheids, sieve tubes.

47. A typical angiosperm leaf consists of a leaf blade with stomata. Each stoma is surrounded by

A bundle-shealth cells.
B mesophyll cells.
C endodermal cells.
D guard cells.

48. The base-pairing rules for DNA are

A adenine-guanine, thymine-cytosine.
B adenine-cytosine, thymine-guanine.
C adenine-thymine, thymine-guanine.
D adenine-thymine, guanine-cytosine.

49. A student found a tree in his garden that produced only male flowers. Which of the following floral organs he is likely to find in the flower of this tree?

A Sepals, petals, carpels.
B Sepals, petals, stamens, carpels.
C Petals, stamens, carpels.
D Sepals, petals, stamens.

50. A student examined the generative cell of a pollen grain and found that there were 20 chromosomes in each cell. What is the number of chromosomes in each of the root-tip cells of the same plant?

A 5.
B 10.
C 20.
D 40.

51. A fern is (an)

A gymnosperm.
B vascular plant.
C bryophyte.
D angiosperm.

52. A student brings a piece of bread with bread mold (*Rhizopus sp*) to the school. The student is <u>unlikely</u> to find which of the following from bread mold?

A Spores.
B Hypha.
C Chloroplasts.
D Sporangia.

53. Hair is produced by

A muscle and nerve ending.
B glands in epithelial tissue.
C adipose tissue.
D dendrites and blood capillaries.

54. Which of the following is the extracellular matrix secreted by cartilage cells?

A Bone.
B Calcium phosphate.
C Myoglobin.
D Collagen.

55. A mycorrhiza is a

A symbiotic relationship between nitrogen-fixing bacteria and roots of a land plant.
B parasitic relationship between a fungus and the roots of a land plant.
C symbiotic relationship between a fungus and the roots of a land plant.
D parasitic relationship between a fungus and an alga.

56. Which of these statements regarding enzymes is FALSE?

A Enzymes are proteins.
B Enzymes display specificity for certain molecules to which they attach.
C Enzymes provide energy for the reactions they catalyze.
D The activity of enzymes can be regulated by factors in their environment.

57. All of the following combinations are possible in the gametes of an organism that is *DdYy* EXCEPT

A *DY*.
B dY.
C dd.
D *dy*.

58. The longest period of a cell's life cycle is

A prophase.
B metaphase.
C interphase.
D anaphase.

59. The products of photosynthesis are

A glucose and amino acids.
B carbon dioxide, water, and energy.
C carbon dioxide, chlorophyll, and oxygen.
D glucose and oxygen.

60. Which of the following statements is generally FALSE?

A Parasites are generally smaller than their prey.
B Slow growing species are likely to be pioneers in secondary succession.
C Competition between members of two species is most intense when the species are most similar.
D The physical home of a species is its habitat.

END OF PAPER

UNIVERSITY ENTRANCE EXAMINATION

NUS
National University
of Singapore

BIOLOGY

Duration   : 2 hours

Please read the following instructions carefully.

1.   This paper is made up of 60 Multiple-Choice questions and comprises **THIRTEEN**
        (**13**) printed pages.

2.   **Do not write on the question paper**.

3.   Answer all questions and indicate your answers on the answer sheet provided.
        Marks will not be deducted for wrong answers.

4.   Do not take any paper, including the question paper or unused answer sheets,
        out of the examination hall.

Answer all questions in this section.

1.   Which of the following statements is incorrect?
      (a)   DNA provides the genetic code for the synthesis of proteins in all
             organisms.
      (b)   In 1983, James Crick and Francis Watson identified and
             described the double helix structure of DNA.
      (c)   In the DNA helix, purines pair with pyrimidines via hydrogen
             bonding.
      (d)   The two chains of polynucleotides in a DNA molecule are anti-
             parallel and complement each other.

2.   Adenine comprised 40 % of the nitrogenous bases in the DNA of cells
      from a bacterial clone. What was the percentage of guanine in the
      DNA?
      (a)   10 %
      (b)   20 %
      (c)   40 %
      (d)   80 %

3.   All cells of an earthworm have the following components except
      (a)   mitochondria.
      (b)   nuclei.
      (c)   plasma membranes.
      (d)   cell walls.

4.   Which of the following statements is correct?
      (a)   Proteins are simple molecules.
      (b)   Carbohydrates are the major molecules from which muscle cells
             of animals are constructed.
      (c)   Amino acids contain carbon, hydrogen, oxygen, nitrogen and,
             also, sulphur and phosphorous.
      (d)   Lipids are not a source of energy.

5.   All the following can be found in prokaryotic cells except
      (a)   cell membranes.
      (b)   cytoplasma.
      (c)   pili.
      (d)   nuclei.

6. Chlorophylls are plant pigments that absorb light optimally in the
(a) green and yellow wavelengths.
(b) green and blue wavelengths.
(c) blue and red wavelengths.
(d) blue and infrared wavelengths.

7. Which of the following plants take up carbon dioxide for photosynthetic reactions during the night?
(a) Hibiscus and lily plants.
(b) Spinach and cucumber plants.
(c) Corn and sugar cane plants.
(d) Cactus and pineapple plants.

8. Which of the following is a polysaccharide found in human muscle cells?
(a) Myoglobin.
(b) Collagen.
(c) Glycogen.
(d) Amylose.

9. Which of the following statements is true of all enzymes?
(a) All enzymes are denatured at 60 $^\circ$C and higher.
(b) The active sites of all enzymes can only bind to only one type of substrate.
(c) All enzymes lower the activation energy of the reaction.
(d) All enzymes catalyze the degradation of large molecules into smaller moieties.

10. Monocotyledons are distinguished by all the following traits except that
(a) they have a single seed leave.
(b) their flowers have a three-part symmetry.
(c) the veins on their leaves are not arranged in a net pattern.
(d) they include plants like orchids.

11. The muscular system of all vertebrates does not include
    (a) smooth muscle cells.
    (b) cardiac muscle cells.
    (c) skeletal muscle cells.
    (d) epithelial muscle cells.

12. Which of the following statements is incorrect?
    (a) Most of the energy in an animal comes from the aerobic breakdown of carbohydrates.
    (b) In all respiratory systems of animals, the exchange of gases needs a lot of energy.
    (c) In the respiratory systems of animals, gases cannot be transported in the gaseous form.
    (d) Seals have more heamoglobin than humans.

13. A woman, who is a carrier of haemophilia, had phenotypically normal parents and is married to a man without the recessive haemophilia gene. Which of the following statements is correct?
    (a) All of her sons are haemophiliacs.
    (b) All of her daughters are haemophiliacs.
    (c) Her father was a carrier of haemophilia.
    (d) Her mother was a carrier of haemophilia.

14. What is a codon?
    (a) A specific group of three sequential bases of mRNA that recognizes and attracts specific amino acids using tRNA as an intermediary.
    (b) A specific group of three sequential bases of DNA that recognizes and attracts specific amino acids using mRNA as an intermediary.
    (c) A fragment of the DNA molecule which codes for a protein.
    (d) A fragment of the DNA molecule which can undergo mutation.

15. Which of the following is an autotroph?
    (a) Shitake mushrooms.
    (b) A fish.
    (c) A virus.
    (d) An apple tree.

16. The C4-pathway of primary photosynthetic fixation is an adaptation of plants to grow in
    (a)   the desert.
    (b)   hot and dry conditions.
    (c)   hot and high light conditions.
    (d)   All of the above conditions.

17. Most of our important crop plants come from the _____ family of plants.
    (a)   grass
    (b)   orchid
    (c)   rose
    (d)   bromeliad

18. The _____ is considered the most intelligent invertebrate.
    (a)   grasshopper
    (b)   mosquito
    (c)   squid
    (d)   crab

19. Impulses can travel very rapidly along the nerves in our leg muscles because
    (a)   there is a high concentration of sodium ions inside these nerve cells.
    (b)   there is a high concentration of chloride ions inside these nerve cells.
    (c)   the nerve cells contain a high concentration of calcium ions.
    (d)   the nerves are insulated by thick myelin sheaths.

20. You have to weigh out 155 mg of sodium bicarbonate salt for an experiment on photosynthesis. Your weighing machine shows weight in terms of g (grams) only. How many g of sodium bicarbonate powder do you need to weight out?
    (a)   155 g
    (b)   15.5 g
    (c)   1.55 g
    (d)   0.155 g

21. In peas, tall stem length is dominant over short stem length. What genotypic ratio would you expect in the offsprings of a cross between a heterozygous tall plant and a homozygous short plant?
    (a)   3 homozygous tall : 1 homozygous short.
    (b)   1 homozygous tall : 3 homozygous short.
    (c)   1 heterozygous tall : 1 homozygous short:2 heterozygous short.
    (d)   1 heterozygous tall : 2 homozygous short:1 heterozygous short.

22. Adjacent plant cell walls are cemented by the
    (a)   cutin layer.
    (b)   primary wall
    (c)   secondary wall.
    (d)   middle lamella.

23. Which of the following class of compounds are generally hydrophobic?
    (a)   Carbohydrates.
    (b)   Lipids.
    (c)   Nucleic acids
    (d)   Proteins.

24. Which of the following transport processes in cells requires ATP?
    (a)   Simple diffusion.
    (b)   Facilitated diffusion.
    (c)   Osmosis.
    (d)   Active Transport.

25. Mary wants to determine the effect of temperature on the activity of a enzyme she isolated from a plant growing in her garden. She can expect that the activity of the enzyme would
    (a)   increase constantly as temperature increases.
    (b)   decrease constantly as temperature increases.
    (c)   increase to a certain level, then decrease, as temperature increases.
    (d)   increase, then decrease, and increase again as temperature increases.

26. Which of the following is produced during both the cyclic and non-cyclic transport of electrons of photosynthesis?
    (a) water
    (b) ATP
    (c) oxygen
    (d) NADPH

27. During photosynthesis, carbon dioxide is fixed by bonding to
    (a) glucose.
    (b) glyceraldehyde-3-phosphate.
    (c) ribulose-1,5-bisphosphate.
    (d) ribulose-1,5-bisphosphate carboxylase.

28. Which of the following conditions favours photorespiration in plants?
    (a) Darkness.
    (b) Plants growing near to each other.
    (c) Hot and dry conditions.
    (d) Cool days.

29. Which of the following statements is incorrect?
    (a) Stomata are found on both leaves and green stems.
    (b) Stomata allow CO_2 and not O_2 to pass through.
    (c) Stomata are specialized pores on plants.
    (d) Stomata close when a plant is subjected to drought.

30. Bacteriophages are
    (a) bacteria that infect viruses.
    (b) bacteria that are parasitic.
    (c) viruses that infect bacteria.
    (d) viruses that are parasitic.

31. A restriction enzyme, used in recombinant DNA technology, is most likely to
(a) join DNA fragments together.
(b) cut DNA into fragments with sticky ends.
(c) transfer a plasmid into a bacterial cell.
(d) stimulate cell division in transformed cells.

32. Another term for neurons is
(a) neutron.
(b) neutral sex cells.
(c) blood cells.
(d) nerve cells.

33. Which of the following statements is correct?
(a) Sexual reproduction is biologically an inexpensive process.
(b) The reproductive systems of most terrestrial animals depend on external fertilization.
(c) Many animal species do not use seasonal changes to coordinate the timing of their reproductive systems.
(d) Sexual reproduction is the dominant form of reproduction among animals.

34. The definition of a hermaphrodite is that of
(a) any organism that produces both eggs and sperm.
(b) a human male who has undergone a sex operation to be changed into a female.
(c) any organism that releases a lot of eggs into its own mouth.
(d) any organism that shows a high rate of haemoglobin production.

35. Which of the following statements is true of fungi?
(a) Fungi are autotrophs.
(b) The food-absorbing part of a fungus is the mycelium.
(c) A mushroom is not classified as a fungus.
(d) Fungi are always harmful to the human race.

36. Each of the following is a function of epithelial tissue except
   (a)   movement.
   (b)   protection.
   (c)   secretion.
   (d)   sensory ability.

37. Calcium in the muscle cells attaches to
   (a)   the neurotransmitter.
   (b)   actin.
   (c)   myosin.
   (d)   troponin.

38. Mammals are unique among all vertebrates because they
   (a)   do not lay eggs.
   (b)   have hair.
   (c)   are warm-blooded.
   (d)   have a cartilaginous skeleton.

39. PCR is a technique used to
   (a)   amplify a region of DNA.
   (b)   chop us a source of DNA.
   (c)   transfer genes.
   (d)   create clone libraries.

40. Each of the following is a function of the Golgi complex except
   (a)   collection of molecules.
   (b)   distribution of molecules.
   (c)   synthesis of molecules.
   (d)   packaging of molecules.

41. Which of the following refers specifically to the transport of water?
  (a) Energy transfer.
  (b) Osmosis.
  (c) Active transport.
  (d) Diffusion.

42. Photosynthetic carbon fixation requires the expenditure of ATP molecules. This ATP is generated by
  (a) formation of glucose during the light-independent reactions.
  (b) replenishment of the photosynthetic pigment.
  (c) chemiosmotic synthesis during the light-dependent reactions.
  (d) all of the above.

43. Which of the genetic diseases stated below is sex-linked?
  (a) Cystic fibrosis.
  (b) Haemophilia.
  (c) Hypercholesterolemia.
  (d) Tay-Sachs disease.

44. According to the Watson-Crick model of DNA, if you know that the base-sequence of one strand is AATTCG, the sequence of the complementary strand must be
  (a) AATTCG.
  (b) TTGGAC.
  (c) TTAAGG.
  (d) TTAAGC.

45. DNA makes RNA by
  (a) repair.
  (b) replication.
  (c) transcription.
  (d) translation.

46. In creating recombinant DNA, the sticky ends of source DNA fragments are joined to the sticky ends of _____ produced by the cutting up of a circular bacterial chromosome.
(a)   antibiotics
(b)   clones
(c)   plasmids
(d)   restriction enzymes

47. A version of DNA that is made from processed RNA is called
(a)   a plasmid.
(b)   a probe.
(c)   cDNA.
(d)   mDNA.

48. The transfer of working copies of genes from normal, healthy individuals to afflicated individuals is known as
(a)   a piggyback vaccine.
(b)   the Human Genome Project.
(c)   human gene therapy.
(d)   DNA fingerprinting.

49. Prokaryotes, including bacteria, lack
(a)   an organized nucleus.
(b)   cells.
(c)   cytoplasm.
(d)   DNA.

50. Which of the following is not an arthropod?
(a)   Butterfly.
(b)   Crayfish.
(c)   Earthworm.
(d)   Spider.

51. Unlike the sponges and flatworms, vertebrates have a
(a) backbone.
(b) coelom.
(c) exoskeleton.
(d) nervous system.

52. Each of the following is a final product of human digestion except
(a) amino acids.
(b) fatty acids.
(c) free sugars.
(d) starch.

53. Schwann cells, which envelop the axon at intervals along the length, act as
(a) dendrites.
(b) electrical insulators.
(c) nerves.
(d) tracts.

54. Which of the following does not promote biodiversity?
(a) Introduction of exotic species.
(b) Larger size of an ecosystem.
(c) Longer growing season.
(d) Climatic stability.

55. The path of energy in complex ecosystems with animals often feeding at various trophic levels is called a
(a) community.
(b) food chain.
(c) food web.
(d) mineral cycle.

56. Cristae are found in which of the following?
  (a) Chloroplasts.
  (b) Mitochondria.
  (c) Nuclei.
  (d) Lysosomes.

57. Darwin believed that the major driving force in evolution was
  (a) molecular biology.
  (b) natural selection.
  (c) divine creation.
  (d) scientific creation.

58. The key advantage of multicellularity is that
  (a) it allows the organism to be motile.
  (b) it allows the organism to reproduce sexually.
  (c) it allows the organism to photosynthesize.
  (d) it allows special tissues to be formed within the organism.

59. A mass of fungal filaments is called a
  (a) colony.
  (b) hyphae.
  (c) mycelium.
  (d) mycorrhizae.

60. About 90 % of the water taken up by roots is lost to the atmosphere. Which of the following structure accounts for the greatest loss of water in plants?
  (a) Stomata.
  (b) Epidermes.
  (c) Cuticles.
  (d) Lenticels.

END OF PAPER